SPECIAL REPORTS.

Report on the Organization of International Exhibition Commissions and Juries, with Especial Reference to the Vienna Universal Exhibition of 1873.

By THOMAS C. ARCHER.

From the commencement of international exhibitions nothing has been more apparent than the necessity for well-organized commissions and juries, and success has always been in accordance with the careful and judicious selection of the chief persons to perform the functions of those two branches of the management.

The commissions here referred to are those which are instituted by the nations in whose territories the exhibitions are held, for the purpose of making the general arrangements, providing the necessary accommodations, and framing such regulations as will give confidence to the other nations of the world, that, in accepting their invitations to exhibit, their interests will be fairly studied and amply protected.

Another kind of commission has also been found to be essential to the success of any exhibition, and its constitution is also of great, if not vital, importance; namely, the national commissions, or commissions appointed by the various exhibiting nations, the functions of which are, to take such steps in their individual countries, as will make known to their countrymen who are interested, all the advantages likely to accrue to those who agree to exhibit; to make the exhibitors acquainted with all the rules and regulations of the exhibition; to secure the safe transport of the exhibits; to adjust the space allotted, and to keep, generally, a watchful care over the interests of their countrymen in all that relates to the exhibition wherever it may be held. Regarding these two forms of commission as a combination to effect one main object, we may designate the former as the Local Administrative and Executive, and the latter as the Foreign Departmental, Commission.

First, then, in order is the Local Administrative and Executive Commission, appointed by the government of the nation in whose territories the exhibition is to be held. Very much depends upon the wise selection of those who are to constitute this important body, for it is necessary to inspire all nations with confidence in their administration. Each nation will, of course, have its own opinions upon this point, but it would be absurdly presumptuous to attempt to lay down any general rules for the selection of this, the most important body connected with an international exhibition; there are, however, one or two points which experience has demonstrated as indisputable facts, which cannot be ignored without great risk of failure. The first of these is that there must be one irresponsible head, a Director-General, whose decision on all disputed points must be final. The necessity for this will at once be seen, when it is borne in mind that an international exhibition is an event which, when complete, only lasts for, as a rule, six months, and, at the utmost stretch, can only be allowed about three months for previous arrangement, during which innumerable unforeseen difficulties arise. If these difficulties are left open to discussions arising from diversity of opinion, many of them would never be settled at all, and the exhibition would represent chaos, instead of nice order and arrangement. Hence it is necessary that the power to give a prompt decision should be vested in one head.

Secondly, a carefully selected but not too numerous body of coadjutors should be chosen to help and support the chief commissioner. Of these, some should be selected for their ability to act as councillors, upon whom the chief can rely for advice and assistance in all cases of difficulty; whilst to others departmental work should be allotted. The Vienna Imperial Royal Commission was fortunate in possessing the first of these requirements; and no better Director-General could have been found on the continent of Europe than His Excellency Baron Schwartz-Senborn; for not only is he a man of great administrative powers and broad views, but he had been thoroughly trained to exhibition life. In the London Exhibition of 1862, the nation which turned that event to the greatest commercial advantage, and which, in all respects, managed the affairs of its exhibitors best, was Austria; and those results were entirely due to the unwearying activity and admirable arrangement of the baron, then Chevalier Schwartz; and well is his genial co-operation and perfect disinterestedness remembered by those who, like the writer, had the satisfaction of working with him on that and other occasions. With his councillors, however, he had difficulties, although on the whole that part of the arrangement worked tolerably well, perhaps even better than was supposed; for, though the public tongue indulged itself in assertions of disagreements, etc., the public eye did not penetrate into its chambers, nor did the public ear hear its discussions. In the third portion of his commission Baron Schwartz was lamentably weak; he had no efficient staff of aids, to whom the separate departments could be safely allotted, and hence arose confusion, and most irritating annoyance to the exhibitors, which was increased and intensified by the efforts to carry out a complicated and impracticable classification. Everywhere amongst the officers of the commission who were intrusted with the departmental arrangements, under the Director-General, there was an almost oriental spirit of procrastination, and a want of knowledge of the value of time, which seriously impeded the completion of the exhibition, and this inertness, added to the utter inability of the railway companies to do the work they had undertaken, at one time threatened to make the exhibition a complete failure. The various national commissions, however, saved it by taking matters into their own hands, and carrying out the arrangements of their own sections as they thought best.

From this a good lesson ought to be learned and acted upon in all future international exhibitions; namely, not to hamper the foreign commissioners with restrictions which cannot be complied with, and which can only result in a petty warfare and an ignominious abandonment, one by one, of all the disputed points, after the sacrifice of much precious time and temper in the discussion. Every nation will, if left alone, do its best to make its exhibits appear as effective as possible, and, provided the general arrangements are not too complicated and unwieldly, a few general directions to each foreign commission will secure as much harmony as can be hoped for in an undertaking so vast as an international exhibition must necessarily be. It is one thing to sit down with pen, ink and paper, and with leisure for reflection, and plan the arrangement and classification of either a museum or an exhibition; it is another, to bring together all the varied products of man's industry, associated with all the peculiar wishes and opinions of the producers, and in a very short space of time so arrange them that they shall not only be in some sort of order, but what, after all, will always be the chief consideration, placed so as to exhibit the individual articles in the most effective manner. It follows, therefore, that the more simple the code of regulations, and the less they interfere with the individual action of the foreign commissioners, —who, as a rule, are earnest and well skilled in their work,— the better for the general management. There never has been, at any of the European great international exhibitions, any proper bureau for information to exhibitors; and yet how much trouble might be saved, and how greatly business might have been facilitated! Suppose, for instance, such a department had been fully, instead of very partially, organized in the Vienna Exhibition, and it had consisted of twelve intelligent men of each of the following nationalities,—French, German, and English,—and there had been four officers placed most conveniently for the exhibitors in different parts of the exhibition or grounds, the functions of these officials being simply to receive inquiries on forms, and to transmit them to the proper authorities and see that answers were obtained in due course and transmitted to the inquirers; these officers, aided by a dozen messengers, could have saved enormous trouble, time, and personal annoyance; their proper performance of their duties would have acted like a good lubricating oil, and would have made the great machine work much more smoothly than it did.

There is another point of great importance in which the Austrian Commission signally failed. It was in regulating the daily admissions of the vast army of exhibitors and attendants necessary to carry on the business of the Exhibition. It is said that no less than fifteen thousand persons had free admission daily as exhibitors, exhibitors' assistants, foreign commissioners, their officers and attendants, the employés of the general direction, consisting of clerks, attendants, police, military, firemen and keepers of the roads and gardens, besides a host of other people connected with the restaurants and other matters. No general rule could be hit upon for the management of this host, and the executive seemed to think that the best way to protect itself from imposition was to keep perpetually changing the passes, and giving all the trouble possible, so as to prevent its being worth the while of any trickster to try and circumvent them; but this was legislating for a few vagabonds, and giving endless annoyance to thousands of anxious, hard-working and honest people. Had a certain number of wicket-gates been allotted for the entrance of the holders of free passes, and picked men placed at them, in a week or two they would have become familiar with the people who had a right to pass, and no real difficulty would have been felt. So irritating was the Austrian process, that upon several occasions it was with difficulty that a general strike amongst exhibitors and their assistants was prevented. About twenty-five nations were represented in the Vienna Exposition; and as many wicket-gates, with three attendants allotted to each, two to be in regular attendance and one to relieve the others for meals and rest, would have made the administration sufficiently secure, and would have saved money, trouble and inconvenience to a considerable extent. For nearly as many gates were open to *free passes*, and even a greater number of people were employed, besides the useless staff whose whole occupation was printing and changing admission tickets continually; but there was no system, and consequently expense and trouble were incurred without any other result than extreme dissatisfaction. Mistakes of this kind, which affected the general management, multiplied of course in all the smaller branches of the arrangement and originated innumerable difficulties and disappointments which greatly militated against the realization of that satisfaction which it ought to have been the general aim of the administration to produce.

The want of reliable departmental officers forced the

Director-General to attempt to do too much personally. Instead of being only the administrator, he tried to manage the executive also, and it was too much for him, as it ever must be for a single individual upon such occasions. The consequence was, that much was ill done, and much not done at all. The proper plan would have been to have allotted distinct duties to each of his executive staff, and to have seen that those duties were honestly and faithfully performed.

The executive staff should be divided into sections, and each should report daily to the Director-General the work it has transacted, calling attention to all points of difficulty which may have arisen, and stating how such difficulties have been surmounted. This would enable the Director-General to correct mistakes before too late, or to approve, and thus guide his officers in their future operations.

Assuming the building to be complete or ready for the allotment of space, the following committees, besides others suggested by local circumstances, should be organized :—

First. The Committee of Installation, with whom the distribution of space rests,—a difficult and arduous duty, requiring great tact and management in order that conflicting interests may be harmonized and the amenities of the Exhibition preserved. A well organized Installation Committee would never have consented to that huge and ugly trophy of stone bottles, supposed to have contained Curacoa, which disfigured the grand gallery of the Vienna Exhibition in the Dutch department, and many other not much less obnoxious things. The Installation Committee, besides distributing space to foreign commissions and to home exhibitors, have a still more arduous duty in seeing that such space is not occupied so as to injure the general effects.

Second. A Railway Committee, whose duty it is to see that the goods delivered into the Exhibition are in good order and are instantly passed on to their proper department. The absence of such a committee in the Vienna arrangements, ought to act as a caution on all future occasions, for nothing more imperilled the success of that Exhibition. A Railway Committee requires a large staff of attendants, some of whom should be practically acquainted with the management of depots for goods, and all should be active, well-chosen men.

Third. A Committee whose duty it should be to issue passes to exhibitors, assistants and workmen, and regulate generally the ticket and free-pass department.

Fourth. The Catalogue Committee, whose duty it is to collate the forms as soon as received, classify them and get them into the printer's hands without delay. If a concession of the printing and sale of the general catalogue is accorded to any one, care should be taken not to include in it foreign catalogues, unless under some especial proviso which protects the interests of foreign commissions and encourages them to print their own special catalogues, which are always the most valuable portions of the literature of any International Exhibition. The French Imperial Commission in 1867 so mismanaged this matter as to create lawsuits and suppress to a large extent this valuable source of information. The Catalogue Committee should also undertake the printing of forms and other documents required by the other departments. Without some efficient supervision much waste of time and extravagant expenditure is sure to occur in the printing of useless and inconvenient forms, and even in the wasteful production of well digested forms.

Fifth. A Committee to regulate the police, the fire-brigade and the attendants and cleaners, is of course necessary, and its functions are second to none in importance.

Sixth. The gardens, roads and grounds generally should have a separate Committee, upon which both men of taste and practical experience should be placed.

Eighth. An Engineering Committee should undertake the arrangement of boiler-houses and other matters connected with the Machinery Department.

Tenth. A Fine Art Committee is necessary to regulate the disposition of art objects with a view to secure the best and most effective placing of them; this may be a sub-committee of the Installation Committee; or, if not, the two ought to act in unison, especially with regard to *trophies*, which, rightly placed and tastefully designed, add much to the beauty and interest of the exhibition, but otherwise, often disfigure it most seriously.

Eleventh. The refreshment establishments and the musical entertainments should be under a Committee or Committees, and on no account ought a control over the charges to be relinquished. This cannot however be fairly retained unless the concessions to sell are made in a liberal spirit. For well-regulated refreshment rooms with moderate charges are great aids to the success of an exhibition.

Twelfth. A Committee is necessary to organize and arrange the International Juries, and besides scientific knowledge, the gentlemen composing it, or at least some of them, should be good linguists, and amongst them, or the jurors for the country holding the exhibition, must be selected reporters who will, by careful reports, give an enduring value to the exhibition.

Thirteenth. A competent Finance Committee is a matter of course.

The organization of the Foreign Commissions rests entirely with the countries from whence they come, and it is only left to the country holding the exhibition to aid them in every possible way. Nothing that could be said under this head can be of any use to America, where the duties of hospitality are universally understood and practised.

The next important points are the jury question, and the awards; the latter especially, for we have just seen how with the best intentions badly carried out the worst results may be realized. In the Vienna Exhibition regulations, we were told that there were to be five prize-medals: 1st, one for Progress, 2d for Merit, 3d for Good Taste, 4th for Co-operators, and, apart from this series, one for Fine Art, whether in painting, sculpture, or decorative art. Besides these there were two Diplomas,—a Diploma of Honor, the highest prize which could be awarded, and a Diploma of Honorable Mention, the lowest prize which could be awarded. Moreover, it was communicated to the juries that the first four-mentioned prizes were to be valued in the order in which they are given above, that is to say: 1st, Progress; 2d, Merit; 3d, Good Taste, and 4th, Coöperation. Hardly had the work of the juries commenced before the question arose, Can two medals be given to one person; for instance, Progress and Good Taste, Merit and Good Taste, or Good Taste and Coöperation? These were very natural questions, to which an affirmative answer would also seem a natural reply, but the answer was in the negative. This caused much excitement, and even a threat on the part of some juries to throw up their work; for they did not care to identify themselves with a process of self-stultification. Perhaps this may not appear a necessary consequence; I will, therefore, give an example:—

Take, for instance, two manufacturers of Porcelain, one nearly at the top of his profession; and it is at once obvious that he deserves a high reward, which the jury may consider does not amount to the highest; that is, the Diploma of Honor; they, therefore, give him the Medal for Progress. Now, it must be evident to all that in such an art as his, he cannot have made progress without being a meritorious worker, and a man of good taste; but if he is only to receive the Medal for Progress, the two latter and equally important qualities are left out of sight, whilst the general public will be more likely to think highly of the third class medal for Good Taste than of the first, with the indefinite idea of *progress* attached to it. After much discussion the Council of Presidents of Juries, a deliberative body which held a position between the General Direction and the Juries, decided in favor of the jurors' view, that one or more medals should be awarded where deserved, and that another absurd regulation, that only one Diploma of Honor, in any group, should be given to one nationality, should be rescinded. There was a tacit understanding that this was accepted by the Council of General Direction; but after all the labors of the jury based on this understanding were concluded, and the juries themselves dispersed, their decisions were altered and the old idea reverted to. Therefore, practically, the published lists of prizes do not give the true opinions of the jurors and experts.

Anything more mischievous can hardly be imagined, and already many unprincipled people are taking advantage of it. Thus advertisements appear intimating that the advertiser is the only one in his class who received the medal for "Good Taste"; the public are not aware that this is the lowest prize in the form of a medal. Then others are telling the world by advertisements, circulars, and other means of deceiving, that they received the Diploma, but do not say it is merely

"Honorable Mention," and not of "Honor." All the world would understand 1st, 2d, 3d and 4th prizes, and if with each prize-medal were given a certificate stating the grounds upon which it was given, there would not be much room for mistake or imposture.

It has been mentioned that the Council of General Direction modified the awards of the juries after they had been given in, and had been passed by the Council of Presidents. This is a mistake which ought never to be repeated. The jurors are selected by the various nations exhibiting, and, as a rule, in all past exhibitions, the selection has been unassailable. Men have generally been chosen who were specially qualified for the task, and their decision should be final; for if they, as experts, could not give correct awards, it is quite certain a small knot of men without any of their qualifications cannot do so. Moreover, after a large body of qualified men have given their decisions in good faith, and after full discussion and great expenditure of labor and time, it is most disheartening to find them altered, or set aside, by another body which has asked them to act, and which itself is absolutely incompetent to give more correct opinions; and any changes they make are sure, rightly or wrongly, to be attributed to underhand influences and intrigues.

Much has been said and written, pro and con, upon the desirability of having juries in international, or other exhibitions; and in the London Annual International Exhibitions, committees of selection have been substituted for them. These committees act previous to the arrangement of the exhibition, and from the objects sent select those which they consider worthy to be admitted. The admission then becomes the test of excellence, and no other prize is given than the certificate of admission. The jury system, doubtless, has its faults, but they are small compared with those of this system. Whatever the juries do is open to criticism, for they work where all the world can go and judge also. So that there is every reason why they should, as they always are, be anxious to give a just and sensible decision. In the case of the committees of selection no one knows who has been rejected, or whether the best have been chosen. The writer has worked both on juries and committees of selection, and has acquired some respect for the working of the former, but none for the latter; he is also of opinion that public opinion agrees with his own, for he has been quite unable to ascertain that even a shadow of value is attached to the certificates of admission. It is of considerable importance that the local and foreign commissions should exercise a power of selection over the exhibits, for which space is claimed from them, so that the real purposes and interests of the exhibition be not perverted to the advertisement of common and uninteresting materials. As a rule, this need only be suggested to the various Commissions, for their national pride is ordinarily sufficient to keep them from lowering the character of their nations in the eyes of the world by introducing exhibits discreditable to the general collection.

On the whole, the jury regulations carried out at the Vienna Exhibition were good, but they acted badly in very many cases, owing to the mischievous system of control over their decisions, and the very indefinite nature of the prizes.

The number of the jurors was, according to Rule V., regulated by the number of exhibitors in each group; no fairer plan can be devised, but the method of carrying it out had one objection. The regulation as it stood was as follows:—

For every	10 to 100 exhibitors, . . .	one juror.
"	101 to 200 " . . .	two jurors.
"	201 to 300 " . . .	three jurors.
"	301 to 400 " . . .	four jurors.

And so on.

Now, the fault in this arrangement is in the first line, for, as a rule, there are the fewest exhibitors of the most important things. Take, for instance, the case of Great Britain in the Vienna Exhibition: In Group 1, stone-ware, porcelain and glass, she had but thirty-six exhibitors, but amongst them there were the Mintons, the Royal Worcester Works, Messrs. Copeland, Wedgwood, Pillatt, Green and others, who are quite unsurpassed in their productions; but by this law, they and their immense interests were only represented by one juror; whilst *France* had three; *Germany*, three; *Japan*, two; *Austria* and *Hungary*, seven, and so on. Now, as it happened, the exhibitors all through the Exhibition were of two kinds,—those who manufactured the goods they exhibited, and those who only dealt in the goods they displayed. The latter were excluded from receiving prizes, but their numbers counted in the allotment of jurors. The evil of this arrangement must be apparent at a glance. The remedy seems to be, either to exclude all but actual manufacturers from the summation upon which the allotment is made, or to admit traders to the competition for prizes. There are many reasons why the latter should be adopted; subject, however, to stringent regulations. One reason is, that if the promoters of international exhibitions were to depend solely upon manufacturers, they could not get up an attractive and successful exhibition. Enough experience has been obtained to assure us that this is a fact. Such being the case, it is a hardship that those who contribute so much to the success of the undertaking, should be precluded from a participation in its rewards. Had the medal for good taste at Vienna been reserved for such exhibitors, it would have given great satisfaction, and relieved the jurors of a painful duty in passing by those whose good taste in the selection of the best goods so greatly benefited the general effect of the Exhibition, and was a quality in itself well entitled to recognition.

In the seventh article of the Vienna regulations, it was provided that "the director-general may appoint delegates, who will be authorized to participate in the transactions of the jury, and will have a deliberative voice." This is not a good or a fair regulation, unless it is limited to one delegate, because it leaves it in the hands of the director-general to swamp the decision of the juries whenever so inclined; and the personal experiences of the writer lead him to believe that it is a dangerous rule. It is quite right and advisable that the chief executive officer should, if he thinks proper, be present, either personally or by deputy, at all the deliberations of the juries; but beyond seeing that they are carried on in a spirit of fairness and in accord with the regulations, he ought to have no power to interfere.

Another, and a similar mistake, exists in Rule VIII., which permits the Commissioners of Foreign States to participate in and have a voice in the deliberations of the juries. This gives to small states, whose commissioners have but little to do, the power of having an additional juror, who can go to any jury and give his vote for any purpose he may think proper; whilst another and more important commissioner, from having great occupation, can never exercise this function. This is one evil only, but another must be very apparent: no man can be an expert in all the classes of a great exhibition; therefore it is wrong to give any one the right to act where he is otherwise incompetent.

The fewer the classes or groups into which an exhibition is divided, the greater will be the necessity for forming sectional juries, and this necessitates a more liberal representation than that pointed out above, in Rule V., where, in order to remedy some of the defects noticed, and especially the one most prominent, it should be arranged that twenty-five exhibitors should entitle a nation to one juror; fifty to two jurors; and one hundred to three jurors; after that, one per hundred would be sufficient.

The operations of the Vienna juries began on the 16th of June: that is to say, six weeks after the ceremonial of the opening took place. It was laid down as a *sine qua non* (Rule XIX.) that they were to terminate on the last day of July. Practically, they only finished a day or two before the announcement of the prizes, on the 18th of August. Experience has shown that the sooner the labors of the juries are begun and finished, the better, because, to the exhibitors who have been so fortunate as to obtain the prizes, it is of the greatest importance that they shall have the longest time possible to benefit by the publicity which the Exhibition gives. Therefore the jury work ought not to begin later than one month after the opening day, and should not be allowed to exceed six weeks' time.

Whatever prizes are offered in an International Exhibition, their relative values ought to be strictly defined and adhered to. This certainly was not the case at the Vienna Exhibition. An attempt was made to define them in Rule XXII., and the juries gave their awards accordingly, and where an exhibitor showed progress and good taste they awarded him the two medals, and thus in the same way for meritorious work combined with good taste, they gave the medal for Merit and

Good Taste; but these double awards were nearly all disallowed by the supreme direction; and when the absurdity of the position thus created became apparent, then it was gazetted that all the medals had equal value. Thus, to a very large extent, the work of the juries was superseded, and that which remained was made ridiculous in the extreme; for what could be more absurd than to give to two exhibitors of first and third class merit prizes of equal value? These mistakes mostly arose from a desire to have entire control over everything connected with the Exhibition, even to the deliberations of the jury, or judges as they would be more properly called; and from want of firmness to adhere, against pressure, to even the good points in the regulations. They caused great dissatisfaction, and we may fairly hope that they will be corrected in any future exhibition.

THOMAS C. ARCHER, F.R.S.E., F.S.A.S., F.B.S.E.,

Director of the Edinburgh Museum of Science and Art, President of the Royal Scottish Society of Arts, Corresponding Member of the Ministry of Crown Domains, Russia, &c., &c.

MUSEUMS OF ART AND INDUSTRY.—THEIR INFLUENCE AND ORGANIZATION.

By LOUIS J. HINTON.

Group XXII.

Baron Schwarz-Senborn, the conceiving as well as the directing mind of the Vienna Exhibition, announced, early in the progress of preparing for that enterprise, that one of the most important, if not the chief, feature of the undertaking, would be the illustrating of the progress of education the world over;—the various methods and appliances for teaching in use in the different countries of the civilized world. Museums of Art and Science were, of course, to find a place in this display. Their value as educational agencies has been too clearly demonstrated in states where they have been established to admit of leaving them out of the Exhibition. It was thought advisable to form a separate group of their exhibit. This action was not, perhaps, the best that could have been taken, if the object was to show the means by which the public taste is elevated, and how such institutions are enabled to bring a practical influence to bear upon industry. The Museums are only a part of a system or systems that have their root in the common schools; hence, to gather a clear idea of their work, it is necessary to go behind or below them, into the schools where drawing is taught, and other technical knowledge imparted, in order to make a thorough study from the beginning, and so on up to the Museums themselves, before a clear idea can be gained how the known results, existing to-day in industrial art-training, are reached. By this arrangement of one-half of the subject-matter in one group and the other half in another, it was made a difficult undertaking to describe exactly what was shown at Vienna. It is impossible to confine the delineation to either group without marring the usefulness of what information could be collected. To simplify the complex, however desirable, is not always so easy that the Austrian Direction need be blamed for failing to exhaust the whole subject of the influence of Art and Industrial Museums upon public taste and industry, as their first circular relating to this subject would have led its readers to believe they intended to do, if it were possible of accomplishment. What they did achieve was certainly deserving of the highest commendation. What they will yet do, after the hurly-burly rush and hurry of the Exhibition is over, will, it is to be hoped, serve to further elucidate the value or defects of this important factor in education.

There can be but little doubt but that the gentlemen who will have the task assigned them by the Austrian government of making up the official report on Group XXII. will compile from the statistics and detailed information furnished them from many sources a most valuable and interesting document. This must be waited for with patience, as such reports do not usually appear until a lapse of six or twelve months after the close of the exhibition that has called them into being. The fact is to be regretted, for such official data would be extremely valuable in this or any other report dealing with the same subject.

One official document can be given—that referred to above, as it preceded the Exhibition and endeavored to convey, in a rapidly sketched outline, what the Austrian Direction desired might be done. This was "Special Programme, No. 12, for Group XXII."

This paper is in itself an evidence of the deeply-rooted hold Art and Industrial Museums and art-teaching, as applied to industry, have taken in Austria; and, having been written, it is thought, by Herr Jacob Falke, the acting head of the Vienna Museum, it may be taken as the utterance of one who is no mean authority on the subject whereof he writes.

This special programme runs as follows, omitting the excess of title that prefaces it:—

"Among the instructive establishments of our time which have most rapidly proved to be of great utility, the Museums of Fine Arts applied to Industry must certainly be included, and almost every city of importance possesses such an institution. This fact alone would suffice to justify the attempt we will make to show their organization and influence.

"These institutions stand, as well by the object they have in view as by the results they obtain, between real life and abstract theories; they are the mediators between the past and the future of the development of Fine Arts applied to Industry. The eminent position taken by modern industrial art for the last few years, furnishes the best proof of the justness of the remark made above.

"It may certainly satisfy and rejoice professional men to see the careful manipulation of different raw materials, and the use made of machines ingeniously constructed; but if a more elevated taste was not combined with the technical process in the execution or ornamentation of these products, one could hardly say that industry is improving.

"One of the most remarkable improvements made by industry dates back from the time when the idea first occurred to collect carefully together the rich treasures of former centuries, which had remained so long unused, to make model collections of them, to take up again and to organize the progress made by our industrious ancestors in some branches of industrial art, and in those objects produced by manual skill.

"The technical skill with which any object is manufactured is not sufficient to produce an object answering the exigencies of a connoisseur. An intelligent appreciation of the task to be fulfilled, the right feeling of the most suitable form; in short, taste in the invention and execution of each article, has become an indispensable quality for industrial production, and it alone raises the object manufactured to the rank of a work of industrial art, i. e., an object not only useful but also satisfying the requirements of good taste.

"Most of the industrial schools and institutions for promoting the study of Fine Arts applied to Industry, which under the direction of experienced connoisseurs fight every day with greater success against the old methods of proceeding and unthinking routine, owe their foundation to the acknowledgment of these truths.

"Still the creation of Museums of Fine Art applied to Industry, of those treasures of the history of art, are still more the consequence of the right feeling of the ennobling influence of art upon industry. It is from this point of view that the merits of the Museums of Fine Art applied to Industry of Paris, London, Edinburgh, Moscow, Berlin, Stuttgart, Munich, Weimar, Gotha, Limoges, Lyons, etc., just as richly endowed as they are generally useful to all, must be appreciated.

"After these come those museums, which, although not directly promoting Fine Art and Industrial Art, have indirectly the same object, by pursuing a scientific or statistical object. These institutions are also the result of modern efforts toward civilization; as, for instance, the German Museum at Nuremberg, the Romano-German Museum at Mayence, the Museum Richartz at Cologne, the museums at Havre, Amiens, Toulouse, etc.

"It is not necessary to enter into more particulars, to prove the great utility of these creations of modern times for the wants of our generation: the great number of visitors, the extended use made of them, and the influence they exercise upon modern industry, which is easy to remark, are matters of fact which every professional man acknowledges with pleasure.

"These museums attain their purpose by different methods. Firstly, by their collections, which are arranged with precaution and discrimination, and which procure as much to the eye of the connoisseur as to the unprofessional man, a really contemplative lesson. Only instructive and most perfect objects find room in their chests and on their walls. There, one can pursue historically gradual development and progress in the production of every sort of article, and an attentive spectator is enabled to follow the laws of industrial progress in the direction mentioned. There is no room for vain pomp in those establishments, where everything has as its aim, to show how the value of every single article can gain by a tasteful transformation, which, far from prejudicing its sale, augments it.

"Secondly, those museums exercise a very beneficial influence on the schools of Fine Arts applied to Industry, which are combined with them. The living word is found on the inanimate object, and the explanation on the model. The teachers engaged here explain to their scholars all those important qualities which every production of industry, even that destined for every day's use, must possess, in order to answer the exigencies of taste. The scholars learn, therefore, to appreciate the value of a certain simplicity, to understand and make use of the laws of the style of symmetry, and thus become those men who, later on, furnish the market with artistic objects, i. e., with such objects as are remarkable for their utility and moderate ornamentation.

"All the useful methods employed by the museums of Fine Arts applied to Industry to exercise their influence, are to be exhibited and demonstrated for the first time to the public in this group, and in such a manner that every museum will be allowed to organize its own exhibition in the manner the president of the institution may think best fitted to have it worthily represented, at the Universal Exhibition. Still, in order that the whole exhibition of this group may be as complete and instructive as possible, it would be as much conformable to the purpose as desirable, that each single institution should previously communicate in which branch it more particularly wishes to exhibit. Should this proposition be favorably accepted, each artist and industrial workman will find enough to inspire him in his branch; and, to mention only one thing particularly, modern ornamentation will become richer in new models of design.

"But, in order to prove to the public the practical influence of these institutions, it is indispensable that the publications of each single museum should be exhibited in samples and in single numbers; by this, we mean, more especially the reproductions—plaster casts, galvanaplastic impressions, photographs—and the artistic literary publications of the museums. Concerning the former, they must be confined, not only because of the space, to these works of art, the originals of which are in the possession of the country exhibiting. As to the latter, we cannot sufficiently express the desire to see them exhibited in collections as complete as possible.

"Finally, the museums are requested to give exact statistical statements of the number of visitors to their institutions, of the organization of their schools, etc., in order to furnish materials for the statistics of the museums of Fine Art applied to Industry.

"Signed by the President of the Imperial Commission: Arch-Duke Regnier; and the Chief Manager, Baron Schwarz-Senborn. December 10, 1871."

It was a perfectly feasible idea, and one easy to execute, to show the official arrangement of the different institutions mentioned in the programme, and to exhibit a collection of the objects belonging to the museums of Art as applied to Industry.

Any of the museums mentioned above, that at Edinburgh, for instance, might, through its president, have sent a detailed statement of when the institution was founded and opened to the public, the amount of its endowment, its size, number of rooms or galleries, a list of their contents, estimated value of the collection, number of visitors each year, etc., and we should be but a very little nearer to a clear or precise knowledge of the effect produced by the museum upon the people of Edinburgh. It is clear that such information, so desirable to attain, must be sought for outside, and not within the museum, even if it be possible to glean it at all.

We can all fancy the immense influence the classical works of our language have had and still exert upon the English-speaking race. There is no one among us who can measure its extent; but we might imagine our loss, if we were to be deprived of our Shakspeare, our Milton, and all the other bright stars in the galaxy of literature.

So it is with the museums of Arts as applied to Industry. They are silent instructors, with no record other than so many visitors in so many years. The schools of arts generally attached to the museums stand upon a different footing, as it is possible to keep some account of the work they perform.

The author of the special programe clearly saw the difficulty with respect to the museums. Although he forbore to enlarge upon that theme, he clearly indicated how desirable it would be if such information as to the extent and reach of the influence of museums of Arts as applied to Industry could be given. This is still unknown, except as it can be gathered from the opinions of those best entitled to speak upon the subject, and we believe no attempt was made to show its extent, by any of the states which have found their profit in establishing centres of instruction in the Fine Arts as applied to Industry.

The Austrians certainly did not attempt to show, in a direct way, how they had been and are still benefited by their beautiful museum. The endeavor will be made, ere this Report is closed, to state how they did show, indirectly, somewhat of the profits reaped by them, in payment of their enlightened encouragement extended to the Fine Arts and to Industry.

The managers of the Vienna Museum of Art and Industry would, in all probability, have made a fuller exhibit of the scope and object of their institution, if it had not been for some disagreement, or dispute, as to the proper space they should occupy in the exhibition, which occurred, it is believed, between them and the Chief Manager. Their energy was thus circumscribed and turned into other channels; as, for instance, helping to arrange the different sections of the Austrian Department to the best advantage. Thus, in the court where the Bohemian cut-glass ware was shown, Herr Loleymeyer, the chief manufacturer, was in constant communication with the museum authorities, consulting with them as to what was best to do. The results of their joint labor looked like a fairy scene, and produced one of the most interesting displays in the Austrian section, if not in the whole Exhibition building.

It must also be borne in mind that the Museum of Fine Arts, as applied to industry, had been, and is still a power among the Bohemian glass-workers; local museums having been formed, whose contents are so arranged as to bear directly upon the industry of the place where they are established. The Viennese Museum supplied many models, while the neighboring gentry and manufacturers were solicited to give or loan such objects of interest as they had and could spare, bearing upon the business sought to be improved. Lectures are also given, and books, written to teach the principles of Art Taste, as applied to Industry, circulate in the district. The schools also form a source from whence are drawn new supplies of Art workmen. These various means and aims of the Art Museum have certainly improved the value of this special product of Bohemia, one of the most beautiful Art-industries known.

Herr Loleymeyer has helped to advance the whole district —as oftentimes one wide-minded manufacturer will do—by his early recognition of the value of Museums of Art and Science, and his hearty practical coöperation with the Museum authorities. Here, then, is one instance of the direct influence of the Gewerbe museums; and although the fact is not announced, or to be found, in the display made in Group XXII., it is none the less real.

This instance stands not alone. Any one who visited the Vienna Exhibition during the past summer or fall, will remember the large hall leading from the southern entrance to the great Rotunda, entirely occupied by one manufacturing firm—Philip Haas & Son—with specimens of the carpets, rich hangings and chamber-suites, for which the firm is rapidly becoming famous. This hall was arranged and fitted up entirely from the designs and under the direction of the professors and pupils of the School of Arts.

It is also a fact that carpet-weaving and its associated industries, at Vienna, have drawn much valuable information from the models and drawings, bearing upon this handicraft, collected within the walls of the new Museum, not to mention their influence in the improvement of the workmen.

There were many similar instances scattered through the whole Austrian Section. Indeed it would be hard to find a single handicraft, where taste is needed, that had not been benefited, directly or indirectly, by this influence. These are practical illustrations of good effected, that can be appreciated by any one who understands that an improvement in industrial art means an improvement in the community and an increase of the value of the work performed.

To give even a brief resumé of the models, etc., exhibited by the Vienna Museum in Group XXII., would be to turn this Report into something very like a catalogue.

The literary Art publications, either written by members of the faculty or under the direct encouragement of the Museum authorities, occupy the first place on the list. The writing and spreading abroad of works upon the Application of Art to Industry, upon Taste, upon Study, and kindred themes, is one among the many useful labors performed by the Museum of Arts applied to Industry. These works numbered thirty-five.

There were, also, nearly four hundred gypsum models, beside galvanaplastic impressions, photographs and specimen copies of students' work.

The Vienna Museum may be said to be one result of the influence of the idea that gave rise to the South Kensington Museum. Herr Jacob Falke, keeper of the Austrian Museum of Art and Industry, in his History of Modern Taste (Geschichte des Modernen Geschmacks), writes as follows on this point:—

"When the works of industry of all nations were brought together at the first London Exhibition, in 1851, the deplorable state of taste was made palpable to the perception of all those who would and could see. . . . . . There was only one nation wise enough to take to heart so important a lesson, and proceed at once to turn it to account—the English. . . . . . A Museum of Art Industry, that of South Kensington, was then founded.* This Museum, therefore, must be considered as a result of the experiences made at the first International Exhibition. It has now become celebrated through all countries. It was not

* This is not quite correct, as the Museum was first established in Marlborough House, now the residence of the Prince of Wales.

intended for the benefit of the artist alone, but for that of the general public as well. But matters did not rest with the creation of the South Kensington Museum. A large School of Art, comprising all branches of elementary Art instruction, was established in connection with it. *Since great artists, nowadays, do not make designs for manufacturers as they once did*, it was found necessary to educate technical designers, painters and sculptors, and to make them into accomplished artists, and to educate teachers competent to conduct schools of design in an artistic spirit. Moreover, drawing schools were established in all the manufacturing towns; circulating collections of objects for exhibition were organized, and competitive examinations and distributions of prizes established. Competent persons were sent out to give lectures on all subjects relative to Art manufacture; a whole branch of literature on this province of Art was called into existence; in short, a stir was made in every direction in which any practical result was to be hoped for. These efforts have been crowned with success, and it has been proved that something could be achieved in this new way. After the lapse of eleven years, at the second London Exhibition (1862) it became evident that England, which, till then, had been considered as taking the lowest rank in matters of taste, stood side by side with France, in an equally high position in these respects. . . . . . Austria was the first among the continental States to turn to profit the example, even before France had begun to make new efforts, and in May, 1864, a Museum was established at Vienna after the model of that of South Kensington—the Austrian Museum of Art and Industry."

The italics are not in the original. Herr Jacob Falke here indicates the great want of the age—the need of men who are really artists and sculptors, to step down from the pedestals upon which they have elevated themselves, and mingle a little more amid the work of the world, as did the great men of old.

Grinley Gibbon, or Flaxman, did not injure themselves, or lessen their after fame one iota, but on the contrary they increased it, by exercising the powers God had given them, the first-named at Saint Paul's Cathedral, where he was the guide and inspiration of a crowd of carvers and artisans, the latter, working for Josiah Wedgwood designing cups and saucers, etc., for common use, in accordance with the rules of art and classic taste; not to mention the host of other great men, long departed, who despised nothing in industry that could be made artistic.

The museums of Art and Industry will have performed a great work, if they do nothing more than cause a change in this respect, as there are signs that they have been able to do, not thoroughly as yet, but they have made a beginning. It is no longer a rarity to find men who have acquired a reputation for their art-work, designing, quietly and unobtrusively, furniture, plate, wrought-iron gates, carvings for stone and wood-workers, carpets, majolica ware, etc., both in England and on the continent of Europe.

The rank and file of labor need commanders who shall be not alone bent on conceiving great projects. Let a man come among them who can shape out great things, and he will make small things great also, if he is in earnest and loves the work; especially, as is now the case in most of the leading countries in Europe, if the rank and file have had a knowledge of art imparted to them to prepare them for their life's work.

Another fact has been demonstrated so plainly that it is now generally admitted as a truism, by the efforts put forth during the last fifty years to elevate the masses; i. e., "Those who can be taught to write can learn to draw." This fact established destroys the awe that has so long hedged in the Fine Arts, and is another contribution of the nineteenth century to the freedom of mankind. Thus kid-glove artists, who have withdrawn from the company of artisans and manufacturers, have conferred an incalculable benefit upon the world at large, in forcing upon it the conviction that all of God's gifts are universal, if not allowed to perish from neglect, or ignorance of their existence. So, if these artists have become so refined as to fear that the dust of the workshop may soil their fair, white hands, the workers will take up the task, and in the endeavor to elevate their own powers and taste will elevate the whole community. This is peculiarly in a line with the spirit of American growth. It is from the bottom that we work upward to the top. We may hope to develop a grand school of American Art when we have made the whole people familiar with its principles; precisely as we formed great men in politics, in war, and work, by making the whole nation feel profoundly. This accomplished, the captain steps forward, his lieutenants are ready to help him, and an army is at hand, almost as great as himself, and without whom he would be powerless to carry out the ideas he conceives for his country's good.

However galling it may be to our feelings, we must admit that in many things the people of Europe are ahead of us, as we surpass them in others. The Vienna Exposition showed that we are, at least, behind in the matter of education—not that imparted in our common schools and colleges, for as far as they extend they are unsurpassed in their teaching; but the education that makes fairly-rounded men and women, not one-sided individuals, who, when they really enter life have to unlearn much and learn more ere their labors are of any account.

We have a broad basis to build upon, yet it is not so broad or so comprehensive a system as that established by Austria for her subjects. Like her German neighbors, she recognizes the fact that there is no royal or easy road to learning; hence she begins low down, the school law framed in 1869 marking her "new departure."

Mr. Lytton, an attaché of the British Legation at Vienna writes of this law:—

"One of the greatest benefits conferred upon the working classes of Austria is the General School Code of the 14th May, 1869, which renders national education compulsory, and greatly elevates the standard of it. In accordance with this law, compulsory attendance at school begins with every child at the age of six, and is continued uninterruptedly to the age of fourteen. But even then (that is to say, at the end of his fourteenth year) the child is only allowed to leave school on production of certified proof that he has thoroughly acquired the full amount of information which this great law fixes as the *sine qua non* minimum of education for every Austrian citizen.

"The prescribed educational course comprises reading, writing and arithmetic; history—chiefly although not exclusively that of the native country, embracing the political constitution and general social structure of it; geography in the same sense; all the more important branches of physical science, geometry, geometrical and free-hand drawing, singing, athletic exercise.

"Children employed in large factories or prevented by special circumstances from attending the communal school, may complete or continue their education at any special school supported by their employers, and the employers are authorized to found schools for that purpose. But it is an absolute condition that all such schools shall provide the full amount and quality of education required by law, and otherwise fulfil all the obligations prescribed by the General School Code. Every school, whether private or public, is subject to the inspection of the state. In places where a special trade-school exists, the employer is bound to send his apprentices to it.

"In addition to the subjects of instruction above enumerated, every child is simultaneously provided religious instruction in the creed in which he or she is born. The local ecclesiastical authorities or notables of the church or religious community to which each child belongs, are entitled and indeed bound by law to provide competent teachers for this purpose; but this religious instruction, which is altogether denominational, and on a footing of impartial equality for all sects, is kept by the state carefully apart from the secular education, which is in every case obligatory, and with which it is, in no case, allowed to interfere."

These primary schools are of three grades, respectively of three, four and six classes. The course of instruction in primary schools of four classes, is extended in one direction into the Gymnasia, and in the other into the Real or Practical Schools. On the Gymnasia rests the University, and all the special schools in which language and its associated culture predominates. On the Real or Practical Schools rest the Polytechnic Institute, and all the special schools in which mathematics and the natural sciences are taught, in connection with the great industries of the nation.

But all the scholars cannot reach the Universities or the Polytechnic Institute. The majority are needed for workmen. As is indicated in the General School Code, it is possible for the young artisan to pursue a course of studies adapted to his wants, and fitted to help him on further yet, if there be the right stuff in him. The further instruction of lads after leaving school and entering into apprenticeship, is carried on with the assistance and special inspection of Chambers of Commerce and local associations of tradesmen. The instruction is given on Sundays and holidays—except high feasts—and in the morning and evening of other days. It is not confined to a review of the rudimentary studies, but is extended to higher arithmetical calculations, book-keeping, bank dealings, business correspondence and forms, natural history, and particularly to drawing. A record of attendance is kept and delinquent parents and employers are fined, and proprietors of large establishments are subject to arrest and imprisonment for persistent neglect in respect to their apprentices and other juvenile operatives.

The special schools are open to artisans, whether apprentices or not, if they want to avail themselves of their help.

The Museum of Arts as applied to Industry, as its name implies, is part of this system of thorough education. To borrow from one of the Museum's published works:—"The object is to furnish material by which Art-knowledge shall be applied to industry, and thus produce an elevated taste, which is so much to be desired at the present day."

A brief resumé of the growth of this institution may perhaps prove interesting, as Massachusetts is treading in the same path as Austria.

The chief impetus to the formation of the Museum was given by the London Exhibition of 1862. It will be seen, further on, why this Exhibition proved so interesting to the people of Germany, Austria and France. The Exposition of 1851 had agitated the question, but in 1855 the roar of cannon from the Black Sea prevented any active result. In 1862, public attention was again aroused by Professor Rudolph Von Eitelberger, who had been sent to England to report on the comparison of Austrian industry with that of other nations.

He gave a glowing account of Art in foreign lands, and the institutions for its promotion, especially speaking of the South Kensington Museum at London. The report was laid before the Emperor, and in the fall of 1862 the professor was notified to prepare for assisting in establishing a Museum.

The want of funds in the treasury was a great hindrance to doing anything at public expense. Finally, Duke Regnier obtained from the Emperor a formal permission to found an "Aesterreichischen Museum für Kunst und Industry." His Majesty (Francis Joseph) appointed the Arch-Duke Regnier as Protector of the Museum. Professor Eitelberger was appointed Director, and Herr Jacob Falke, Custodian. The

Imperial Ball House was lent for a temporary abiding place for the Museum, and it was opened May 31, 1864. By the gifts of the Court and State the Museum was rapidly increased, and many collections were procured. The need of a special building for the Museum was more and more apparent. On February 7, 1867, a deputation of curators waited on the Emperor, and asked to be allowed to proceed with the erection of a permanent Museum. The permission was given, and in the fall of the same year the plans of Architect Heinrich Ritter von Ferstel were submitted and approved. The building was completed November, 1871, and was then opened.

It is in the Italian Renaissance style. The exterior walls are of red brick, trimmed with sandstone. Portraits of artist celebrities, executed in majolica, are placed around the building. Entering, we go through the vestibule, where are two tablets, commemorating the foundation of the Museum and the Art-School, from which a door on the right leads into a closed court; on the left are the steps leading to the school floor. Vestibule, court and stairs are adorned with appropriate ornaments. The square court, extending the entire height of the building, is surrounded by arcades, supported by pillars and monoliths. Light comes through a double glass roof. Around the court are eight exhibition halls.

The Museum comprises collections of objects in all branches of Art and Industry; gypsum figures, a library, drawings, ornamental pieces, photographs, etc. Companies and private persons, besides artists and industrial workers, can exhibit their work in a hall reserved for that purpose. Admission to the Museum is free four days in the week. Tuesdays and Wednesdays a small fee is charged, and even then artists are admitted free. The library is open weekdays from nine to two, and Sundays from nine to one. During the winter months it is also open Tuesday and Wednesday evenings. On Mondays one-half of the collection is closed for cleaning. Articles exhibited are copied for the drawing department by photographs, photo-lithographs, galvanaplastic impressions or gypsum. Protographic reproductions and the gypsum processes are wrought out in the atelier of the Museum. Copies of these can be obtained from the authorities at cost price, for the use of similar institutions or technical schools.

For the elevation of the public taste, the Museum publishes a literary-artistic paper. This contains drawings of Art-models, articles on the theory and history of Art, reform, taste, etc., critical reviews of articles exhibited, and writings on the technology of Art. "The Monthly Mittheilungen" is devoted to special reviews of Art news, inventions, works on exhibition in the Museum, and answers to correspondents. The Museum has correspondents in all the four quarters of the globe. During the winter free public lectures are held on Thursdays, with subjects taken from Art and applied to natural philosophy, industry, etc. Beside these lectures there are courses for young artists, to instruct them in special branches, as drawing perspective, the architectural orders, photography and technical Art.

The lectures to the public are given from a different standpoint than that adopted by many of our lecturers on Art and its technics. In Vienna the lecturer aims to show the young aspirant how to make a beginning, and how to progress upward in the study of the Fine Arts; while here, lecturers who attempt to discourse upon Art and Artists, generally strive to show how impossible it is for any one to reach the height attained by the masters of old, thus chilling the awakening enthusiasm of their hearers, among whom, perhaps, may be some who would have liked to make an effort to acquire Art-skill and knowledge for themselves. But to return to the Museum.

For the benefit of the country at large, special exhibitions are given in towns outside of Vienna, on the plan adopted by South Kensington. Besides, the Museum gives advice to artists and manufacturers, and even furnishes models. It takes an interest in improving Art matters in technical schools, and is looked to for counsel by all institutions of learning.

The Museum is under the Ministry of Education. Its Government consists of Protector, Curators—whose term of office is three years—and Director, with whom lies the entire charge. Under the Director are four Custodians, two of whom are in the Art-galleries, one in the library, and one employed as Secretary.

The following Table shows the number of persons recorded as having visited the Museum since it was opened :—

1864,	56,891	persons.*
1865,	118,438	"
1866,	101,733	"
1867,	118,802	"
1868,	102,460	"
1869,	97,680	"
1870,	87,892	"
1871,	52,927	"†
	42,746	"‡
1872,	129,441	"
Total,	909,010	persons.

Soon after the opening of the Museum in 1864, the Board of Trade and Industries, of Lower Austria, asked of the State's Ministry that an industrial school be started in connection with it. This request was warmly supported by the country. On the 18th of February, 1865, the Council of Education ordained that a higher school of Art-Industry should be established in connection with the Museum. A committee was appointed to draw up a code. Little was done the first year, besides familiarizing the pupils with the regulations. The artistic education of scholars was so limited, that about half the entire number admitted, or 24 out of 50, were obliged to enter the Preparatory Department.

One great trouble was the lack of funds on the part of pupils. In 1869, a number of friends of the institution formed a "Society for the Advancement of the Art-School," whose object is to aid needy students, by distribution of school money, travelling expenses, etc., without distinction in regard to nationality, religion, or anything else. The Emperor is Chief of this Society. During the first four years of its existence, about one thousand dollars were gathered for a fund, and over six thousand for yearly expenses. In 1869, the Trade Ministry set apart six thousand

* First six months. † Temporary building. ‡ New building.

florins as two years' pay for ten students, and renewed the same in 1871. To this were added twenty thousand florins given by Baron Louis von Haber-Linsberg, for students of Lower Austria. Prince Schwarzenberg gave a capital of one thousand florins ($500) to be used for the support of a pupil born on his domain. These are not all the donations the school has received, but they are the principal sums given to help the students. Many manufacturers and friends subscribed smaller sums.

Apropos of donations, a compliment was paid to America by one of Vienna's able professors: "Ah, we want a few men such as you have so many of, who would donate us a sum that would place us at once in a position to achieve the much larger amount of good results we could attain, had we some such generous friend. The sums given by Peter Cooper, Ezra Cornell, Mr. Peabody, Commodore Vanderbilt, and a host of other gentlemen, to help on the cause of education, amaze us, not to mention the enormous grants of land made by your Congress for the same purpose."

One can hardly doubt, after observing what they have done, with what, in this country, would be considered very limited means, that had they but half the money so freely poured out for the cause of education here, they would achieve astonishing results, working as they do, upon strictly economical and practical systems, wasting nothing, and utilizing every force and help that converge to form the real, able, skilful and tasteful worker, whether he be an architect or mason, professor of languages or teacher in an infant school; whether he be the inventor of a steam-engine or the man to run it; whether he be the designer of the patterns for rich carpets or the man to weave them; whether he be the skilled forester or the woodman who fells the tree; and so on, through every profession and every handicraft.

Perhaps, on the other hand, if they had the grand resources of this country to draw upon, instead of having to be keenly alive to the value of every cent they can earn, they would be moulded into free, pushing, go-ahead people, lavishly careless of that of which they now show themselves to be so minutely careful,—the intellect of the nation.

It is most certain that they have a very practical method of training all within the confines of the state. No matter how successful or unsuccessful their efforts toward that end may be, the method is sound.

As, for instance: at the Art-School, where the term begins in October and ends in July, pupils who attend the lectures contend for a prize at the end of each year. Female students have the same rights as the males. The admission fee to the Art-School is one dollar; tuition fees for the preparatory school, two dollars and fifty cents; for the higher school, four dollars and fifty cents, half-yearly.

There are ten professors, who have brought to them all the work they can perform. This is a point worth noting. The method of teaching involves practical work. It is no mere copying, but the real thing itself, at which the students can work with the professors. It would also seem to indicate that the school is a success, that their labor is in such demand as it is, by the manufacturers of Vienna.

The School and Museum aim to improve and elevate public taste. Although the most recent they are not the only institutions founded in Vienna for a somewhat similar purpose, and therefore care must be taken not to ascribe to the Museum alone results only partly brought about by its agencies.

Technical, scientific education it does not attempt to touch; yet the imparting of this involves oftentimes the teaching of a right taste and feeling for the beautiful.

There is no need for the Art and Industry Museum to stir in this matter, as very ample provision has been made to meet the needs of the whole country in this respect. Technical instruction is of very long standing in Austria. At the beginning of the present century, three important schools were in operation, and others were instituted, long before the neighboring German States had moved in this direction.

The Polytechnic Institution in Vienna, as organized in 1815, was the culmination of efforts begun in 1765, to shape the instruction of schools to meet the special wants of pupils in their future mechanical or commercial occupations. It is one of the best equipped schools of its class in Europe. If it were combined with the Art Museum and School, it would stand next to the Science and Art Department at South Kensington, at present the largest centralized institution of its kind in existence, with the tendency to still further extend its power. There has been some talk lately in England of placing the British Museum under the same direction. This proposition is not very favorably received by the English people, who are not all satisfied as to the ability of the managers of South Kensington to get all the good from what they at present control.

At the Vienna Polytechnic Institute, there is a technological museum, the contents of which comprise more than 200,000 specimens of models, machines, etc., beautifully arranged. The whole Institute numbers about sixty professors, librarians and superintendents of the museum and astronomical observatory. It has an average attendance of five hundred pupils, distributed into four special schools or divisions, besides a mathematical course. These are: 1. Civil engineering. 2. Architecture and construction. 3. Machinery and manufactures. 4. Chemical technology, including students in the evening classes and preparatory division. The attendance exceeds two thousand every year.

It is difficult to draw a distinct line, and declare, Here Science ends and Art begins. This will be acknowledged by any one who visits the Polytechnic at Vienna, or any of its fellows.

Take the study of architecture as an example. It is certainly necessary that the architect should have exact mathematical knowledge, that he may calculate the power of tension, capacity of bearing weight, etc., of the different materials he uses; but he must also be educated in art taste or his designs will be sorry, tame affairs. Indeed, there is no man in our midst who needs to be so thoroughly an artist as he who would aspire to be a real architect, and none who has more influence upon the life of the people whom he serves. A house, if it is ugly, still represents so much labor and capital, and cannot be pulled down simply on the score of its ugliness; but a beautiful building, harmonious in each part, represents more than its mere cost: it becomes a silent educator, and remains a charm to all who see it. It is, therefore, but right to look for Fine Art instruction in any institution that professes to teach architecture. This is found at Vienna, where the pupils are instructed, as were the Greeks of old, by drawing and studying the best buildings in their neighborhood, the professors—men whose names alone carry commendation—pointing out and explaining every grand, broad, general effect, as well as the minutest detail that can be shown.

To the Viennese, architecture is a very important profession, as it has depended and still depends upon the able men in this department whether they shall have a beautiful city or the reverse. So far, it is in the first state, if the opinions of the many visitors drawn thither by the Exhibition can be taken as sufficient evidence.

Thus, then, though separate institutions, it will be seen that the Museum of Art as applied to Industry and the Polytechnic Institute have much in common, and fitly dovetail into each other. The Museum of Arts reaches out after other objects than its neighbor, while it does much to fill in the necessary details, of great value to the students of the Polytechnic Institute, and *vice versa*.

Take, as an illustration, the manufacture of Terra-Cotta—a business that has grown prodigiously in Austria, Germany and England of late years. The determining of the right clays, to form a fit combination; the formation of kilns to harden these clays; the calculations as to the shrinkage of the clay while passing through the firing process, with other details, rightly belong to the Polytechnical Institution; but the artistic modelling of tasteful ware and statues in Terra-Cotta comes fairly within the province of the Museum and the School attached. That this aid has not been slight, but, on the contrary, extremely beneficial, is the testimony of the manager of the largest clay-working establishment in Austria, and the second largest in the world, verified by personal observation.

It would be a vain task to attempt to describe the high perfection to which this art has been brought by the Viennese. Remembering this, it is a source of regret that our own country is so backward in this manufacture, when all the needed materials exist in abundance. Nature has here been bountiful in this as in nearly all her raw materials. It is an industry that could be promoted in this country with a fair prospect of remunerative returns; first, to the manufacturer, and more remotely, in improving the public taste by supplying cheap and enduring statues, vases, fountains, etc., modelled to correct and artistic forms.

It is also available for architecture, being the natural sequence of brick making—the attempt of artistic power to progress from machine-pressed, square, clay bricks to hand-modelled clay, fine art objects for the million. Once modelled, these can be reproduced by pressing in moulds, *ad infinitum*—alike, yet unlike, as the artist can touch up each pressed form while the clay is yet pliable, ere it is put into the kilns. Then, too, it is made in different colors. The Italian Terra-Cotta is famous for its deep rich red color. The German and Austrian manufacturers endeavor to make theirs resemble stone, so that it may be used for ornamental work in combination with that material, thus effecting a considerable saving in outlay, and securing effective ornamentation for the façades of their buildings. In England all colors are used, although the principal architects, who favor it as a building material, desire that the English work should show the natural marks of the firing, so stamping it as no imitation of another material, but as a legitimate and old-time medium for forming buildings and articles of utility and art.

Several buildings lately erected in London are particularly striking. The combination of terra-cotta with pressed brick-work is charming in the highest degree. It is safe to request—in these latter days when almost every one travels—that if any of the readers of this Report, in the future, find themselves in London, they should seek the merchants' offices, built directly opposite the Ludgate Hill Railroad depot; and if the London soot and smoke have not blackened the building, there is no fear but that this suggestion will be pardoned on account of the pleasure experienced. While in this locality, round by the home of the "Thunderer," near Printing-house Square, is a neat store, the elaborate front and interior of which will bear inspection and pay for the time bestowed upon them. The inside walls are lined with Minton's encaustic tiles, evidently designed and made for this building. The pictures on the tiles are beautiful paintings of pastoral scenes. This tile work is another artistic production which should be carried on in this country, but which is entirely neglected, on the reasoning that we can buy all we want from England, while we devote ourselves to rougher and better-paying labor.

In Europe they have the advantage over us, in the long artistic training that has been afforded the people; but we can avail ourselves of their previous experience, and progress more rapidly from the knowledge so gained, as is evident from the work already accomplished in Massachusetts. But, as has been indicated in the instances cited above, without exhausting the list, there are so many kinds of artistic work of which we know nothing, except as we purchase specimens ready-made from foreign markets, that much hard and continuous labor is entailed upon us, if we desire to be an artistic as well as an industrial people.

It is worth while to note the fact that terra-cotta, like brick-work, is a fire-proof material, hence deserving of notice in America where the fire-king has wrought such terrible havoc. Specimens of terra-cotta that have passed through a fierce and destructive fire are shown at Vienna, to prove its power of resisting heat. The facts, as related, certainly demonstrate that it will stand fire without being very seriously damaged, if it is not injured by the falling masses that generally cave in, at any really calamitous conflagration. That it will endure for ages is proven by the specimens of ancient workmanship exhibited in almost every European museum. There are articles made of terra-cotta in the British Museum, at least three thousand years old. The mark of the artificers' tools show as plainly as when first burnt in.

While writing of terra-cotta specimens in the museums of Europe, it may be said that they contain specimens of everything, many articles and subjects exhibited being to-day priceless, on account of their antiquity, rarity, and intrinsic value as exemplars of ancient art and industry. Vienna is abundantly supplied with these collections. The imperial palace* is a rich treasury of works of art and collections of scientific objects easily accessible to the public. The Swiss Court has the private library of the Emperor; also some sixty

* The principal royal palaces of Europe are becoming more and more every year show-places or art-galleries for the occasional use of the crowned monarchs, who nominally own them, and for the general use of the public, who really own them.

thousand maps. The jewel office is open three days in the week, during the summer months, to the public. There is also a collection in this court known as the Physico-Astronomical Cabinet. This is likewise open to the public, but visitors must make application to the custodian. The Royal Library is situated near the Winter Riding School and contains over three hundred thousand volumes, twelve thousand parchments, twenty thousand manuscripts, and upwards of eight hundred volumes of wood and copper engraving, etc. In the palace, there is also a Cabinet of Zoölogy and Natural History—one of the richest collections to be found anywhere. The public are admitted one day in the week. A Mineralogical Cabinet is attached, beside the Numismatical Cabinet and collections of antiquities. Its collection of specimens of cut-gems stands unrivalled, and the bronzes, vases, gold and silver-work accumulated represent an enormous value.

The Belvidere Gallery is one of the world-renowned art-buildings. Any good guide-book will tell of the works of the old masters collected within its walls, a single one of which would be considered a grand acquisition to any of our modern formed galleries; but they cannot be bought; they are not for sale. At the Belvidere, there is a collection of antique works of art, which forms the complement of the Cabinet of Coins and Antiquities in the Palace (Hoffburg); and, lastly, there is a Museum of Egyptian Antiquities.

The Royal Armory is in the building called Stallburg. This collection includes a fine assortment of all kinds of weapons, and other appurtenances of war, which may be seen daily, free.

There is also a Museum of the Academy of Art, containing a number of valuable engravings, ancient paintings, marbles, and a great assortment of plaster of Paris casts, of considerable merit. This is open, free, once a week.

There are Medical, Botanical, Polytechnic, University, and many private galleries, to which the public can gain admittance.

Prince Liechtenstien's Picture-gallery contains some twenty-four thousand free-hand drawings,—many by Albert Dürer, and two hundred thousand engravings on copper. This is open twice a week.

In front of the Imperial Palace, the Museums of Science and Art are in course of erection, and will be immense structures, if the foundations are any guide to an idea of their proposed size. The fact that these buildings have been commenced indicates that the judgment of the leading men and of the Parliament of the Austrian Empire is still favorably inclined toward this method of fostering and cultivating public taste. They ought to be able to judge well of its effect, having had so long an experience with the galleries already in operation.

The following is a concise summary, from the official catalogue, of the facilities for technical education provided by the Austrian Government for its people. It does not include the Art and Industrial Museum or School, or the galleries and collections above enumerated.

"In Austria proper there are 45 Superior Schools and Academies for scientific instruction in agriculture, horticulture, forestry, the cultivation of the vine and the silk-worm, and veterinary surgery, also of mining, navigation and commerce; with seven Polytechnic Schools, in all having 6,000 pupils and 426 professors and teachers. These schools are in part sustained by the Imperial Government, and are under the general direction of the minister charged with educational matters.

"Hungary has 13 similar schools, with 116 teachers and 1,311 pupils.

Bohemia has an extended system of industrial instruction, more diffuse than in other parts of the empire.

"What are termed 'burgher schools,' answering to our secondary or grammar schools, have special courses, designed for mechanical and commercial training.

"Besides, there are, throughout the Austrian provinces, many workman and apprentice schools, usually teaching some special trade. In Vienna and Prague there are a number of these. In the latter city, there is one whose course includes the technical sciences, practical weaving, linear and free-hand, machine and constructive drawing, lectures on machinery, practical chemistry and modelling. These are classes for machinists, building trades, weavers, dyers, industrial artisans—as goldsmiths, jewellers, porcelain makers, etc."

It must be confessed that Austria presents a splendid arrangement of practical and artistic educational agencies, and it is already evidenced that in the future they will increase rather than decrease. The principal trouble there is the extreme difficulty of obtaining a sufficient number of competent teachers. This will be remedied in the future, now that it is so generally recognized that the teacher's post is a most honorable one.

It is safe to say that it is educated labor that prevented Vienna from sinking into a torpid state after the terrible blow Austria received at the hands of Prussia in 1866, so soon after her defeat in Italy, by the combined Italian and French forçes. Her rulers were compelled to see, through the sober light of misfortune, that their true interest consisted in fostering industrial progress, and developing the resources of the empire. This had been done to a very considerable extent previous to the events referred to above; and because such was the case, the city of Vienna could not lose her prestige; but by continuing to work in the same path of educating labor and fostering taste, she has attained a greater degree of prosperity than she ever before possessed—fortunate in having men at the head of affairs who see the importance of encouraging industrial enterprise and progress in the widest and broadest sense; fortunate in having a splendid system of instruction by which the citizen is helped in his life's work; and in having men who were already first in the trades and business for which Vienna is, and is becoming, famous.

A slight glance at the work done in the Austrian capital and its natural advantages will show the correctness of the assumption that the strength of this empire lies, not in her drilled legions of soldiers, but in the armies of busy, skilful, hardy, trained workers. The industrial progress so apparent in Austria may really be said to have commenced in 1860, when the old walls that encircled the city were thrown down, and new boulevards built on their site; and confirmed when her rulers, in 1866, were taught that a stronger military power existed than their own.

It must be remembered that, with all her educational facilities, Vienna could not have attained her present degree of importance in the world if there were not unusual natural advantages to help to form a great city. The position of Vienna is unique, and had not the evil influence of a repressive governmental system checked private home or foreign enterprise, preventing everything like thorough development, Vienna must have been, at the present hour, second in importance to no continental city. It stands upon the confines of civilization and semi-barbarism, on the bank of a stream which receives into its waters no less than thirty-four navigable rivers, and which, connected as it is with the Rhine and the Maine by the Ludwig's Canal, directly unites the German Ocean with the Black Sea. Of all European capitals it is nearest to those points where the Elbe, Weichsel, Oder and Dniester rivers become navigable; the nearest to the Adriatic (Trieste), the Grecian Archipelago (Piræus), the Ægean Sea (Solonica), and the Black Sea (Constantinople, Varna, Kurtange and Odessa). From Moscow or Petersburg to Italy; from Moscow to Spain, France and England; from London, Edinburgh and Dublin to Constantinople; from Paris to Odessa; from North Germany to Stamboul or Athens,—the road to be taken must run through Vienna; and that road must be the Austro-Hungarian Railroad, long in contemplation, and which will be built, if the Austrian executives pursue with vigor the path upon which they seem to have set out. Vienna is the greatest and most advanced outpost of manufacturing industry on the banks of the Danube; it is the natural depot of the raw produce furnished by the vast tract of country known as the Lands of the Danube, from which it may be distributed to its proper destination for consumption; the central mart for the corn, woollen, hide and leather trades, for wine and other agricultural produce of these territories by the Danube, is in Vienna. The numerous railroads radiating from the city are obvious proofs of the magnitude of the existing and expected commercial traffic.

The above is but a brief summary of the city's natural and acquired advantages.

The real struggle between the great powers of Europe to-day, lies in the endeavor to gain control of rivers and territories where commerce and industry can find the best paying return for their work.

Special products and industries are necessary conditions, appertaining to the commercial importance of a city. Even seaports, in which traffic and the forwarding trade predominate, require the support of productive territories, which, in at least one or more branches of industry, give it a particular excellence in the department especially cultivated by it. The Viennese cultivate so many that it is hard to select the few principal ones.

All the various trades are reached, in a greater or lesser degree, by the Museum of Arts as applied to Industry and the numerous Fine Art Museums and Industrial Schools existing in the city.

The workmen take the raw material brought to them, and, as an English artisan once said of the Parisian *ouvriers*, in comparing them with his own countrymen, they put a hundred dollars' worth of work into it where we put one, before they permit it to pass from their hands.

Every one knows or has heard that Vienna is famous for its meerschaum trade. The raw material is brought thither, where the taste and skill to manipulate it is to be found. The cutting and carving of this "foam of the sea" is here raised to a fine art, and the workmen produce the most marvellous results. The fine, soft nature of the material gives the carvers opportunity to produce elegant and tasteful effects, and this the artisans in meerschaum ware at Vienna fully improve; hence they supply all the known world, where smokers exist, with their goods, and everywhere, because they are Viennese, they command a higher price.

The bronze trade is another business carried on there, and bears quite a Viennese character—just as the French bronze work is Parisian. Austria used to purchase the bronze goods she needed from the French houses, until this trade was developed in Vienna, where, in the first place, bronze-work is applied to useful ornaments, such as lustres, candlesticks, chimney ornaments, etc.

The strict observance of the truest rules of Art is particularly remarkable, and is chiefly due to the Museum of Art and Industry, where considerable pains is taken to collect and exhibit the best, most chaste and most useful models applicable to this special trade.

The leading architects of Vienna—most of whom are connected with the Art and Industry Museum—furnish many of the manufacturers engaged in the bronze trade with designs, so that the articles made after them harmonize with the buildings into which they are to be fitted. This course enables the Viennese to compete with the best French houses, as was shown at the Exposition. It was there evident to all who attempted the comparison that Austria had made rapid strides toward reaching the artistic plane long ago attained by the French, and beyond which the latter do not seem to advance.

The many little nick-nacks made of bronze, and known as "Articles of Vienna," have very often combined in them fine woods, leather, paper, mother of pearl and *papier maché*.

This development of the bronze and leather trade has not taken place without exerting an influence upon the higher branches of artistic book-binding, which has likewise been peculiarly improved.

It is noticeable that the development of one artistic idea, applied to industry, is sure to beget others in rapid succession, if the ground be but favorable for their growth. The manufacture of portrait albums, ornamental covers for diplomas, books, etc., calls for, besides the leather material, gilding, bronze, jewels, enamels and ivory. Workers in all these different materials are found in Vienna, as competent, if not more so, than those elsewhere, working cheerfully, "day in, day out," for wages which would here be deemed miserably small. Indeed, it does seem strange that they should continue there, when this country would be glad of their help, and willing to pay treble what they now get for their labor.

England has, in the past, given us a useful hint on this point. When she could secure a good workman, with special artistic skill, from the Continental countries of Europe, by paying extra for his services, she did so; the result produced was counted and sold as English work, and this practice insensibly educated the native artificer and designer by the new blood infused into the veins of their industry.

It is to be expected that the Jewellers' Art would be fostered in Vienna, as it is in every Catholic country in a greater or less degree. Such is the case. The aristocracy of this part of Europe have for ages been noted for their love for fine jewellery; hence here are found wonderfully cunning workmen in gold, silver and precious stones. Influenced on one side by the ruling church, with its highly developed Italian goldsmiths' art, and on the other side by the nearer Orientals and Hungarians—who have to this day the most gorgeously dressed nobles and gentry in the world when they don the national costume—public taste chiefly governed by the rich, who dazzle with their profuse magnificence, thus has the Vienna jewellery attained a distinctively marked character, combining the richness of the East with the taste of the West. The Museum and School of Arts strive to keep this distinction prominent, as being a trait well worth the perpetuation.

Without further attempting to enumerate the thousand and one trades carried on in Vienna and the surrounding country, many of which are of recent date but now firmly seated, we may notice that the great number of new buildings erected since the Ringstrasse was made, has called into being a new race of cabinet-workers. All the trades which find their occupation in furnishing houses have had an impetus given them by the efforts of the distinguished architects who have designed so much of New Vienna, to improve the interior decorations and furnishings of the new buildings. Cabinet-making, carpet-weaving, bronze-work, modelling and frescoing for walls and ceilings, marble-working, etc.—with all these trades the Museum has had direct contact, and has met with the greatest measure of success that has rewarded any of the efforts of the authorities to improve and elevate work and the workers.

The influence of these attempts of the leading minds and teachers of Austria to elevate the taste and improve the skill of all her workers, professional and artisan, bids fair to be crowned with the happiest results. By enlarging the scope of the people's mental vision, they insensibly polish their manners and aspirations, rendering them more content, cheerful and industrious. By giving them an interest in their daily work other than that which comes from it as being the means of earning a livelihood, an ambition is fostered to excel in what each produces. It is of vital importance to the world at large that this should be done.

The introduction of steam machinery into industry has, without doubt, added greatly to the power and comfort of mankind; but in its onward progress it has left behind, or destroyed, some things that it would have been well to retain; and, among others, the artisan, thoroughly master of his craft in all its parts. One-branch hands are in the majority to-day—quick at a single thing only, as making the head of a pin or the handle of an iron shovel.

It is not at all surprising that there are so many empty-headed and shallow-pated men in each community, who are so conceited as to think they have nothing to learn. This dwarfing of mental powers engenders a whole train of evils. Open the closed mines of the workman's brains, and he becomes at once a thinker for himself, his work a pleasure to himself, and his life a blessing to all with whom he comes in contact. Thus, if Austria should apparently lose money in her immediate efforts to elevate the taste and aspiration of her people, ere long it will return to her with compound interest.

The Exposition itself will have a great effect upon the nation. The native artificers, manufacturers and designers, have been able to compare the work of all the world with their own. In making this comparison they will have learned many lessons, and the varied literature the Exposition has called forth carries to their homes the ideas of men trained to observe and to report upon their observations. They must have noticed the general average ability of nearly all the European countries, in the staple manufactured articles in every day use, such as calicoes, boots, woollen cloth, etc. This is owing to the general acceptance of the same kind of machinery to perform the work. No sooner is a labor-saving machine invented in one country than it is copied entire, or in its essential parts, and used in every country where it is needed.

America and England have supplied the rest of the world with more practical help in this way than all the other nations put together; yet with all this start, the other nations are creeping up to these in industrial progress.

The Technical and Polytechnic Schools have greatly helped to effect this result; while, upon the other hand, Austria, Germany and England, have, by diligent attention, greater or less in degree, paid to the subject of Art-industry, gradually neared the two nations so long famous for fine work, industrial and artistic—France and Italy. The United States is not in the race, if we may judge her by what was exhibited in the American section of the Vienna Exposition. Not that it was worthy in any respect of the position we occupy among the nations of the earth, though we secured more prizes in proportion to the number of exhibitors than any other country. Those prizes were all awarded upon the basis of industrial merit. The artistic element was *nil*, if we except Prang's chromos and the photographs exhibited. The first germs of a change in this respect were shown in the School Group; viz., samples of drawings executed by the pupils of our common schools and by students of the evening classes, established in several of our large cities. It was but a grain in that vast granary, but any one who took the trouble to compare these drawings with those exhibited as the work of the pupils of a similar grade in the Austrian, Swiss or German section, found that their merit was as great as that of the others, notwithstanding the much shorter period this kind of instruction has been imparted to the young scholars here. This is a small but very encouraging fact. Those countries that have not paid the same attention to Art-industrial education as have the principal nations of Europe, were poor in proportion in their exhibition. Spain and Portugal are illustrations of decay in these matters. Russia, Sweden and Denmark illustrate the results of a one-sided education, i. e., technical; the bulk of their exhibit consisting of articles of utility, industry and defence. Austria, as we have seen, showed an even balance. Germany is not so strong in her Art as in her Industry, but is still very respectable, and evinces a strong tendency to improve in the future in this respect. Much that she has done is of the first order; still, the professional men engaged in the endeavor to elevate the standard of taste in their country's work are not satisfied. They regard their own progress as too slow, and continually fret under the influence of French inspiration. Honest Germans are not wanting to tell their countrymen of their faults, and to point out what they deem to be the remedy for them. One of these, writing in a publication issued for the special purpose of improving the taste of the people, says :—

"The German States have still a great work before them, ere they can emancipate themselves from the influence of French art. They have made considerable progress since the Paris Exposition of 1867, but it is still evident that very much of the German art-industry is altogether bound by French taste. No matter how well one race may think they are copying the works and art of another, in so much as it is copying, the result will be void of originality, expression, and freshness, and becomes fainter and weaker at each repetition."

The German critic assails French taste at some length, and claims that it is based on entirely wrong principles :—

"An all-prevailing fashion, and the decline of all art during the last centuries are the causes through which it has acquired and retained its powerful sway. The superiority of the French art-workmanship lies in the possession of a great number of artists who extend and practice an hereditary skill and dexterity. The fascinating charm of their creations consists in mere outward finery and show, or, in an accomplished superficial treatment, a manual facility or genius for arrangement, and an originality of invention instead of truthfulness of expression and faultless beauty in structure and form. These accomplishments and charm, certainly of great value, when combined with true art, are necessarily lost in copies and imitations, because they are the exclusive specialty of the French artist; hence the miserable failure of our own artists and designers, who imitate French teachings and turn out mongrel conceptions, neither native or French."

Some part of the above will apply to ourselves if we will but be candid in our confessions. Admitting this, we must look to it that the aims of our slowly increasing number of museums and art schools, shall mainly be directed to correct this servile defect. We are strong enough now to walk alone in this path, as we have in so many others.

The critic quoted above points out a remedy for the evils of which he complains, and as his words help to show the influence and drift of modern art-industrial education, a further quotation will be pardoned :—

"There is no difficulty in finding the path we must follow. England has already chosen it with great success, and it lies open to us also. It was fortunate for the reforming endeavor in England, and is beneficial for us, that French taste and French art-industry are, in themselves, hollow, insipid and perverted. It is here that the English apply the lever with a keen understanding. Had they continued following the French, they would have naturally always kept in the back ground ; they would not have been able to overtake the amazing start their rivals possessed. They were obliged first, to oppose a new and true taste to the old acknowledged bad one, and then to convert the world—perhaps the hardest part of the task. To the arbitrary caprice of the French, they opposed conventional strictness of style ; to frivolity, principles ; to outward show and puppet-like attire, the dignity innate to art. In order not to be led astray or to permit the ascendancy of what ought to be secondary, they kept constantly before their eyes the goal they aim to reach.

"The recent international exhibitions showed that wherever the object was taken up and pursued with strict consistency, as in paper hangings, carpets, porcelain, terra-cotta and upholstery, but above all in works of crystal, the English either surpassed, or, after traversing the wide distance which had separated them, equalled the French. Where, however, they allowed themselves to remain subjected to French fashion, especially in works of gold, silver and jewellery, there they remained far behind. * * *

"We are aware, indeed, that the efforts which the patrons of art in England, supported by the government, have made to act upon the public mind, are of the most manifold kinds; that museums and other institutions, general instruction in drawing, public lectures, popular literature, are constantly extending their influence. We know, too, that this influence is gradually gaining ground every day, and that its ultimate result cannot be doubtful. The present state of the case, and the path we have to follow, are thus clearly marked out for us. In the first place we must, and that immediately, emancipate ourselves from French taste. We must no longer allow ourselves to look with slavish admiration on Paris. We must not, as hitherto, regard whatever comes from thence as faultless in beauty and unexceptional in taste, without exercising our own reflection and judgment, but rather look upon it with the persuasion that much that comes from there is faulty. We allow that French works of art-industry are very much better than our own, but still they are not absolutely good, only relatively so."

The writer's words, addressed specially to his own country-men, have certainly a meaning for us, if we ponder them over well, now that real, earnest efforts are being put forth to found a genuine American system of Education in Art-Industry. But it must be remembered, that if we want quick and valuable results, our outlay and exertions must be in proportion to our desires. To give a lukewarm support to the movement, and then, ten years hence, grumble because we have not effected as great changes as other countries in a like period of time have done, would be but a sorry way to bring about a beneficial result, though it is what is likely to happen unless a very strong interest is aroused in the public mind in behalf of the idea.

In England, it is the fashion to grumble and growl at the amount of work performed by the South Kensington Museum and Schools, and their method of doing it, even for those who are ignorant of what is really accomplished. The work has been something marvellous in extent and rapidity of execution, as is fully shown by the opinions of the critics and observers who are not English.

That Austria believes in following the example set by the English is plain from her actions, as is also the case with most of the German States, who, if they have not already established Museums and Schools on the South Kensington plan, propose to do so in the near future, to supplement their already existing systems of technical and artistic instruction. Even Italy moves into line, notwithstanding that her name is almost synonymous with the Beaux Arts. France early acknowledged the value of the movement, and her recorded statements are curious but clear proofs of how soon it is possible to inaugurate a new reign of taste, and create the skill to meet it. Bearing in mind the fact that the International Exhibition of 1851 showed the unrivalled supremacy of France in nearly all matters of Art-Industry, the reports of the French Commissioners and Jurors of the Exhibition of 1862 will show that swift work had been performed in the decade between these dates, and will establish the fact that this Art-education as applied to industry is no natural demand, but one entirely artificial in character, shaped by the demands of our complex system of civilization, yet capable of an early and rapid development in the hands of vigorous and well supported leaders.

The following extracts are interesting, as showing the influence and value of the institutions comprised in Group XXII., illustrated by a single example—that at South Kensington:—

French Jurors' Report—1862.

[Extract from Report by M. Natalis Rondot.]

"On the closing day of the Exhibition of 1851, Prince Albert pointed out to England the new object which she ought henceforth to pursue. His words found an echo in all workshops, and the mayor of one of the chief manufacturing towns then said that 'the greatest benefit which could be conferred upon industry would be to give, by the development and improvement of Art-education, a purer and more practised taste to the producer as well as to the consumer.' The Department of Science and Art has been created under the sway of these ideas. * * * * In almost every direction, the influence of a larger number of teachers of drawing, and of working draughtsmen is making itself felt. The manufacturers of Nottingham, Manchester, Sheffield, Worcester, and Staffordshire recognize the fact that their best designers come from the Schools of Art, and that, thanks to them, the general character of designs and of forms has undergone the most happy modification.

"Before the next ten years have passed, English industry will have more than one million workmen, who will have acquired, by several years of schooling, sound notions of Art and Science, and an intelligent practice of drawing; circulating museums and collections will have familiarized many millions of manufacturers and workmen with the styles of all countries, and of all great epochs, with the most beautiful types of ornament, and the most esteemed models of every kind."

[Extract from Report by M. Rapet.]

"The study of drawing in the primary schools in England dates only from ten years back. Until then it had remained a privileged study, reserved exclusively for the richer classes. But the Exhibition of 1851, which rendered distinctly visible the superiority of France, in those products which demand taste, and the value of which is based upon a knowledge of design, revealed to England the cause of her inferiority. With that ardor which she displays in the pursuit of an object, as soon as she thinks it useful to attain it, she undertook, almost immediately after the close of the Exhibition, to establish Schools of Design over the whole of the United Kingdom. Since then, she has pursued her work with characteristic perseverance, and without shrinking from the sacrifices demanded by an enterprise in which everything had to be created. A new branch of the council on education has been established, under the title of Department of Art. Its special mission is to urge forward the creation of Schools of Design, the professors of which receive a direct payment from the government, and further remuneration, proportioned to the number of pupils to whom they give instruction. At the same time a Normal School was established for the training of masters, and a system of awards and prizes organized to encourage the study of drawing on the part of the pupils who attend the schools. A Museum of objects of Art was likewise formed to help this teaching, and the Department of Art itself caused to be prepared from the commencement, models to serve for instruction in the schools. Its example has since been followed by publishers, who have already begun to publish important collections of models of design.

"It would be out of place to expect from a system of education which is still in its infancy, the progress which such a system may have made in countries where it has been long established; nevertheless, in examining the English Exhibition, we must at once admit that England has turned to good account the experience of other nations. In particular, she has borrowed largely from France, whose published models may be found frequently employed in the English schools.

"In observing the results of these efforts, and taking notes of deficiencies, it is impossible to ignore the fact that a serious struggle awaits France from this quarter, and that by slumbering in treacherous security, our country would risk the loss of that superiority to which numerous branches of her industry owe their importance and their glory.

"It may not be useless to add here that England is in another respect our competitor by carrying off our designers. For many years her manufactories have attracted them, by the high wages with which their services are remunerated. But it is a very remarkable fact that these artists have often lost, after sojourning some time on the other side of the channel, the superiority of taste by which they were previously distinguished."

[Extract from Report by M. C. Robert.]

"Since the Universal Exhibition of 1855, immense progress has been made throughout the whole of Europe, and although we have not remained stationary, we cannot conceal from ourselves that the advance which we have made has diminished, and even has a tendency to disappear.

"In the midst of the successes obtained by our workmen, it is our duty to remind them that defeat is possible; that it may be even foreseen at no distant date, unless they exert at once all their efforts to maintain a superiority, which can be kept only on the condition of incessant self-improvement.

"English industry in particular, which, from the artistic point of view seemed greatly in arrear at the Exhibition of 1851, has, during the last ten years, made amazing progress, and should it continue to advance at the same rate, we might soon be left behind. This state of things appears to us to merit the most serious attention of the French government and manufacturers. * * *

"It is particularly in that which concerns the application of art to industry, that England manifests the happiest and most notable improvement. A new school has been founded, on a plan admirably devised for the advantage of industry, and neither care nor money has been spared to render it worthy of its mission.

"With regard to the influence exercised within so short a period by this great institution, we fully admit the testimony of our colleagues, the English members of the jury. When questioned by us as to the causes to which they ascribed the progress so obvious, this year, in the products of their manufactures, all have assigned a chief place to the new resources which are opened to industry by the schools of South Kensington.

"Such are the rivals whom our workmen have encountered in the Exhibition of 1862. It is impossible to hide from ourselves that the impulse given to English industry has not yet acquired its complete development, and we must look forward to see it make new efforts, and yet more brilliant advances.

"By the side of this increasing energy among the English, we regret to discover among our countrymen a little too much confidence, a sort of indifference and relaxation, which are not uncommon results of long-continued success. The position is, however, serious; nay, even threatening; it calls for prompt remedies."

Quotations might be made from the same sources until space was exhausted, and prove, as Herr Jacob Falke has expressed it, that "The reputation of the South Kensington Museum, or at least the acknowledgment of its merits, is greater in foreign countries where people look on with impartial eyes, than in England herself." (See "Die Kunst-industrie der Gegenwart: Studien auf der Pariser Welt-Ausstellung in Jahre, 1867.")

It is strange that so little has been written by the English, to give a clear view of what has been and is being done. Apart from the government reports, it is difficult to find the least particle of information relating to the progress of the work among them. Perhaps this is due to the fact that they are too much engaged in extending the progress to stop to add up the results. Even in that very interesting work by J. M. Ludlow and Lloyd Jones: "The Progress of the [English] Working Class, from 1832–1867," we find very little upon this point, while on other subjects the information is extremely full and exhaustive. These authors, however, place the original motive which prompted the manufacturers and governing classes of England to put extended facilities for improvement in art and taste within the reach of the working people, upon the right ground:—

> "The progress of the working class in science and art belongs, we consider, rather to the education of the man than to that of the child. The rudiments of both may and should be acquired in childhood, but it requires the matured powers, the developed taste of the adult, to make either study a reality.
>
> "The public recognition of the claims of the workingman to prosecute both, belongs entirely to the period under review [1832–1867].
>
> "It was in the field of design that such recognition first took place —not, indeed, from any appreciation of the workingman's right, as a man, to enjoy all means of manly culture, but simply with a view to making him a more useful instrument in the battle of competition with foreign countries."

The authors then proceed to give an account of the rise and progress of the South Kensington Schools, etc., and state that within ten years (1855–1866) the number of art pupils was all but trebled. And further:—

> "No higher testimony to the success of England's efforts to spread the knowledge of art and design amongst her working classes can be offered than that of the French workingmen dele-

gates—keen, critical, jealous observers—who were sent to the great Exhibition of 1862. Nothing seems to have struck them more than the development of our system of art-education and the progress in design of our workers.* Thus the sculptors in ornament say: 'The progress made by sculpture in England is immense since the Exhibitions of 1851 and 1855.' The cabinet-makers: 'Comparing the products of England in 1862 with those of 1855 one sees that she has made a gigantic advance.' The shawl-designers speak of England's great progress, and envy her her schools of design. The jewellers, who admit, on several points, England's superiority to France, regret that all competent men, in the jewelling, carving, engraving, enamelling and goldsmith's trades should not have been able to go to London to see Kensington Museum. The painters on porcelain dwell on the vast progress of the English workmen within ten years, and attribute it mainly to the 'immense extension given to the study of drawing,' etc.

"Quite apart, however, from the commercial effects of our public efforts for Art-Education, is the growth, amongst workingmen, of a real sense of the visibly beautiful. Those who have had the opportunity—as students in Mr. Ruskin's Drawing-Class at the London Workingmen's College—of seeing the fascination exercised over many a workingman by the gradual discovery of the hidden charms of form and color in the works of God and of man, know that the artisan is as capable of appreciating Art, for its own sake, and pursuing it with disinterested love, as the most refined aristocrat."

The opinions quoted above, all relate to the progress the people of England have made in improved powers of design, art taste and skill as applied to industry.

It needed the great Exposition, held at Paris in 1867, to show the English another want in their systems of education. It was during the period that this Exposition was open, and since, that a profound and wide-spread interest was awakened in Great Britain in the cause of special scientific or technical education. Endeavors had been made to establish something of the kind in England for a series of years previous, but with little success,—with how little, the Paris Exposition demonstrated conclusively.

The London Society of Arts did a great service, in connec-

* See the interesting volume, entitled "Rapports des Délégués des Ouvriers Parisiens à l'Exposition de Londres, 1862," Paris, 1862–1864.

tion with this subject, in selecting and sending to Paris a body of as intelligent practical artisans as they could find. The observations and ideas these men gathered while there, were afterward printed and published in what made a notable book, calling forth a wide-spread utterance on the subject of Technical Education from every one interested in the advancement of the nation.

The artisans paid but little attention to the subject of Design and art taste, except to notice the rapid and more facile methods in vogue on the continent for teaching the art of Free-Hand Drawing; but they at once saw and felt the disadvantages under which the British artisan labored in competing with the workmen of Germany, France, Belgium and other countries where there are so many schools of different grades and kinds for the instruction of the workman, foreman and directors in technics of the several crafts that they followed.

The press took up the theme with ardor; meetings were held in almost every town or industrial centre to consider the question; much was written and spoken explanatory of the systems of education established in France, Germany, etc.

Quite a flood of literature, purporting to deal with the interesting subject, appeared, some of which is of value; as, for instance, "Cassell's Technical Education."

At last, a Royal Commission of eminent men was constituted, with powers to examine into what existed, to hear testimony, opinions, etc., of those who could throw light upon the matter, and finally recommend such alteration in the existing system as they should deem necessary.

The result of the Commissioners' labors appeared in 1872, in the form of a voluminous Blue-Book, containing much that is interesting, and much more that is not. From this report a few facts are selected that help to throw light on the history of the attempts to popularize science among the English people.

Mr. Cole, late head of the South Kensington Museum, but who resigned that post upon accepting a similar position over the Annual International Exhibition, held in London, was the first witness called, and his testimony is the main basis of the facts collected.

It is said of him, or by him, "that he had witnessed the conversion, since 1852, of twenty limp Schools of Design into one hundred and twenty flourishing Schools of Art in the kingdom, and other schools like them had been established on the continent, in the colonies and the United States. For artisans, five hundred night-classes for drawing had been established; one hundred and eighty thousand boys and girls were now [1873] learning elementary drawing, and one thousand two hundred and fifty schools and classes for Science had spontaneously sprung into existence. The South Kensington Museum had been recently founded, as a national centre for consulting the best works of Science and Art, and as a store-house for circulating objects of Science and Art throughout the kingdom. While this Museum had been visited by more 12,000,000 visitors, it had circulated objects to one hundred and ninety-five localities, holding exhibitions, to which more than 4,000,000 local visitors had contributed above 93,000 pounds sterling."

The happy result of the labor of Mr. Cole is spread over England, Ireland, Scotland, and Wales. It is proposed to present him with a national testimonial. The idea was mooted in London last summer, and is a happy one; for, without doubt, his has been a life-long and ardent work in this special department of progress. That he still believes in it, the earnest words uttered by him at a provincial School of Art quite recently, bear witness.

Mr. Cole said people were still apt to look at Museums as mere collections of "things rare and curious—things for learned people only, for rich people only, for dilletanti only.

"The late Prince Consort and his followers looked at them from a different point of view—the point of view of Science and Art applied to Productive Industry.

"What did the architect do who wanted to learn his profession? He looked at buildings. What did Flaxman do when he applied himself to pottery? He studied Greek pottery. What did Herbert Minton do to enable his manufactory to compete successfully with Sevres? He collected and studied the master-pieces of Sevres. Why was Mr. Phillips, the jeweller, trusted to set jewels with good taste?

Because he studied the ancient and mediæval models. What gave Pugin his reputation for Gothic metal-work but his study of mediæval models? What had created a trade in majolica, in England, but the Soularge collection? What had given the Craces, and Jackson and Graham, and Gillows, and Holland, their reputation for furniture, but their knowledge of ancient examples. It was simply savage ignorance and priggish pedantry not to recognize the absolute necessity for examples of art, easily consultable by the public who were consumers, by the manufacturers who were producers, and by artists and artisans who were students. Where were they to consult them if not in public Museums? Why was the Frenchman more apt at Industrial Art than the Englishman? Because, for a century, he had had his free Museum in Paris and every other large town.

"And public Museums were necessary for Science as well as Art. Collections of diagrams, of educational apparatus, and of specimens of natural history, were indispensable to the managers of schools and teachers. The fact was, if Museums were not educational they were of very limited value."

Without doubt it is greatly due to Mr. Cole that the South Kensington Museum and Schools have attained their present proficiency and value—sufficient to secure for it the Medal of Honor given to it as the best of this class of institutions at the Vienna World's Fair.

To return to the Commissioner's Report and the subject of Science-teaching.

To begin at the beginning, it is necessary to cite the speech of the queen, in 1853. She then, by the advice of her Government, declared that the time had come when the nation should systematize scientific instruction having a bearing upon industry.

That was at the opening of the sessions of Parliament. After her majesty's speech Lord Aberdeen's government took the subject into consideration, and, after a correspondence with the Board of Trade, they enlarged the department called the Department of Practical Art into the Department of Science and Art. The object was to extend the system of encouragement already commenced in the Department of Practical Art to local institutions for Practical Science.

The minutes further say, that "the Treasury agree that that object will be best attained by the creation, in the metropolis, of a school of the highest class, capable of affording the best instruction and the most perfect training, which can alone be hoped for from an institution which has the command of the most eminent and distinguished talent, the advantages of which will be experienced by minor institutions throughout the kingdom, not only as furnishing a central source of information, but as a means of furnishing competent and well qualified teachers for local institutions, and of completing the education of pupils who desire higher accomplishments than can reasonably be expected from minor schools."

That creation of a central Science School exists at present only in words. There is no Science School, but it looks as if this minute would be carried out ere long.

It is even proposed in England to create a National Institution of Science, or college of the highest class, at which shall be assembled all the great authorities in this domain who can be got to act as professors, and such students as desire the highest training that can be received. It is only a proposal as yet, but serves to indicate which way the tide is running.

Various attempts were made, after the passing of this minute, to create what were then called Trade Schools. For a few years they did not succeed very well, and when the late Lord Salisbury became Lord President of the Council, he firmly determined either to abolish the word Science out of the title of the department, or to cause some Science to be given to the country. Accordingly, about the year 1859, certain principles were laid down which enabled the department to encourage the teaching of certain sciences assumed to have a direct bearing upon industry throughout the country.

The principles then established have been carried much further. The Science-classes were, in 1860, nine in number, and have increased since to twelve hundred and fifty. They are conducted by certified and uncertified day-school teachers, and are commonly held in day-school rooms. The subjects taught are as follows :—

1. Practical Plane and Solid Geometry.
2. Machine Construction and Drawing.
3. Building Construction.
4. Naval Architecture and Drawing.
5. Pure Mathematics.
6. Theoretical Mechanics.
7. Applied Mechanics.
8. Acoustics, Light and Heat.
9. Magnetism and Electricity.
10. Inorganic Chemistry.
11. Organic Chemistry.
12. Geology.
13. Mineralogy.
14. Animal Physiology.
15. Zoölogy.
16. Vegetable Anatomy and Physiology.
17. Systematic and Economic Botany.
18. Principles of Mining.
19. Metallurgy.
20. Navigation.
21. Nautical Astronomy.
22. Steam.
23. Physical Geography.

In the Government Tables, every institution in which scientific instruction is given is counted as a school, though the subjects taught and the number of classes in them vary much. In some instances a school consists of but one class, in which only one subject is taught, while in others there are ten or more classes in different subjects.

The progress of the Science Schools since the passing of the general Science minute, June, 1859 is shown in the following Table :—

	No. of Schools.	No. under Instruction.
1860,	9	500
1862,	70	2,543
1864,	91	4,666
1866,	153	6,835
1867,	212	10,230
1868,	300	15,010
1869,	516	21,500
1870,	810	27,956

At present, as before stated, there are 1,250 Science classes in Great Britain in direct connection with the South Kensington centre. It is stated that 212 schools, in 1867 had 560 classes in different subjects; of these 10,230 scholars, 4,520 went up for examination, besides 400 persons not taught in classes aided by the Department.

It was stated by Mr. N. McLeod, one of the South Kensington masters, "That whilst the pupils who attended the Drawing classes belong *almost entirely* to the working class, the proportion of ladies and gentlemen being very small, on the other hand, those who attended the Science classes belong *entirely* to the laboring class."

Mr. Cole said, in the course of his statement before the Royal Commission, in reply to a question concerning the earlier pupils who had been educated at these schools :—

"The best of them come to the surface and get scholarships, and I should hazard the prediction that they turn into Science teachers, who make teaching the business of their life. (In some instances within my recollection are young people whose ability has first been manifested at those examinations, who, taking several high positions in different examinations, became qualified to obtain scholarships, and studied afterwards, either in the London School of Mines, or at the College of Science in Dublin, and now earn their living wholly by teaching.) Manufacturers also employ them, on account of their scientific attainments."

It has not been the policy of the State in England to aid or interfere with the education of the middle classes, except to some slight extent, and that indirectly, by State endowments in colleges.

The general opinion of the country, working through the School's Enquiry Commission, and such agencies, can alone be looked to, to make any important change in the way of introducing the study of Science. Nothing, however, can have much effect on the Grammar Schools and Middle-Class Schools of that country, until the Universities, which give the key of education in the country, allow a fair proportion of their endowments to the reward of scientific studies. The instruction in the primary schools is, of course, only of an elementary character. That in the adult night classes, though in some cases carried a little further, for want of time, means and apparatus cannot go to any depth. Such instruction, generally diffused, is of great use; but it only goes far enough to warn people of the mistake they may fall into from their ignorance; to teach them not to be satisfied with mere empiricism; to show them how Science may be applied to their work, and to induce them to follow up their education. The application of Science to the Arts can only be made by those who have a thorough knowledge of special branches. The masters, mechanics, foremen and others, who have learned what they know of Science by the aid of the South Kensington Museum are but a small percentage of those engaged in industry. Any of the poorer people, who show a special ability and aptitude for Science can only follow it out if supported while pursuing their study. The richer classes can always get what they may desire by paying for it.

The efficient head of the Science Department of South Kensington, I. F. D. Donnelly, makes the following statement:—

"Much is said about the necessity for technical instruction, and efforts are being made to induce the State to supply it. It becomes, therefore, necessary to consider how far, if at all, the State can take this up advantageously, as distinct from the general scientific instruction.

"This idea is proposed from two rather different points of view. The one proposed is to have a Technical School adapted to the staple industry of a place; the other, apparently, to teach trades which do not exist there, with the idea of their introduction.

"Real, technical instruction, the teaching of a trade or art, itself, on scientific principles, necessarily entails workshops for practice.

It would be scarcely possible to devise a more effectual blow to the manufacturers of a place, than for the State to establish a really Technical School for their trade, with its workshops under no constraint to pay its expenses, underselling them, and interfering with their market. A State Pottery School and Messrs. Mintons' could not exist side by side.

"On the other hand, for the State to teach trades where they do not exist, with the view of introducing them, and thereby most probably tempting them away from where they have established themselves, could, at the most, only be innocuous so long as it was ineffectual.

"With regard to general industry, it may be taken that the action of the State cannot safely go further than by aiding and encouraging instruction in general Science—or such applied Science as Mining and Metallurgy.

"The Commission for the College of Sciences for Ireland laid down that its aim should be to impart a sound and thorough knowledge of those branches of Science which may be applied to industry, leaving it to the student, subsequently, to specialize his knowledge, and turn his attention in the direction he may find most suitable."

The Captain points out a method of aiding pure technical instruction "in the very best way," by means of the existing system of payment on results. That is to say, the teachers will received a fixed sum from the Department of Science for every pupil of theirs that passes the necessary examination, in addition to the fees paid by the pupils, or the help that manufacturers might extend, either separately or in combination, to establish schools for the instruction of their employés.

"The state, by paying on the results of elementary and scientific instruction, would assist in the instruction of the students just up to the point of their learning the absolute trade.

"There is nothing to prevent manufacturers, with energy and public spirit, from establishing as good schools as those of M. Schneider at Creuzot, and obtaining as much government aid toward them."

It will be seen from the foregoing account that the South Kensington Department of Science and Art has commenced the work, in a broad sense, of diffusing scientific instruction, generally, throughout the length and breadth of the nation. It will be also seen that its action is preparatory as yet, but indicating, as the result aimed at, a much higher and wider system of training in the future.

As the Commissioners whom we have quoted write in their Report:—

"The ground thus prepared may hereafter be occupied, step by step, with Elementary Science Schools in well constructed buildings, supplied with proper apparatus and a sufficient staff of trained teachers. These schools may train assistant teachers, may group around them humbler classes, and aid them with apparatus and superintendence or instruction.

"The first steps have been taken with such vigor, and the result has been to such an extent successful, that we confidently expect that, with needful guidance and encouragement, a thoroughly efficient system of elementary scientific instruction for the working classes, may, ere long, be founded on this basis."

The "working classes" themselves begin to move in this matter. Last summer was very prolific of meetings among them, called for the purpose of considering this subject, besides a deputation of members of their body, who waited upon the head of the Board of Education, Mr. Forster, M. P. for Bradford, and the authorities of South Kensington, to urge various questions they wanted noticed, upon the powers that be.

The facilities already afforded them for special instruction, the museums, the independent institutions existing having a like object in view, the flood of literature prepared for their enlightenment during the last four years, and the utterances of the trained leaders among them, gradually bring to the front this need of the present time.

In considering what can be done to help the present generation of grown-up artisans, as well as the rising generation, they themselves see that it is not possible for them to go back to the primary or elementary schools, but that something should be done for them, or by them, to supply what is lacking.

It is generally admitted all along the line, that Museums of Art and Science are of the first importance, as places of instruction and reference. The fault found by the artisans is that there are not enough of them; that those existing are either too far away from their homes, or closed when they have leisure to visit them,—in the evening or on Sundays,—or that they are so crowded by mere loungers as to drive earnest students away. Then, it is complained, that the present facilities for education are not quite what are needed, or what the workmen understand by the term Technical Education. It is felt that something practical must ere long be accomplished if the English artisans are to maintain their high reputation as cunning and skilful workers, especially in view of the fact that the apprenticeship system, as with us, is almost obsolete. It is thought by many that the mediæval system of Trade Guilds, if they could be revived, would meet the needs of to-day. The discussion upon this point, if related fully, would prove extremely interesting to workmen; but it can only be briefly noticed here, in preference to the European, Continental, Government Trade-Schools, for the reason that the English are trying to bring about an improved system of training, more in accordance with the free, American government; namely, by individual or combined effort in preference to clamoring for state help; the feeling being one of watchful jealousy lest the government crush out all the springs of healthy, free individual action, dwarfing the people into mere automatic beings, with everything marked out for them and limited.

It is well known that the technical and practical knowledge how to work at any trade in the best way, is a valuable possession. It can only be acquired at the cost of time, money, mental and bodily labor. It is a species of capital, only to be parted with for a fair return. Formerly, each employer of labor, for the most part, had learned his own trade as an apprentice, had worked at it for a time as a journeyman, or as his own employer, and taught apprentices to help him in his business. Hence, he had a direct interest in making his assistants the best possible workmen, and imparted freely to them all the ordinary knowledge and all the more hidden secrets of his trade. But with the modern system, of great capital, of large workshops and factories, which has been inaugurated during the last century, the duty of teaching apprentices devolves on journeymen, who—except in the case of a father and son—have not only very little interest in teaching the youth, but who, in many cases, feel that they are training pupils to become their rivals. When an employer finds that a young man of twenty can do his work as efficiently and more rapidly than an old workman employed at double the wages, there is great danger that the older hand will be discharged, the younger one being put in his place. This, though true of England, is only partly applicable to us, owing to the fact that the demand for skilled labor exceeds the supply, though this is lessening every day, as the population increases; so that, like the British people, this nation will have to consider the question of apprenticeships and Trade Guilds, or some other system that will give a constant supply of able workmen.

The working of the two systems is well described in the following passage from an able and interesting paper on "Guilds," read by Dr. Yeates at a meeting of the London Society of Arts, January 29th, 1873.

He had been showing how the old "Guilds" of the different trades, formed by our ancestors, in which employers and workmen were alike enrolled, provided for technical education:—

"As we have already seen, the Craft-Guild did, aforetime, largely take charge of industrial education. This was, indeed, its first care. Apprentices were regularly enrolled, and provision was made for their instruction. Journeymen, likewise, were constrained to improve themselves in the mysteries of their craft. What would be called examinations in our day were periodically held in different parts of the country; and frequently, too, comparisons were instituted between the work of native artisans and of foreigners, not always to the advantage of the former. Many of our Grammar Schools owe their existence to the 'Guilds,' and higher institutions profited by their liberality."

And again:—

"One point of contrast between the old Craft-Guild and its modern analogue—the Trade-Union—should be noticed. Trade Unions are societies of workmen, while the Craft-Guilds included master and workmen alike. It is necessary, however, to distinguish between the master of modern times, the wealthy capitalist at the head of a great concern, employing workmen by the hundred, or even by the thousand, and the masters of mediæval England. To be a master it was necessary to have been, first, an apprentice and then a journeyman, and it can easily be seen that such masters would rarely be large capitalists. While this state of things lasted, workmen who would, in all probability, become masters, and masters who had been workmen, were actuated by similar motives, and therefore worked together harmoniously. As the masters became capitalists this community-interest died out, and from the time of Elizabeth the Guild declined; and now its modern lineal descendant, the Livery Company, has too often preserved little of the character of the parent institution but its conviviality and the distribution of some antiquated charities."

The agitation now proceeding in connection with this revival of the question of the utility of the old Craft Guilds, points out to the modern Unions that it would be for the interest of the Trade Societies of the United States and the United Kingdom that they should see that the required practical instruction in their respective trades is supplied to their members. It is of the greatest importance to them to keep up a high standard of workmanship, and all the more so as they aim at keeping up a fair standard of wages.

It is proposed that classes for technical instruction—as distinguished from the higher and scientific education—and for Art-workmanship in trades requiring it, should be established, supported and managed by each Trade Society in its respective locality; in fact, that they assume more of the functions of the old Craft Guilds.

In connection with this movement it is stated that the University of Cambridge wishes to help workingmen to obtain higher education, by sending some of its ablest men to give instruction on subjects of interest or importance to workingmen, provided that in each locality there shall be a proper organization for making the requisite arrangements, and a sufficient number of students to benefit by the proposed teaching. "As the nation cannot go to the Universities, let the Universities—through their ablest representatives—come to the nation."

The South Kensington Institution has so far achieved one of its objects for the good of the people as "to teach them not to be satisfied with mere empiricism; to show them how

Science may be applied to their work, and to induce them to follow it up."

The exhibit made by it at Vienna, though not at all equal to the high position it occupies in the world, showed that it had also been enabled to help to bring about a solution of another important problem; i. e., the enlargement of the confines of woman's work. Many of the students at South Kensington are ladies, who have, through its agencies and teachings, been enabled to earn a fair competence for their work; this, in some instances, being entirely new to the industries of England. Examples of woman's work were shown in the hall occupied by the South Kensington Museum at the Exposition, consisting of designs for Lace, Fans, Etchings—an old art revived—Decorative Wall-paper, and other Art-industries.

The remainder of the objects exhibited do not call for any special notice, consisting as they did of the usual collection of articles that go to make up a Museum, similar in character to those shown by the Vienna Museum, differing in detail but not in the general tone.

Instances were not lacking among the seven hundred and fifty British exhibitors, serving to illustrate with more potency than the official display of student's work, the beneficial influence of the South Kensington School of Art.

Here is an illustration: Messrs. Doulton, of London, amid their multifarious display of sanitary earthenware, drain-pipes, plumbago crucibles, terra-cotta, and domestic utensils, such as water-pitchers, drinking-mugs and jars, showed a set of this latter kind of ware that consisted of real objects of Art, both as to form, coloring, and the designs upon them. These have all been made within the last two years. The material used is the same as that from which the old brown "Tobies" are made, so common in the English country ale-houses, and with which nearly every one is familiar, in the form of the earthenware teapots, sold by all dealers in like commodities.

One of the firm (Mr. James Doulton) illustrated in a most forcible and direct way the value of Art-taste in works of industry, by a simple method. Selecting two pitchers from his collection he said: "This is an old-fashioned jug worth tenpence; this other one, made from precisely similar materials, both in quality and quantity, is an example of our new style, and is worth ten shillings." The difference consisted in the improved form and simple quaintness of the designs burnt on the sides of the new examples of the potter's art. No two are made alike.

"The artist workman who has shown an aptitude for this work is the son," says Mr. Doulton, "of a journeyman wheelwright, and would in all likelihood have continued a wheelwright, like his father, if there had not been a local branch of the South Kensington School near his home to which he went, out of curiosity in the first instance, and afterward continued to attend because of the new and absorbing interest awakened within him. At this school the manufactory found him, and drew him to a field of usefulness where he could turn his developed talent to account, not only to the profit of himself and his employer, but to that of the nation. Some other less apt and artistic man could fill the wheelwright's position which he vacated."

Mr. Doulton laughingly said that his old brown pitcher was one of the objects collected by Mr. Cole to form what he termed his Cabinet of Horrors; i. e., objects in every day use, devoid of taste, art, or beauty in any shape. It is devoutly to be hoped that no one will act on his idea and make a similar collection on this side of the Atlantic. The bare thought of such a contingency is fearful to contemplate, and we must be held blameless if it should arise.

So much space is already used that it becomes impossible to give as full an account of the many exhibits made by the German States illustrating the subject as could be wished, remembering their great value. Brief allusion may be made to some of them, or rather to the result.

An instance has been cited of the influence of the German system of Technical Education upon the English nation, which, awake to its deficiencies in this particular, noted what its Teutonic and Swiss neighbors had achieved. This is a good recommendation as to their value. In this country no other proof is needed of the efficiency of German home-training than the quality of the citizens sent thence to our shores.

No expense was spared in fitting up the different halls and separate buildings, wherein the various states of the German Empire exhibited what they had sent to Vienna, for the purpose of illustrating their educational systems. Here were really Museums of objects used in Technical or Art Schools. It would have been a splendid thing if one of our rich men had gone over, and bought up some one of them and sent it home for the benefit of his countrymen. A perfectly feasible idea, if the rich man had only existed.

It was most surprising and interesting to note the reach of the educational facilities afforded to the people of some of the smaller states by their respective state, communal and social agencies. It was to be expected that the larger and wealthier states would have admirable arrangements. The prosperity of these small states can be noted by almost any one, which fact may be taken as a proof, if proof be needed, of the efficacy of the judicious course pursued in the past and continued in the present.

Selecting examples at random, one may find that in the Grand Duchy of Hesse all that can be done is done for the people. The workingman has every opportunity for improvement. Education is provided for his children free of charge, and for apprentices and workmen desirous of improving themselves, there are winter schools, where book-keeping, mental arithmetic, etc., are taught, and similar schools are open in summer for women and girls.

Of the men called out to fill up vacancies in the ranks of the Hessian Division in 1870–71, out of the total of 4,542, only 14 were without a school education.

There are also the so-called "Handwerks Schulen," or Schools of Design for Artisans. These were first started with a surplus of $250, which remained from the receipts of the first International Exhibition in 1837; and two schools were started as an experiment, one with fifty pupils and another with twenty-eight. These were found to answer so well, that now, there are fifty-two such schools, with 3,000 pupils attending them. As a result, coöperative societies,—benefit clubs, managed by the workmen themselves,—exist in considerable numbers; also savings banks, of which the artisans avail themselves more and more every year.

The schools commenced with $250! The statement seems almost incredible, but it is easier to believe it after what was seen at Nuremberg, where a museum on the plan of that of South Kensington has recently been formed. It was evident that the Nurembergers were more bent on making a start than on building a grand edifice for their museum. Having decided that such an institution was needed, they went to work at once, without being too particular as to where they worked, so that a commencement was made.

The exclamation was natural, when first seeing what was pointed out as the Museum: "This cannot be the Museum of Art and Industry!" for it was over a meat market, in what had once been a prison. Yet this was, or rather had been, the Museum, which changed its quarters but a few days before the writer visited the city for more commodious though still not palatial shelter.

Thus it is that the German museums and educational systems grow bit by bit, until, some day, it is discovered with astonishment, what splendid results they have achieved.

Bavaria presents a capital example of the good results flowing from a wise encouragement of the Fine Arts in other places beside Nuremberg, one of its cities.

Munich, its capital, under liberal and systematic expenditures by the central government, has become, within the last half century, eminent among the capitals of Europe for its public buildings, its historic monuments and memorials, its art treasures, its libraries, laboratories, and facilities for high literary, scientific and art culture.

The following is an extract from a Report on Education in Germany, issued by the National Bureau at Washington:—

"In a mere economical view, in their relation to the industrial development of the capital, the large expenditures required to build and equip the *Pinakotheks*, with their 1,800 pictures, 300,000 engravings and 9,000 drawings; the *Glyplothek*, with its twelve galleries of ancient sculpture, and its large collection of the works of Canova, Thowaldsen, Schadow, and other modern sculptors; the *Royal Library*, and its 800,000 volumes,—four times the number in the Library of Congress; the *University*, with its five faculties, 100 professors, and the Conservatorism of Sciences, with their laboratories, museums of natural history, botanic garden and arboretum; the *Royal Foundries*, to which this government is obliged to resort, for casts of its bronze doors and memorial figures, even when designed by its own artists; and the *Public Parks*,—all these expenditures, not extravagant in any one year, but liberal and systematic from year to year, after fifty years have made Munich the home of artists, and professors foremost in every department of Science, and have been felt in their beneficence throughout all the mechanic industries, and by every class in the kingdom."

The instance cited above, of our Government being compelled to get work done at the royal foundries at Munich that ought to be done at home, if the right conditions existed, as they should exist, is not a solitary case. A long list might be compiled, of cities and individuals, who have been compelled to send thither for similar work, needed for fountains, memorials, etc. So much is this the practice that it has come to be thought the right course to pursue. Thus, for want of a knowledge of some technical and artistic details in manipulation and finish, purchases are made to a vast extent from Europe, which, if our workmen and designers had but some of the facilities afforded them which there exist, would be made at home.

Happily, Massachusetts has commenced this needed work.

Nuremberg, a city of less than 80,000 inhabitants, four thousand miles away from these shores, can compel us, under our present system to send it, in exchange for their manufactured goods,—take as an example the years 1870–71, and 1871–72,—in dollars:

Amount for 1871–72, . . .	$2,511,419 65
" " 1870–71, . . .	2,107,663 18

and this for articles we claim to make, in the main, for ourselves, as will be seen by the citation of the following articles, from the list before us; viz., cotton and linen goods, leather, boots and shoes, gas-burners, stockings, baskets and basket ware, combs, hardware, colors, etc.

The fact is, no doubt, partly due to the cheaper rates at which the goods can be manufactured in Germany, and all over Europe, owing to the low wages paid the work-people; but it is also due to the superior skill and taste displayed by the workers, taught in the schools and museums existing in their midst.

In conclusion, the fact must be admitted that in this Report it has been impossible to present anything like a complete statement of the facts brought out and noted down in the course of the investigations made before writing it; but probably enough has been written to prove the great value of the institutions that the Austrian authorities sought to illustrate at their recent grand World's Fair, and to show the beneficial effects produced wherever they exist, upon the industries of the country, and in the general education and improvement in art and taste of the whole people.

One fact is proven, standing firm as a rock, by the united testimony of all the European savants, who claim to speak with authority on this subject; that is, that if any improvement is to take place in the Art-Industry of the country, it must come from the better education of the people in Art, and this must commence with popular instruction in free-hand drawing. It is also shown that such knowledge as is imbibed at the Drawing School, the Technical Educational Class, Art-Gallery, and the Art-Industry Museum, educates men to feel more interest in their work; that new methods of doing old-time work suggest themselves to the man who has been taught in the principles upon which the success of his work depends; and finally that a vast improvement can rapidly be brought about by earnest work, even though it be true that—

> "So slow is
> The growth of what is excellent—so hard
> To attain perfection in this nether world."

LOUIS J. HINTON.

FINE ARTS OF THE PRESENT TIME.

GROUP XXV.—PAINTINGS AND SCULPTURE.

BY F. D. MILLETT.

PART I. PAINTINGS.

It was the original intention of the Directors of the Vienna Exposition to invest the Art Department with a character not unlike that of the annual exhibitions held in almost every large city in Europe, and to assemble at Vienna pictures from every country, which would represent the art of the present day, and indicate the artistic development of the world within the last decade. In a very mild degree was this plan followed, and instead of an exhibition we had a museum; and the distinction is a strong one. An exhibition proves what the artists of the present generation can do; a museum shows what artists have done, and is a collection of superior or curious specimens of art, made up regardless of the date of production. A large proportion of the pictures were from state museums and private galleries, and comparatively few came from the studios. In consequence of this method of filling the halls, the display offered much less advantage for the study of the tendencies of art in the present generation, than was confidently prophesied by the managers and expected by the public. The reasons for this change in the composition of the art department are numerous. Some are based upon the inharmonious relations existing between the artists and the selecting committees, in which case the art-treasures of the government were drawn upon to secure material for a worthy representation of the country, and other causes are found in the poverty of the inducements held out to artists, in comparison with those of local exhibitions, where the distinctions to be acquired were quite as high, and the pecuniary gains much more promising. In its character of museum, the art department was one of the grandest displays of the century, and after the elimination of the works which, from their universally recognized merits, serve as models for the direction and instruction of artists of to-day, enough remains in almost every section to give a hint of the current of art in the country there represented, and to show its capabilities, its tendencies, and its natural character, if it has any. France, England and Belgium, more than any other countries, borrowed the treasures of the state galleries to grace the art halls at Vienna, and Germany, Austria, Italy and the rest sent comparatively weaker but more truly representative collections.*

In the presence of as magnificent a collection of pictures as was shown in Vienna, it can hardly be denied that artists have gained in at least one direction, and that this progress, if continued in the free and untrammeled course that art at present claims as its own, will result in a higher development of artistic culture, and in the production of works nobler and purer than any creations of the past two centuries. This progress is in the direction of expression; and in the refined subtleties of this quality of artistic power, it is clear to my mind that we of to-day are in advance of any age. Not that any one example of superior refinement and truth of expression can be produced which will surpass some of the sublime monuments of the skill and genius of the old masters, but the faculty of comprehending and analyzing expression, and the facility of illustrating it, are much more widely spread among artists of the present day, than ever before. And why is it, then, that the majority of pictures leave the spectator passive and unimpressed? Because the artists themselves, as in every period in the history of art, too often paint with little or no sympathy with their subject. The

* Germany contributed 753 paintings and 194 statues; France, 664 paintings and 196 statues; Austria, 436 paintings and 198 statues; Italy, 340 paintings and 259 statues; Belgium, 217 paintings and 20 statues; Holland, 164 paintings; Hungary, 112 paintings and 27 statues; Switzerland, 108 paintings and 35 statues: Russia, 104 paintings and 44 statues; Spain, 90 paintings and 30 statues; England, 72 paintings and 22 statues; Norway, 58 paintings and 1 statue; Sweden, 35 paintings and 2 statues; Greece, 24 paintings and 22 statues; America, 17 paintings and 1 statue.

great triumph of art is to produce in the spectator feelings akin to those experienced by the artist; to awaken in the depth of the soul some passion long dormant; to appeal to the inmost nature with a voice that demands recognition, and thus to bring all men to the common level of humanity, endowed with the same faculties, moved by the same feelings. As the king and the peasant both bow to the same holy symbol, so do they meet on the common ground of human passions and feelings, in the contemplation of a noble work of art. The artist must remember that the public is passive, and that it lies with him to stir in its multivalve heart an echo of the passion burning in his own breast, or to strike a sympathetic chord. The public cannot be impressed with the same degree of feeling as that which excites the artist to communicate his idea through the medium of colors or marble; for there will always be the cold barrier of the material and tangible to weaken the warmth of sympathy between soul and soul. Then, for an artist to succeed with a subject, he must be so thoroughly possessed with the idea he wishes to represent, that it penetrates every corner of his soul, and enters into every thought, until it becomes a presence not to be escaped, not to be avoided, until he has worked out its image on the canvas, or formed it in the clay. Spontaneous, impulsive works are almost always highly impressive, but the public feeling may be considered as more inclined to chord with the cold and passionless, and to be moved only when the impulse is a vigorous one. The great and noticeable lack in works of the present day is this same spontaneity, which, in its overflowing strength and warmth, takes a form sure to impart some of its glow to the spectator.

The peculiar circumstances which controlled the enlistment of artists in the time of the old masters, were calculated to sift out from the ranks many of those who could not keep pace with the soaring spirit that inspired the true artist. The limitations of art have been removed, the field of action is broader and more comprehensive than ever before, and the qualifications of artists have diminished with the increase of the branches of art in which it is comparatively easy to become, by courtesy, an artist. With the introduction of the academic system grew up a cold, passionless and formal manner, and thousands, even in the present day, annually learn the trade of artist with the same ease as they would learn to become blacksmiths or shoemakers, and with much the same idea. While the true artist will rarely fail to find his way to the fountain-head, notwithstanding the enervating and withering influences of academic training, an army of worse than mediocre painters and sculptors is raised up by this system, and their pulseless productions cover the walls of our picture galleries, or pall upon the visitor from stilted pedestals.

It is not my intention to discuss the merits of the academic system, or even to attempt to support the opinion which I entertain, that we would be worse off without these institutions, for this argument would occupy a great deal of space, and the simple statement that all academies are rapidly acquiring the character of the old studio system, and are developing individuality and encouraging originality, is enough to answer the most valid objections to them.

Another tendency in art has a double signification. This is the admiration for truth of tone which is happily gaining ground among painters. In a material sense, truth of tone adds greatly to the value of the work as a mechanical production, and, in a higher sense, it is absolutely necessary to the perfect expression of an idea in painting. Examples of the perfect harmony of tone with the sentiment expressed will be found by no means rarely in the review which follows. Black and white illustrations do not impress to the same degree with paintings, and when falsities of tone prevail in a picture, to the sensitive eye the force of color is nullified, and the idea might have been better expressed by a photograph or a print.

The great characteristic of French art is its impressibility, and by this quality alone it ranks above every other national art, or school, or whatever it may be called. The French are more truly artistic by nature than their contemporaries, and their capability of seizing the salient points of a subject, the characterizing lines of the expression of any idea, no matter how trivial, is beyond dispute. Endowed with these high artistic faculties, and enjoying the advantages of an art-education superior to those offered by any other country, it is not surprising that French art takes the lead. As we find the most brutal and disgusting vices go hand in hand with the highest efforts of civilization, so, joined with these superior powers and rare capabilities, we meet with the most ignoble creations and worthless trivialities, often in the garb of masterly execution,—an incongruity rarely found outside the ranks of the French artists.

Perhaps the most discouraging feature of their art is the persistent illustration, so generally indulged in, of woman, as she is understood in Paris. A French artist poses his mistress and paints her, and all the world recognizes her in the picture. There is no spark of sympathy for the beauty of line, the charm of texture, the invisible vesture of chastity. The nude is painted for the satisfaction it gives this false society of gazing upon it, and to supply the demand the artists paint it. In the French art department at Vienna, the walls glared at the visitor on all sides with nude forms, nearly all painted in a cold, impassive manner, or invested with the spirit of unblushing wantonness, worthy only to be turned face to the wall or to fill a corner in some *maison dorée*. Among all this abundance of nudity, scarcely a single figure could be pointed out that charmed with its color or texture, and but one or two attracted by a refined beauty of line or form. The highest effort of artistic execution is the representation of the texture and color of human flesh and the imitation of its forms. The French fail signally in the former, and are not irreproachable in the latter acquirement. Rubens' portrait of Helen Forman possesses these distinguished beauties of flesh painting, more than any other work that has come under my notice, and, while painted with a bewitching voluptuousness of color, and drawn with this master's well known *abandon*, it is a marvel of chastity and delicacy. It is by comparing this picture with the tortured poses of the French nude figures, that we see in what consists the charm of the master's work, and the weakness of the modern productions. Rubens was inspired by the tenderness of his love, by his passionate admiration for the beauty of his young wife, and perfect faith in her purity, to immortalize her in all her chaste loveliness. Similar inspirations do not often possess the breast of the modern French artist; he either constructs some group of nude figures, in irreproachable truth of contour and foreshortening, to all appearances simply to prove his knowledge of the proportions and anatomy of the human form, or else he is inspired by the unblushing boldness of his model, and he paints her in a manner to cause the spectator to blush in her stead. When, by chance, the artist has a conception of the beauty of the form, and gives us something passably attractive, he seldom unites with it a power to represent other and equally high attributes of human flesh, the surpassing richness and depth of color, delicacy and variety of tones, and the refined and velvety texture! In a word, successful flesh painters are uncommon among the French. With this general desire to paint the nude is joined often another equally unhealthy aspiration, hardly to be qualified by one word. By this latter impulse the artist is prompted to seek the extreme vigor of action, which renders his figures highly dramatic, and forces the sentiment to an obtrusive and unpleasant degree. This heat of dramatic power often finds refuge in the wildly outstretched arm, in the rigid straightening of the limbs, or in the sweep of the longest line in the body, from the foot to the tip of the extended hand. A glance at the walls of the French department revealed many of these tortured poses, each quite as significant as the other, and the sum-total hardly worth the mention.

The peasant painters of France, of whom Jules Breton and Jean François Millet are the strongest examples, occupy a sphere of labor which demands the most acute perception of all that is noble and poetical in the simple and unassuming rustic and his surroundings, and a deep, unchanging sympathy with him, his life, and his inmost feeling. Both of these artists—peasants in the simplicity of their natures, as well as by birth and a life-long residence among these people—love their neighbors with all the tenderness of brothers, and paint them with a fervent admiration for their honest, manly traits, and a feeling for the poetical current in their lives, that give to their pictures the stamp of an impressive seriousness of purpose, a harmonious rythm of sentiment and execution, and make them pastoral poems, marking the artist as a true poet.

Jules Breton's *Blessing the Harvest*, from the Luxembourg palace, is a work of great power, displaying a grand unity of conception and singleness of purpose, added to a forcible and masculine execution. The scene is a common one in the rural districts of France. The procession of the church officials and state dignitaries is passing through the fields to invoke the blessing of God upon the ripening grain. The aged priest, bearing the holy symbol, is preceded by maidens dressed in white, carrying an image of the Virgin, and is accompanied by the flower-bearers and the censor-swingers. Behind march the pious villagers, with uncovered heads, and on every side kneel the peasants, in humble adoration. The strong sunlight shimmers over the tops of the yellow grain, plays upon the rich trappings and gaudy vestments, touches the white robes with streaks of warm light, and twinkles everywhere, in the clouds, in the distant village, and in the landscape, seeming to diffuse with its warm glow the feeling of respectful quiet and solemnity, when even the notes of the birds are hushed in the presence of the sacred ceremony. The types of the peasants are unaffected but true, and their actions unconsciously given. Observe with what skill the perspective values of the tones are secured, so that the long row of figures is neither monotonous nor tortured, and the landscape and the groups are united to form an ensemble, with the interest centred in the principal actors. No figure is superfluous, each sustains his role, and all are possessed with the same idea.

Another picture is *The Fountain*, in which two peasant girls fill their jars at the spring, in the twilight. Their poses are full of natural grace, their actions simple and true, and above all, the deep, rich tone of the fading light is so faithfully given, that the spectator feels the growing coolness and the mysterious quiet of the falling night stealing upon the scene. Similarly inspired is the *Return from the Fields*, with troops of gleaners strolling home in the twilight; and another, with three girls, with interlocked arms, walking home through the fields, sharing their simple confidences with each other. In all these pictures there is no obtrusiveness, either in the sentiment or the execution, and they appeal to every one alike, requiring no initiation into the mysteries of art to recognize their superior qualities of expression and color.

Millet is of a deeper poetical nature than Bréton, and while his peasants are all true to the life, he clothes them, as he does the commonest object he represents, with a poetical sentiment that transfigures the coarse garments and the ugly features, and we see the peasant through the eyes of the artist. The simple incidents of their history become stanzas of a life-long pastoral which it is the loving work of the poet-artist to perfect. Millet was represented but by two pictures: *The Sower*, and *Death and the Woodcutter*. As in all his works, the charm of simplicity was grandly present in both of these. The former is a single figure in the shadow of a hillside, scattering the grain with a swinging stride, and in the sunlight, a laborer with his team, harrowing. The breadth of effect, the perfect action of the figure, and the depth and richness of the color, all point to the sincerity of the artist and to his unaffected sympathy with the subject. In the second picture, the skeleton with scythe and hour-glass, its hideous form covered with a winding sheet,. stretches out a bony hand to grasp the trembling rustic, who crouches in dread beside his bundle of faggots. The figure is draped with wonderful skill, the expression of the pose masterly, and the color of bewitching refinement.

Bougnereau is a peasant painter by name, though not by sympathy. He is inspired by the exterior of a peasant life, and by the less picturesque side of it. With all the skill of a *modiste* and a hairdresser, he combines costumes and coiffures, and paints his subjects with great care and a minute attention to details of form and color, without grasping the decisive character of either. His actors are always soulless, and their waxen faces bear no impress of individuality, one being the counterpart of the other in expressionless perfection of contour. This artist exposed several large pictures, and with his pupil, Perrault, represented a certain class of painters whose chief qualification lies in an undeniable facility of execution.

Bonnat's subjects are not altogether wanting in human interest, and he paints with a strong hand. For example, his *Italia* is charming in expression of *naïve* merriment in the face of the child, hugging its mother with impulsive affection; a little crude, but not altogether unpleasant in color. Cabanel triumphs with his crayon in perfecting his lines, shows great facility in a certain weak manner of execution in which he appears to have set his palette with onion skins, and his sentiment always remains a long distance behind his skill. With him, artfully posed and perfectly draped figures constitute all worth striving for, and as in his *Francesca di Rimini*, you find perfectly imitated stuffs, irreproachable contours, and not a note struck in the melody of the human heart. His *Triumph of Flora*, painted for the Louvre, was exposed in the *Salon d'Honneur*. Its greatest merit was its size, if that be a merit. His portraits are as feelingless as his skilfully arranged and well posed groups.

If, for a moment, I turn to the portraitists, I must rank Carolus Duran among the class who bow down to the power of execution, and are artists with their fingers but not with their brains. He contributed three very dazzling full-length portaits of ladies in rich costumes. They are posed with skill, and painted with much nerve and swing, but speak only as portraits of costume; for the faces are subordinate to everything else. Without grace, and with little more than rude dramatic effect, the portraits shock from their harsh oppositions of tones and general poverty of color, though painted with all the richness of M. Duran's rather meagre palette.

There were, as I have said, many examples of the nude, without exception perversely opposed to any ideas of delicacy of sentiment or power of execution. Among these were found several by Lefebure, for the most part finely drawn;—and all is said. Contrasting strongly with these trivialities, a large number of the works of the late Delacroix, stand prominently forth. All deliciously rich in color, strong in tone, and full of delicate sentiment, they serve as a sort of landmark to guide us in our review of the twenty years since they were painted. A wan, haggard, savage woman, with her newborn babe, a tale of suffering on the mother's features, and sympathetic lines in the wild face of the father kneeling by her side; a lion tearing his prey, all bloody and mangled; biblical and historical scenes; all are treated with like feeling and characterized by a depth and wealth of color, little in keeping with the faulty execution.

Very rich and varied in color are the pictures of Isabey, of which he exposed several. Hardly more than suggestions of pictures, very sketchy, the figures forming themselves out of an apparently confused mass of lines and blotches of color, few contours, no attempt at finish, the pictures are nevertheless full of interest. The forms are suggested with a vigorous touch, and the action strong and well understood. For an example of the whole, take one of the long, narrow panels. It is *Breakfast in the Forest.* The lords and ladies in their most brilliant dress, hobnob at a table on the left, cooks and scullions stagger under the weight of steaming dishes or huge pots of food. In the centre, the fire, with the fat attendants, and to the right, the esquires and servants drink and carouse in their boisterous way. All is movement and stir; the woods are full of figures, and brilliant costumes, shining armor, the blaze of the fire reflected on polished dishes, the foliage and all the beauties of the forest make the picture a bouquet of rich color. Isabey's figures are so small that there is a temptation to class him among the liliputian painters; but he pays so little attention to detail that his characters are grand in their breadth and vigorous action.

With Gerome, who was represented by some of his best works, size does not always remain a necessary attribute of his productions, but he is always best seen when his figures do not exceed a certain very small stature. His *Slave Market*, a life-size picture, a sort of studio combination of a naked girl, a crouching negro, a parrot and a few accessories, has little to recommend it. Then there were also shown one or two rather hideous subjects, where decapitated heads and cold-blooded guards told some story of Eastern barbarity. Finished with more than photographic nicety, the details are rendered with such exactness, that you are almost sure that there is a miniature *porte-monnaië* in the pocket of each of the diminutive personages. There is, nevertheless, a skill in composition, a knowledge of costume and antiquities, a considerable truth of expression and strength of color that pleases. While the pictures do, like Meissonier's, impress one more by the skill shown in their execution than for the ideas they illustrate, there remains often much to admire outside this material qualification, and we find occasional passages of honest, spontaneous feeling. The best one of the pictures shown was the *Gladiators*. The multitude of spectators crowding the benches of the arena are impatiently awaiting the final act of the tragedy passing before their eyes. In the foreground, with one foot on the throat of his vanquished opponent, stands a gladiator, half naked, half in armor, turning to the imperial box for the unfavorable verdict of the thumbs. The courtesans give their vote with ferocity, and shout for the death of the conquered, while the emperor, almost helpless in his obesity, listlessly eats a fig. Through the awning come streaks of sunlight, which straggle over the arena and the crowds of spectators, and beam in a mass in the background. This effect is especially well managed. Another picture is an Arab supporting the head of his horse dying in the desert;—a bit of sentiment, finely executed.

Meissonier neither can be classed with Gerome, or be said to be totally different from him. He paints on a smaller scale, with less detail, and manages to give a great deal of breadth in a very small space. He exposed a number of small panels,—a soldier or two under a white wall, a group of cavalry, an interior with figures, neither impressive, and all well done,—and the the most eloquent picture I have seen from his hand, *1807*, a cavalry charge. Napoleon and his staff are seen on an eminence in the background, and, sweeping across the front, is a squadron of cavalry led to the charge, every man saluting his chief with an enthusiastic swing of the sabre. The horses are unfinished; in fact, the whole foreground is but an *ébauche*, yet there is a dash and vigor in all the movements, a free and unconventional action in the horses that is rarely equalled. Certainly the charm of Meissonier's pictures is in something more than their liliputian size.

Perhaps the finest figures in full action were shown by Boulenger;—three Kabyles pursued by French scouts, the fourth just rolled over by a ball from the gun of the foremost soldier. The dark-skinned, half-naked natives, rush down the steep hillside with swinging arms and vigorous stride; one only, with a very natural movement, turns his head to watch the pursuers just appearing over the brow of the hill. The action is full of life and perfectly expressive. Side by side with this manly, honest work, hung several prettily painted, feebly conceived scenes with Pompeian women, posed and grouped and expressing nothing. One would hardly believe them to be by the same artist.

It is not my intention to discuss whether it is the province of art to deal with metaphysical, psycological or philosophical questions, but I will salute in passing, a volume of satire by Glaize, which he calls *The Spectacle of Human Madness.* He has represented four scenes : the biblical massacres, the Christian martyrs, the heretics and the slaughters in the French Revolution, and has given them all as if he painted on a panorama, while the artist himself, with an anxious look and half apologetical shrug, stands on the stage in front to explain the illustrations.

Few portraits were shown, possibly because there were few good ones to send. Nelie Jacquemart exposed by far the best and much the larger number of heads. With an almost too rigid observance of actualities, she joins a delicate sense of color, a love for harmony and a great facility for executing with remarkable precision of line and relief of form. Occasionally the portraits are somewhat labored, but she enters so well into the life of the personages she portrays, that one can make their acquaintance from her portrait of them. Contrasted with Carolus Duran, Mlle. Jacquemart gains by the unaffected simplicity and natural movement in the poses, and a far greater capability of suggesting the fleeting expressions of her sitters, beside being undeniably the better colorist. Henri Regnault, one of the most promising of the young French artists, unfortunately killed at the battle of Buzenval, January 9, 1871, may be ranked among the portraitists for his equestrian portrait of General Prim, if for no other attempt of the kind. The General is seated on a black horse, settling into the saddle with a very natural movement as he reins up the charger and faces to the front. The animal, though strongly touched, is too evidently from a photograph, with the exaggerated perspective of the hind quarters and the magnified head and neck which almost dwarf the rider. The background is compused of rolling clouds of smoke, waving banners and enthusiastic soldiers, admirably relieving the figures of the horse and man, and eloquently significant of the General's wild and stormy career. Regnault's *Execution in a Moorish Palace*, with the ghastly head and bleeding trunk, is too dramatic and tricky to be considered first-class art, but the figure of the stalwart executioner carelessly wiping the sword, is boldly posed and strongly drawn.

Of the superior excellence of French landscapes shown in the Exposition there can be little question, and they were varied enough in character to show the adaptability of the French artistic nature to this sort of work, with high attainments in every direction of procedure. From the broad and free treatment of Corot to the minutely finished and somewhat formal realism of Robinet, there was every grade and good specimens of each. A large number of admirable examples of Rousseau were exposed, all of them of a fruity juiceness of color and strong effect. Rousseau gives more than any other artist the exact meteorological conditions of the atmosphere and the associated effects in perspective, aërial and terrestrial. The many twinkling trees, with their opaque masses of foliage, the deep rich shadows and the broad strong opposition with the sky, and above all, the mysterious, indefinable play of the sunlight, repeated and reflected everywhere;—all this is found to perfection in his works. Of a simple line of meadow, with a clump of trees against the sky, he makes a picture full of interest, representing nature in her most delicate phases, impressing from richness and variety of color, grand oppositions and wonderful suggestions of nature as she is found. The most striking of the pictures shown was a motive on the border of the forest of Fontainbleau. Grand masses of trees on either side, marshy ground between, a plain beyond, the sky full of flaky clouds, and all bathed in strong sunlight which gilds, defines and mystifies in a thousand ways.

Corot, on the other hand, impresses from his depth of feeling for the subtle charms of nature seen from a different point of view. He suggests the grand features of the landscape, infuses his picture with the one great solemn beauty of nature, and leaves it to the imagination to supply what, in the enthusiasm of his love for nature as she moves him, he forgets to detail. The grandest artistic efforts are not the most complex ones, and in the noblest strains of poetry is found a heroic simplicity which dignifies the verse and is more eloquent than volumes of detail. Corot's individuality and his poetical sympathy with nature are illustrated by his smallest works, and, although he sometimes falls into a careless treatment and frequent repetition, the same conception of the subtleties of nature's charms is always prominently displayed in the loving and impulsive manner in which they are rendered.

Nature's more positive moods are successfully represented by Emile Breton, who chooses the mournful aspect of the landscape, in the autumn or winter, and very sympathetically illustrates it. He exposed an *Evening in Winter*, with snow-covered earth, and trees, and a chill light, in harmony with the season. Much feeling for like phases of nature, and a strong, free touch, with a well-trained eye for oppositions of tone,—these are his characteristics. Daubigny was represented by but two canvases, neither strong examples of his power. Français was also but feebly seen. A nook in the forest, with impenetrable hedge of foliage, and well-grouped trees, skilfully managed light, and Daphnis and Chloe in mutual embrace in the solitude of the beautiful glen, rather scenic in effect, and a trifle harsh in tone,—this is one of his pictures. The other—a scene in Pompeii, with the laborers among the ruins—is much better felt, and has a delicious glow of light in it. Robinet finds a year's study in the gravelly bed of a stream, rough bowlders, and a clump of trees. The smallest pebble, and the irregularities of each, are painted with microscopic fidelity, and, though the light is sometimes harsh, the general effect is often good. In several pictures shown, it was wonderful to observe the perfection of texture and minute finish, and withal a very perfect subordination of the detail to the mass. One feels, in the contemplation of these and similar pictures, wonder at the infinite patience, more than admiration for the illustration of any one of the myriad of nature's expressions.

Of the animal paintings, Troyon's works were almost the only ones claiming attention, and my admiration for the unequalled power of this master finds satisfaction in none of the ordinary formulæ of praise. His pictures are models of a vigorous handling, strength of tone, and above all reproach of indecision of drawing or meagreness in any direction. A group of cattle and sheep under the trees; a simple motive, and a canvas of limited size; but no further example is needed to show the master in all his masculine strength. The tree trunks are marvels of fatness; the foliage is a wealth of fine tones; and the broad side of the red cow in the light is as rich and varied as a Turkish carpet. In the whole department there was found scarcely an echo of the richness of color and vigorous strength of tone seen in Troyon's pictures.

In this somewhat categorical review of French art, as seen at Vienna, I have endeavored to give an idea of the distinctive characteristics of the various classes of artists, and my opinion concerning the school as a whole is elsewhere expressed. Several well-known names will be missed from my list, no doubt. Difficulties arising between the selecting committee and the artists, analogous to those experienced in our own country, a want of harmony between these parties, induced even by political feeling, resulted in the refusal to exhibit by more than one famous painter.

The Spanish school has so many of the French elements in it, and the pictures shown in the exposition were so evidently influenced in their conception and treatment by French ideas, that this department properly follows the one just described. The general aspect of the small room that contained the Spanish pictures was unfavorable. The walls were hung high with large canvases, illustrating religious subjects, treated with the worst conventionalism, or indifferently successful attempts at historical pictures. There was, however, a rich tone of general color, an impress of a warmer sun and more impulsive nature evident in most of the works. Two portraits, by Navarre and Rodriguez respectively, both of sitters in rich costumes, and equally inspired by the lustre of the silk and the sparkle of the ornaments, more than by the character of the head, were in every way similar to the flashy canvases of Carolus Duran, and quite as meritorious. These, with a few strong *genres* by Mauresa, as rich in color as a basket of Spanish fruit, complete the list of the noticeable figure pictures. There was but little seriousness of purpose evinced in this branch of the art; nearly all the subjects were as trivial and as superficial as one of the Spanish love songs. In the landscapes, on the contrary, were displayed a surprisingly intimate sympathy with nature, and a grand conception of natural beauty. Urgell and Torrescassana seem both inspired by the sublime solitude of the landscape, where the presence of the human figure only makes the solitude the more impressive. The former artist exposed a sea-coast view: a long stretch of sand, a gray, lazily-rolling sea, a cold sky, and the dimmest vision of a departing ship in the horizon; a single figure of a girl alone on the beach, watching the vanishing sail;—this is all. But how impressive is the maiden's loneliness, as she feels for the first time the longing that will not cease until the sea brings back the loved one! A gray sky, a broad plain, and a single row of trees, quiet, truthful, and suggestive of one of the solemn hushes in the working of nature's forces, when they seem to pause for breath before exciting new convulsions;—this was one of Torrescassana's motives, and the same feeling inspired a twilight scene, with a simple silhouette of houses and trees against the sky.

The influence of the artistic productions of the Netherlands on the art and artists of every nation, has always been disproportionate to the political and geographical importance of this country, and at the present day is as strongly felt as ever, though less generally recognized and acknowledged. In sculpture, no less than in painting, this comparatively insignificant country has moved a current of art far beyond its conceded strength. The noble examples of the famous masters of the Netherlands serve as salutary guides to artistic progress in every country where art has had a foothold, and need no repetition of their good qualities here. Of the sculpture of the Netherlands very little is generally known, and there has been, I believe, no description published of this extensive and interesting branch of Dutch art. Probably few art connoisseurs will remember that some of the most famous examples of old sculpture in Europe are from the hands of artists of the low countries. I speak of Belgium and Holland collectively as the Netherlands, and of their art as Dutch art, because the arbitrary political division of these two countries has existed only for twenty-one years, and in art, least of all, are they two countries. I will not attempt to account for the richness of color that is certainly found, to an exceptional degree, in the Netherlands, or to analyze the causes that have developed a peculiar love for color, and fatness of tones and contours in the native artists and the people at large. Overflowing with natural spirits, and physically robust and hearty, the people—and above all, the Flemings—have all the impulsiveness of children, and a horror of everything that is meagre, indecisive and tame. In the warm countries, where the greater part of life is passed out of doors, and where family ties are weak, and comparatively of little importance, the artist naturally seeks his subjects in the creations of his imagination; but in the low countries, where a somewhat rigorous climate forbids an extended outdoor life, motives are found in the scenes of family life, the interiors, and kindred subjects. The birth-place and home of the *genre*, and the nursery of a high realism, the Netherlands develops a class of artists who incline more naturally to the representation of positive fact and simple expression, than to the illustration of the deeper and more delicate sentiments. In point of execution, they are in advance of any school; and in keen perception of the beauties of color, and in innate ability to represent fine distinctions of tone, they also take the lead. Delight in the charms of color is, it seems to me, one of the highest enjoyments of our nature, and the gratification of this sense is one of the noblest aims of art. The Netherlanders often impress by their harmonious and sympathetic coloring, when, in other respects, the picture may be comparatively expressionless. This element of judicious composition of color, which should always march *à pas egal* with other, and, in general, more popular conditions of superior work, is a salutary one in the influence of the art of the Netherlands, and to the high standard adopted by this school in the direction of color and tone as important qualifications of artistic execution, all artists do homage.

That sentiment is by no means lacking in even the average productions of the Belgian and Dutch artists, and is occasionally found in its most exalted expression, while, as a rule, that their highest attainments are in the sphere of color and tone, was proved by the extensive display made by these two countries. The Belgian exhibit was by far the larger, and occupied a number of rooms. Several of the works of the late Baron Leys hung in the *annexe*. The most original artist of the age, Baron Leys created a school which has taken root in all countries with more or less vigor, and is grafted, in noticeable strength, into the manner of numerous artists unconverted to his way of seeing and painting. The largest picture shown, and the one which represented the artist best, and at his strongest period, was a study for the fresco in the Hotel de Ville, at Antwerp, *Burgomaster Launcelot van Ursel haranguing the Militia to defend the Town against Martin van Rossem*. The gothic simplicity of line and naïvété of pose in the burgomaster and the assembled crowd of militia, the disregard of all academic rules of composition, and above all, a deep sympathy with the character of the people portrayed, joined with a superlative richness of color and strength of tone—these are but a few of the good qualities of this work. In the *Fête given to Rubens*, from the museum at Antwerp, painted in a totally different style, one finds less to admire in the somewhat strained effect of light, and in the labored figures. It recalls Rembrandt's *Ronde de Nuit*, in the force of the lights, and in the admirably managed shadows. A picture by Baron Leys' most promising pupil, the lamented Joseph Lies, was also sent from the Antwerp Museum. It is an episode from one of the numerous invasions of Flanders, and is called the *Approach of the Enemy*. From the picturesque village in the distance pours a motley train of peasants, and teams heavily laden with the household goods, and goaded on by the reported approach of the much-dreaded foe. In the foreground halts the advance guard, a young lord and a trusty attendant or two, with a score of cowardly boors, armed with the implements that come first to hand. The venerable parson and his pretty daughter have just come through the gate, and she is evidently not unconscious of the presence of the handsome young leader of the guard. Full of incident, and grandly illustrating the character of the people, it has all the charms of most beautiful color besides. Another pupil of Baron Leys, Victor Lagye, who has assimilated much of his master's admiration for the quality of tone, exposed three pictures, all very strong in this respect. *The Bookworm*, a library interior, with two figures, is a marvellous example of perspective of tone, and very strong in color and treatment. *The Sorceress* is less successful as a picture, for the witch is but a common-place model, posed before a fire, and very meagrely drawn and painted, and the two visitors who enter with a baby are expressionless and cold, but the interior is beautifully rendered. To another and degenerate class of followers of this master, who imitate their teacher with more affinity for his faults than for his better qualities, belong Frans Vinck, of Antwerp, and the two De Vriendts, of Brussels. Vinck's idea of a picture is a row of *poses plastiques*, before a flat and obtrusive background of Antwerp architecture. He calls it *Sortie d'une Eglise, L'entrée joyeuse d'un Roi du Tir*—you may call it what you will, and be sure of a fit. When he sings of love, it is a Belgian soldier with a nursery-maid, and the sly priest, to play his part in the farce, all posed before a stiff hedge-row of trees. Julian and Albert De Vriendt,—and they might be one for all the difference that can be discovered in their works—both exposed large historical pictures, subjects chosen under pressure, painted with no spontaneity, and adding to a certain strength of color little expression, much gothic rigidity, and no human interest. Generally painting with a great deal of feeling, Louis Gallait was scarcely suggested by two dramatic pictures called *Peace* and *War*. The latter is a very unpleasant episode, illustrated with a horrid realism. A dead mother and infant, a child wild with grief, and a grimy, pallid hand, showing the fate of the father, the situation of the scene marked by a few trophies, it formed a group to be reverently covered with a sheet. Two portraits of Belgian gentlemen, and one of Pope Pius IX.—a reproduction of the one in the Vatican—were painted with a skill rarely found outside Belgium.

The morbid taste for a spice of horror so evident in the picture just spoken of, recalls to my mind that one of Wiertz's largest canvases, *The Fall of the Angels*, hung in the *Salon d'Honneur*, opposite the weak and monotonous expanse of Cabanel's *Triumph of Flora*. A confessed imitator of Rubens, and like all copyists far behind his model, endowed with a lively, and to all intents, a diseased imagination, and governed by the most haughty conceit that ever possessed an artist, Wiertz's life was one series of disappointments and failures, and his pictures are but milestones of his toilsome life journey. Assembled now in the Wiertz Museum at Brussels, they form a sort of chamber of horrors, where the public goes to get a taste of the mysterious and the horrible, and young artists go to take a lesson from this great example of misapplied talents. *The Fall of the Angels* is a confused mass of nude figures, evidently inspired by Rubens,—flocks of very earthly angels, monsters breathing fire, streaks of lightning, precipices falling and distortion and convulsion everywhere. It is a violent step from this picture to the methodical and logical, and consequently uninteresting and tame production of M. De Keyser, the director of the Academy at Antwerp, painted for the Museum of the Academicians in that city; *Charles V. Delivering the Christian Slaves at Tunis* is the subject. The really fine group of slaves has no distinctive character that marks their nationality, the emperor is posed with thorough academic formality and there is a general chocolate tone over the whole picture. The artist has not taken advantage of the resources at his command, one of the most prominent of which is the grand opposition of tones in the flesh of the two sexes, and the work is much less meritorious than the frescoes in the vestibule of the Antwerp Museum completed by M. De Keyser about a year ago, after ten years of labor, and at a cost to the government of only 500,000 francs—a reward small enough in proportion to the real value of the works. J. F. Portaels, of Brussels, whose influence is noticeably great in the formation of a number of young artists who receive the benefit of his generous instruction, exposed very little. One rather cold portrait, and *The Young Witch*, a dark-skinned maiden with a black cat on her shoulder, were the only ones seen bearing his name. One of his pupils, Emile Wauters, exposed two large historical scenes, very well studied, but not of remarkable strength of execution. Other pupils were also represented.

Of the pretentious works of Slingeneyer and Smidt, whose glowing canvases covered much space and possessed merits in inverse proportion to their size, little need be said. The former artist enjoys a great newspaper reputation in Belgium, and, like all painters who advertise their productions in the same manner that the tradesman puffs his own wares, M. Slingeneyer has a certain mercenary success and a fame among a certain class. There is hardly a redeeming quality in all his pictures shown. Willems, too, falls far short of his reputed strength, as he was seen in the Belgian department. His finish is extreme and porcelain-like, his contours are hard and inflexible, and his groups of lay figures are drawn without an idea of expression and without an idea to express; besides, no great charm of color adorns his pictures.

Less distinctively Belgian, and combining much of the French aptness for picture-making and freedom of execution, with a fine sense of color belonging to him as a birthright, Alfred Stevens may be classed among the painters of the *salon* order, but frequently rising to a higher and more serious effort. A large number of pictures shown comprised every variety of subject, and proved the exceptional versatility of the author. These were several interiors, beautifully painted, a few trivial costume pictures, a number of charming ensembles and simple but excellent studies. A young girl in blue, holding a dove, called *Spring*, is as full of poetry as the lines of Tennyson it recalls, and is distinguished by appropriate richness and simplicity of tone with a perfect harmony of ensemble. The costume pictures of M. Stevens are painted with much seriousness and facility of execution, showing more than ordinary artistic feeling. The collection was a unique and remarkable exhibition of the productions of one artist. There is a long list of figure pictures which it would occupy too much space to particularize, and among them are many choice works. On the whole there was a gratifying absence of conventionalism and marked individuality among them.

In the ranks of the landscape painters is found an equal diversity of manner and of individual strength. Lamorinière, who exposed several of his pictures, is one of the most strikingly original landscapists. By sentiment realistic, he finds more to admire and study in a simple corner of Flemish landscape than in the most varied accidental combinations of forest, and hillside or plain, and has little sympathy with the grand in nature's architecture, or with her most striking moods. He paints trees with all their richness and multiplicity of tones, and lovingly details the texture of the trunks and the graceful contours of the limbs. His perspective of line and of tone is as faultless as his execution of the tree-trunks, and he gives us nature as she is, appealing only through her simplest charms. The two landscapes by Van Luppen scarcely kept up this artist's reputation. His strength is found in the solidly painted distances and in a keener sense of the picturesque than Lamorinière has. Grandly broad and superbly rich in color, a marine of Clays always fixes the attention. It is generally a clump of the bright colored Dutch boats and their harlequin sails, all reflected with the glories of the sky in myriads of ripples, or a choppy sea, a breezy sky and a fishing boat, tossing about on the waves. Grasping the grandest elements of the scene, the artist represents it with a rare vigor and a strong, suggestive touch that reminds one of some noble adjective of Homer, expressing a world of beauty in a few syllables and characterizing with bold lines. Clays exposed four of his finest efforts and they found no rivals.

The Ducal Palace at Brussels contributed the large landscape with cattle, by Robbe, as the most shining example of this artist's superior powers. The skill with which he has treated both elements of this picture, rank him among the foremost of animal and landscape painters,—a broad expanse of meadow, with a herd of cattle feeding, or drinking in the pools, a grand sky full of piled up clouds and all in full sunlight; this, rendered with a master's hand. A touch of color, like an echo of Troyon vigorously and boldly placed, is a bull fighting with dogs. M. F. H. De Haas exposed some firmly drawn and solidly painted cattle, also a pair of donkeys on the beach at Scheveningen, very strong in color and well in the open air. With Joseph Stevens, who sent a market of dogs, a picturesque scene, the list is complete.

It is with reverence that I approach the masterpieces of Joseph Israels of the Hague, which in my estimation rise supreme above anything in the Dutch or Belgian departments, and find no parallels in the whole Exposition. Israels inclines with a tender feeling of sympathy, to all that is pathetic and touching in the history of peasant life, and, *par excellence*, the peasant painter among the Hollanders, everything that he illustrates, be it the simplest episode, he poetizes with a solemn earnestness of feeling, and almost unconsciously adds an element of pathos, though where and how it is one cannot tell. He, in common with many of his compatriots, loves a warm, brilliant light and a large proportion of shadow, which in its depth and mystery remind one of Rembrandt, and, accompanying this admiration for strong opposition of tone which with so many artists is satisfied by a brusque and harsh contrast, is a rare feeling for the harmony of effect. With Israels, his key of color is always admirably attuned with the chord he touches in the human feelings, and his work is the grandest illustration I can refer to of this power of melodious conception of a subject, and the highest proof of the progress which I alluded to in the first part of this article, as noticeable in this direction among artists of the present day. Israels' interiors are marvels of depth and richness of tone and positive truth of opposition, and in the management of shadows he has no equal. He exposed two pictures of the same motive, a mother feeding her child, noticeable for the strength of color and play of light poetically rendered; but his *chef-d'œuvre* was *From Darkness to Light*. It is a Dutch interior, sombre and mysterious. In the foreground is a mother with two children, motionless under the crushing weight of the grief they feel as the coffin, with the remains of the husband and father, is borne from the apartment by the assembled villagers. A soft light steals through the open door, defining the forms of the rough peasants who, with all the tenderness of women in their sympathy with the grief of the family, reverently bear their burden. You feel all the oppressive quiet of the scene, broken only by the mournful tones of the bell that tremble in the air, and, with the peaceful light, half subdued, steals into the darkened room. No dramatic exaggeration, no violent contrasts, all solemn and peaceful and quiet;—a true elegy and nobly expressed. After Israels everything seems cold and passionless, but there was a similar inspiration of color visible in the works of several other artists who exposed less eloquent pictures. Sadée hung some charming bits of quiet color, one illustrating a scene common enough at a cathedral door, the poor receiving the bread bequeathed by some pious burgher, to secure the prayers of the recipients of this rather selfish charity. The figures are remarkable for solid truth of tone and charming execution. There were few pictures inspired by a very picturesque element of Dutch peasantry, the fishermen. Elchanon Verveer was the only one who was moved to try this path, and even he does not enter enough into the spirit of the fisherman's life to produce more than a skilful study of a quaint model well posed. Beside Israels' portrait of his mother, there was but one other which made itself seen. This was Bisschop's portrait of John Lothrop Motley. The light is harsh, the tone false, aud though artistically treated, especially in the accessories, it is not a portrait from which one could ever make the acquaintance of the historian. This artist also exposed a life-sized figure of a young girl, a little crude in color, and several interiors with many good qualities of tone, but an occasional meagreness of light. Among the landscapes were found few motives from the characteristic beauties of the Dutch landscape. Almost no windmills, a canal or two by S. L. Verveer, with but a hint of the richness of the local color, a few brilliant studies by Roelofs, and several marines, were all the noticeable efforts in this direction, with the exception of several strong architectural pictures by Springer. Among the marines, two pictures by Heemskerck van Beest, and two by Mesdag, were painted with more than ordinary skill, but were not especially attractive. Madame Ronner, with her strongly touched and well understood groups of domestic animals, was the most original animal painter represented.

Entering upon the review of German art, it is clear to me that I leave behind the field of impulsiveness and spontaneity, and am penetrating the arena of plodding and logical, well reasoned and conscientiously studied efforts, but with accompanying results necessarily dry and only superficially impressive. This may seem strong language to apply to such a powerful and influential school of art, as the one I am about to discuss, but this is the idea induced by the general aspect of the German department of the Exposition, and the impress left upon every unbiased mind after a serious study of the examples shown. Grand exceptions to this sweeping statement there are indeed, and I shall endeavor to render them full justice in the detailed review which follows. The striking difference between the German art and the art just considered, lies in the very lack of that element which characterizes the latter, impressibility. Then on the one hand we have formality, a cool calculation of the means and the results and an almost servile imitation; on the other, freedom, spontaneity and originality;—all this in general terms. In Germany the idea of an artist seems to be to adopt the principles and arbitrary rules of some recognized light in the profession, and to base all future efforts on the attempts to reconcile these rules with the requirements of his own temperament. Each artist of note has, then, scores of followers, many of whom paint even better than their master, and they are all similarly inspired. If we take the *genre* painters, which represent by far the most numerous class, we shall find hardly a trace of individuality in their ranks. They paint the same subjects, compose after the same rules, execute in the same manner one with another, and it was a rather monotonous succession of *genres* that constituted a large proportion of the pictures in the German department. As a rule, these pictures are painted almost above reproach, so far as the mechanical execution goes. The flesh has often very charming tones, the figures are unexceptionally draped and drawn, and the arrangement is pleasing. They impress one, however, from this very perfection of execution, and by their unmistakable traces of cold reasoning, leave the spectator unmoved and unsympathetic. Not accompanied by any superior force of imagination, the artistic taste exhausts itself in perfecting the productions to a degree which compels the spectator to follow the same passionless course and arrive at the same logical sequences. A scene is illustrated so calculatingly correct and ploddingly detailed, that no imagination of the spectators can mould and adapt the ideas set forth to his individual current of thought. It is the supremest pleasure to enjoy this play of the imagination which creates and transforms, and harmonizes all things with the experiences of our own lives, and perfects and glorifies beyond the limits of human execution. Where there is room for this play of the imagination, there we shall always find we are impressed the strongest, and it is partly in this respect that the Germans fail to speak eloquently with the brush. In their treatment of the *genre*, as at present developed, there is an evident tendency toward the exaggeration of type, action and even costume which degenerates often into broad caricature. This inclination to caricature is not limited to the less noted of the *genre* painters, but affects all to a greater or less degree, and it results, it is plain, from pushing too far the admiration for peculiarities of type, and from a low order of perceptive faculties which grasps only the broadest distinctions of character. The ability of caricaturing holds the lowest rank among the qualifications of an artist, and wherever this element exists in a picture, the work loses by so much its seriousness, and palls the sooner on the spectator's vision. In an imaginative and imagination-inspiring picture, —and these qualities are inseparable—there always remains something undiscovered, there is a continual enticement to the unveiling of new beauties. Such charms are rarely found in the German *genres*.

Carl Piloty's great historical picture, *The Triumph of Germanicus*, was hung in the *Salon d'Honneur*, and was the most important of the academic works shown. It is a picture of great personal presence; it makes itself seen and impels study, attracting almost solely from its exceptionally powerful expression. Briefly described, it represents the triumphal procession of Germanicus on the occasion of his return from Germany by command of the jealous Tiberius, as it moves through a triumphal arch and passes in front of the imperial throne. The emperor, accompanied by courtesans, and surrounded by his favorite officials, sits gloomily regarding the scene from the height of a raised throne. Directly in front, with chained wrists, walks Thusnelda, leading her little son Thumelicus. Before her march three sturdy followers chained to the yoke, and a venerable harper whom a brutal Roman soldier drags along by the long white beard, grasping the tether of a huge bear with the same brawny hand. Behind Thusnelda follow her maids and sisters, moved by different emotions of their unconquered spirit, and in the distance on a triumphal chariot, surrounded by his five sons, among whom is seen Caligula, proudly rides Germanicus in the regalia of a conqueror, the mark for showers of bouquets and garlands. There is nothing especially original in the composition of the picture, the light is concentrated on the white-robed figure of Thusnelda, and the shadow encircles it completely, of course magnifying the importance of the principal group and subordinating all the rest. The distance is treated with great skill, and the fine effect of light artistically managed. The color is not absolutely bad nor yet fine, and certain passages are decidedly conventional. The figure of Thusnelda is a beautiful one, full of haughty pride and queenly grace, and the action of the little boy clinging to his mother's hand is charmingly *naive*. The character of the blond Germans is finely portrayed, and there is no lack of interest in the personages or incidents. As an expressive illustration of a familiar event in Roman history, it is worthy the highest praise, and is far more feelingly composed and lovingly studied than the majority of similar productions.

The Building of the Pyramids is the title of Gustav Richter's largest and most pretentious picture, and the name suggests much more than is found on the canvas. Such a subject is fertile in resources, and requires little invention or forcing of situation to make an interesting composition. But Richter has produced an illustration neither remarkably instructive archæologically, nor abounding in other interest. His pyramids are buildings after a decidedly modern principle, his types are more Abyssinian than Egyptian, and there is hardly a costume correctly given. There is, withal, very little unity of idea in the work. The figures are moved by no common impulse; they are as diverse in sentiment as they are false in type, and in a large proportion are simple *remplissage*. Take the figure of a young girl with a jar of water, leaning idly against a tree, and gracefully raising the ten-gallon jar full of water for a boy to drink as easily as if it were a feather; or the vegetable carriers, entering the underground apartment, where the artist has even been obliged to introduce the effect of torch-light, to enhance the somewhat flagging interest in that portion of the picture; or even consider any figure away from the immediate vicinity of the queen and chief architect, and you will find they are unconscious of the presence of the illustrious visitors, and are all posed and grouped to perfect the composition, but not to illustrate a shadow of the main idea. In treatment, the flesh is hard and inflexible, the light is harsh, and falsities of tone prevail. The shadows are, for the most part, of a chocolate opacity. In two portraits, hung either side of the large picture, Richter was seen to much better advantage. The artist's wife, with her infant on her arm, very gracefully posed, and the face full of motherly tenderness, is painted with great skill, and excellent in color and drawing. This portrait had no rival, but its companion, which is of the artist himself, and an older child, who holds a glass of champagne to the light, its chubby arm supported by the strong hand of the father. These portraits possess all the interest of pictures, and are beautifully arranged and charmingly rendered.

Of the immense allegories and numerous religious pictures exposed, there was little more remarkable than their general conventionality and parallel merits. One of the characteristics of the *genres*, and even of the pictures above described, is their adaptability to almost perfect representation by a photograph, gaining rather than losing by this means of reproduction. Any one who is acquainted with Paul Meyerheim, through the photographs of his pictures, cannot fail to be greatly disappointed at the sight of the originals. Without exception, as they were seen in Vienna, they are hard and dry in contour and color. *The Menagerie*, in which the burly keeper performs with the boa-constrictor, to the amazement of a gaping crowd of country people, and the wise-looking pelican, the awkward flamingo, and the garrulous parrot, adding to the interest of the occasion, is one of the better examples of this artist. *Shearing Sheep*, and one or two others, are noticeable only for the lack of the good qualities which belong to the one first mentioned, and in none of these is there any story told worth recording. Knaus is evidently resting on his oars, having put off the student's cap, and occupying himself with the elaboration of what he has already acquired—judging from his half dozen pictures exposed. There is not a suggestion of direct inspiration from nature in any of them, and they all could have been, and probably were, painted by heart. The heads are, for the most part, broadly caricatured, and his attempts at sentiment fall flatly and coldly on the spectator. A group of peasants, gathered around a table, represent to the disinterested spectator little more than a collection of yellow faces, expressionless where not caricatured, and less impressive than so many mummies. A village funeral, with the dusty old mourners, the groups of children, the same ugly bier and black pall that have figured in so many similar conceptions, very little pathos, and no juiciness of color—this is hardly to be ranked with Knaus' best efforts. The common motives among German *genre* painters are found in the comic incidents of peasant life, or pleasant little scenes at social gatherings, and among all the long list of painters who illustrate peasant life, there is not one to be found who acknowledges, with his brush, at least, that the being he represents has any deeper feelings than those which prominently distinguish him from the higher brutes, and more than the facial expression of grief and joy. Vautier, who was better seen in the Swiss department, exposed one of these scenes, irreproachably painted, full of humorous situation, and valuable only as an illustration of an interesting custom among peasants. It is a dance in a country inn, with a group of girls standing on the benches, to see the fun, three quaint musicians, and the room in the background full of grotesque figures. Deffregger has more of the best side of peasant life in his *genres*, and certainly paints with much more feeling for color, and heartier sympathy with the peasants as something more than simple models for superficial imitation. He exposed, among others, a picture similarly inspired with the one above mentioned, and conceived with more genuine humor, and having more interesting situations. The Munich artists contributed largely to the collection, and some idea of the number of pictures sent from that city may be gathered from the fact that to Munich alone went fifty art medals. It must be remembered that this is no criterion of their superior excellence, for the artists not rewarded with medals are the exception, not the rule. The large proportion of these pictures were of the class of *genres* I have described; scarcely one poetical idea, and little seriousness of purpose in them. It would be unjust, however, to place Kurzbauer and Mathias Schmidt, of Munich, under this category. Of the first, I shall speak later, in the Austrian department; and the latter, although a young man, even now excels in many ways the older and better known *genre* painters. His subjects are always interesting, and the figures broadly touched, with an evident inspiration from the Dutch treatment. Besides, there is more *naïveté* of expression and pose found with him.

In certain examples of Munich work is seen the results of a new departure from the conventional manner of execution, and an extreme tendency in the opposite direction. These artists have mistaken carelessness for breadth, and freedom, which is the result of ignorance rather than knowledge, for bold precision of touch. They ignore contours and forms, their touch is brutal and feelingless, and they think they are geniuses when they have learned to be careless. Several portraits painted in this manner were shown, and one or two *genres*. That good results may follow from this radical change in manner is quite probable, when it shall have been modified by the teachings of experience.

One would suppose that the Franco-Prussian war would have supplied the victors, at least, with motives innumerable; it was an agreeable disappointment to find war pictures few and comparatively insignificant. There were one or two incidents in the war history of the crown prince, a charge or two, and a little artillery duelling; but the war pictures illustrated little heroism, and often exposed the weaker side of the Prussian nature. For example: a picket-guard of Prussians, with pointed guns, ready to slaughter at the word a half score of unsuspecting, hungry French foragers, on the search for vegetables, in the thick mist of early morning,—this does not inspire respect for the sentiments of the conquerors.

There were few portraits shown, and beside those of Richter, already spoken of, two fine equestrian portraits by Camphausen, and several heads by Lenbach, of whom I shall speak at length in the Austrian department, there were none of remarkable merits. In the way of landscapes, there were a number of gratifying exceptions to the rule of conventionalism and mediocrity which has so long applied to the German landscapes. There were landscapes, to be sure, almost measured by the acre, executed in the same feelingless manner, which proves that the reverence for the established, arbitrary rules which have so long governed this branch of art in Germany still holds a place in the breasts of many German artists. The noticeable difficulty with which the landscapists struggle is their mistaken enthusiasm for the grandeur of nature, and the attempt to represent immensity by very liliputian means. They are generally impressed by a scene which has magnificent distances, towering mountains, grand heights, and no elements of picturesqueness other than may be added by a chalet and a clump of evergreens. When they do leave this field of grand, but not necessarily picturesque beauty, they are more successful in their rendering of nature as she exists in her most charming phases, and impress by finer and less stagy contrasts, inspiring a deeper and quieter admiration for her beauties. Adolph Lier is one of the artists who have turned aside from the traditions of this branch of German art, and is pursuing a path of originality of execution and conception. His *Country Road on a Rainy Day*, a beautiful gray picture, is full of sentiment, and the *Spring Landscape*, with fresh foliage, interlaced branches, charming distance, and strong foreground, has rare qualities of light. Not unlike these pictures is one by George Oeder, of Düsseldorf, painted with very much the same feeling for quiet grays, and with a skilful touch, and one by Sleich, of Munich, with similar qualities. These gray landscapes form much the strongest class of a large number of excellent pictures, and are characterized by very quiet effects and simple composition.

Among the animal painters, Carl Steffeck, of Berlin, exposed by far the most expressive pictures. In his appreciation of the depth of feeling which may stir the heart of a dumb animal, he stands alone. A finer bit of sentiment than his *Dead Foal* was not seen in the German department. The colt lies dead on the ground, and the mother, with an unmistakable expression of the acutest grief and anxiety visible in the dilated nostrils, sad eyes, and pointed ears, stands over the body, watching and almost weeping. In the twilight, the forms of the rest of the herd are seen moving off toward the shelter, and a mournful tone of approaching night harmonizes with the grief of the animal. The horses are drawn with great precision of line and knowledge of forms. The same may be said of another picture, *The Service of Friendship*—a finely-built gray mare, making acquaintance with the mother of a litter of pups in the corner of the stable. On a much smaller scale, and with little or no attempt at expression in the animals, are the horses of Max Gierymski, who exposed a number of cavalry groups, admirably drawn, artistically composed and painted. In these groups, the landscape is not the least interesting part, and this is also true of the small horse pictures of Professor Dietz. The latter are effective as landscapes, and are rich and fine in tone and color. Schreyer sent a few of his mediocre works, none of them giving a hint of the masterly power that is found in the *Cossack Horses in a Storm*, in the Luxembourg Palace at Paris. Charles Verlat, who was represented by a portrait of the Queen of Holland in this department, and by two or three strongly painted, but overdrawn and dramatic pictures in the Belgian section, was seen in his element in *The Artist*, a monkey, at work at an easel—a work full of the richest color and most skilful handling.

The Swiss painters are thoroughly German in their ideas, and this department differed only from the German one in the much smaller proportion of excellent works. This may be accounted for by the fact that Switzerland sent few or no pictures from the museums, but depended on her artists to represent the country in her full artistic strength. As there was no high standard of admission to the collection, the number of mediocre works was large, and consequently the aspect of the hall was not agreeable. The Swiss seem to be slower than their neighbors to give up their old, conventional ideas, and are, as a rule, much more inflexible adherents to the doctrines of the past. Very many of the best artists paint in Germany, and, from patriotic motives, exposed under the flag of their fatherland. Vautier added three pictures to the Swiss collection, one of which, *The Village Funeral*, is generally considered his best work. The story is told with more skill than feeling, and while, in its presence one sympathizes with the mourning friends, the impress is not a lasting one. The motive is not strikingly new, nor treated in an original way; indeed, the picture has its counterpart in the German department. The scene is easily suggested by the title. A few uniformed attendants are bringing the coffin out of the house of mourning, and the villagers are gathered around to pay their respects to the family of the deceased, or assemble from motives of curiosity. There are, of course, immense resources of costume, pose and expression, and all this the artist has skilfully taken advantage of. The types of the villagers are well caught, but there is little charm in the color. In many respects, the *Sick-Bed* was the most impressive. A laborer, at the death-bed of his wife, holds in his rough fingers the wasted hand of the dying woman, and receives her last counsels for the care of their child. The sentiment is unobtrusively urged upon the spectator, and the interior is fine in color and painted with Vautier's best touch.

E. Stückelberg is, with the exception of Gleyre, the only one who professes to represent the nude, and his attempts are not always eminently successful. However, his young girl and her lover at the fortune-teller's is an attractive group, well painted. Gleyre sent *La Charmeuse*, a single nude female figure in the thicket, very delicate in contour and in color. By a too highly finished background, he weakened the effect of his flesh, and lost the otherwise charming contrast of texture. There was one picture shown, inspired from an American scene, which deserves mention more from its unique appearance and pretentious air, than from any distinguished merits it possessed. The subject is *Mary Blane*, and at a distance the picture looked like a group of plum-colored negroes, afflicted with the leprosy, clothes and all; but at a nearer view it is found that the yellow spots on the darkeys gathered around the banjo-player are intended for spots of sunlight struggling through the foliage,—the bluest of skies, blue mountains in the distance, blue shadows on the white horse, blue trees, blue dresses, and very blue blue everywhere; and the stranger must believe that Charlottesville, Virginia, must be a great mine of blueing, and the inhabitants get their peculiar color from life-long residence in this locality. The canvas bore the name of Frank Buchser. Neither in animal painting nor in landscape was there anything of special note.

Austrian art has very little distinctive character; it has more of the French than of the German element in it, and it has drawn from these two sources liberally. Regarding the Viennese as the typical Austrian, it is surprising to see how they have assimilated French and German ideas in their society, in their literature and in their art. Vienna is far from being an artistic city. Unpicturesque as she now stands, unimposing architecturally in comparison with many other European cities, and with superficiality of character in the people, well illustrated by the very celebrated, but, on acquaintance, wearisome music of her pet musicians, the Strauss family, she offers no special advantages to her artists in the way of public instruction or patronage. It is little to be expected that in a city where there is, generally speaking, no homes, in our sense of the word, and where you may visit a thousand apartments without seeing a library or even a bookshelf, that there should be a great public taste for art. The Viennese, as a rule, seek amusement outside their own rooms, and do not, like the English or the French, strive to decorate their interiors with an idea to the solid and lasting gratification of the eye. The Englishman and Frenchman in quite humble circumstances will often buy a small picture, which, hung in the best light their rooms afford, shown with loving pride to every visitor, cherished as if it were from the hand of an old master, stands as almost food and drink for its happy owner, and certainly does furnish much mental nourishment. On the contrary, the Viennese affect the flash and glitter of the French taste, display as a people no ideas of proper combinations of color, and yet have the reputation of possessing original artistic faculties to a high degree;—a reputation founded on this universal genius for assimilation of other men's ideas, and not always the best ones at that. The art academy does not rank high, either in the means of instruction or in the number of its students, and most young artists, tempted by the superior advantages of the schools of Munich or Paris, and the easy access to these art centres, seek the establishment of their ground or foundation for their future artistic career in one or the other of these two schools. The Austrian empire has within its boundaries a greater variety of picturesque natural scenery, of type of race, of various costumes and peculiar customs, than any other country in Europe. It has yet almost unexplored fields for artistic labor as fertile as any in the world; its history is full of incident and abounding in resources; infinite motives may be found for the *genre* painter, the peasant painter, the landscape or the animal painter;—and in Austrian art we find, with one or two noticeable exceptions, none of this home inspiration. There are French, German and Italian *genres*, historical scenes from each country and few from Austria.

The three prominent figures in the rank of artists are Makart, Munkácsy and Matejko. Makart was not represented in the Exposition, but there were several historical pictures and portraits by Matejko, and a good display of Munkácsy's works. Matejko is a remarkable example of unselfish devotion to art for its own sake, and, as his pictures witness, he has a deep and serious purpose in painting. His art is the child of his patriotism, and he applies himself untiringly and constantly to the awakening of the slumbering patriotic ideas in his unfortunate countrymen, and to the elevation of this people from the state of apathy into which they have been forced by years of oppression, and he devotes to this service his incontestable talent, illustrating the noblest and grandest incidents in the history of Poland. It is interesting to know something of the life of this painter, who joins with his wonderfully acute artistic nature such a deep and passionate patriotism. He is but thirty-three years of age, living in his native village, Cracow, in the simplest manner, perhaps not untempted by, but yet proof against, the attractions of the honors and fortunes which await him in the wide field open to his talents in the outer world. He lives with his family in the most modest of cottages, almost a hut, and his studio, if it can be called such, is so small that he is unable to paint on more than a part of one of his large canvases at a time, being obliged to roll it up as he finishes a portion. This may account somewhat for the occasionally remarked want of harmony in the ensemble of his large works. It is said that the municipality of Cracow have just decided to build him a comfortable studio out of the public funds.

His historical pictures shown in the Austrian department were conceived by the artist with the idea of illustrating three great acts in the drama of Poland's history, which should mark three distinct epochs, together eloquently expressive of the tale of the rise and fall of Polish supremacy. They represent Poland by the alliance with Lithuania taking its place among the European powers; Poland in the triumph of its arms, and in the first symptoms of decadence. The first picture is the interior of the council-chamber at Lublin, with an assembled multitude of Polish, Lithuanian and Ruthenian deputies, to witness the administration of the solemn oath which was to bind these peoples together as one nation. This was in 1572, sixty years after the marriage of Edwidge of Poland with Ladislas Jagellon of Lithuania, and under the reign of Sigismond Augustus II. The king erect, with the crucifix in hand, is repeating the oath to the grand chancellor, who kneels, with one hand upon the Bible, and reverently assents to the conditions of the oath. The venerable cardinal, Hozuus, the president of the Council of Trent, in his red robes, stretches out his hands and with a trembling gesture invokes God's blessing on the act. Around are clustered, with expressions of solemn earnestness, the dignitaries of the church and state. Besides an immense wealth of resources in the costumes of Oriental magnificence and rich accessories, Matejko has personated with wonderful accuracy the types of the different races, the heads being drawn with great precision. All his personages are individuals in face, figure and in gesture, and as a physiognomist he has scarcely an equal.

Later in the history of Poland an incident furnishes, if possible, a more interesting motive for the artist. It is King Bathory in the midst of his victorious invasion of Russia, where he has conquered Ivan the Cruel, destroyed the cities and overrun the country. The scene is passing on the snow-covered plain, under the walls of the smouldering city of Pskov, just destroyed, where the soldiers, secretly induced by the Jesuit Possevini, the tool of Pope Urban V., compel the king to cease advancing and to receive the bread and salt from the hands of the Muscovite archbishop. The king, richly dressed, sits in the door of his tent with a stern look upon his face. All around are the warriors in their half-barbarian armors, and with curiously ornamented arms and robes. In front is the kneeling archbishop, with the symbols of peace on a salver, and behind him the Jesuits crouch and fawn with terror in their eyes, lest the sword lying idle on the knees of the king shall find a sheath in their own bodies. The types are perfectly rendered, the expressions are individual and the heads full of character. The richness of the stuffs and the variety of the costumes, the waving banners and barbaric skin-dresses and feather ornaments, are all painted with hardy touch and picturesquely combined. The third and last picture represents the harangue of the eloquent priest Scarga, before the king and his ministers in the cathedral at Cracow. In the wild, nervous gestures of the patriot, declaiming with all his force against the dissolution of the times, there is much nature. As in the other two the composition is pleasingly original, but the color is less effective though the general tone is more harmonious. In his portraits, of which he exposed seven, Matejko is successful in so far that he represents his sitter with religious truth, often, it is reported, giving offence by the accuracy of the likenesses. His love for distinctive types of face, and his wonderful facility in the delineation of character, is plain in all his portraits. The heads are often brutally painted, and the tones, though strong, are not always pleasing. One of his best efforts is a group of three Polish children in their national costume. Broadly painted, and with charming delicacy of expression, it ranks among the highest works of the class in the Exposition. In Matejko we have an artist who does with all his heart the work he aspires to do, and his productions are stamped with the impress of spontaneous artistic talent;—an impulse to illustrate, that no obstacles delay, that urges him on with a power that only finds satisfaction in spirited compositions boldly rendered.

A very skilfully painted and well-drawn group, by Heinrich Angeli, *The Revenger of his Honor*, illustrates, as the name suggests, a scene full of commotion. The husband bursts into the midst of a dinner-party, to find his wife in the company of another gentleman, and, after the true romance fashion, runs his sword through the adventurer, who sinks dying to the floor. The cavaliers attempt to rush at the husband but are kept back by his attendants;—a dramatic scene and full of varied expressions, worked out with little exaggeration and forcing of sentiment. Angeli also exposed several portraits, one of Emperor Francis Joseph, more noticeable for the almost feminine weakness of touch and religious precision of line, than for any great force or character. Meissonier has a diligent follower, in the person of Pettenkofen, who fairly flooded one room with diminutive panels of such subjects as the *Bathing Gipsy*, *Maiden under the Gate*, and like figures, expressing nothing, and only valuable as proofs of a more than ordinary facility. Some of the tiny pictures were, nevertheless, attractive, but all appeal more on the score of execution than sentiment. The *Hungarian Shepherd Wagon*, a rude cart filled with a rollicking crowd, dashing along a dusty road, was one of the best of the scenes. In a like way, Herbsthofer recalls Isabey in his selection of subjects and in his free execution, by no means approaching this artist in strength of color or vigor of manner. The figures of Herbsthofer are full of life and touched with a *chic* seldom found outside the ranks of the French artists.

Thoroughly German in its treatment, and charming in sentiment, is *The Fugitives Caught*, by Kurzbauer, a pupil of Piloty. The situation is well chosen. A young couple are surprised in a country inn, where they are resting after the fatigues of the first stage in their elopement flight, by the angry mamma who has followed them. The young man rises with a proud look of mingled anger and disappointment, and the girl hides her face in her hands overcome by the unexpected presence of her mother, who regards her with a wonderfully well given expression of reproach. In the faces of the assembled guests and the landlord's family, is found the same masterly rendering of expression, and even to the look of utter irresponsibility on the florid countenance of the footman who accompanies the mother, every touch is full of truth and life. In the management of the light, as well as in the sober color and quiet range of tone, are found equally commendable qualities. Leopold Müller inclines to the school of the Netherlands in his devotion to the beauties of color. *At the Well*, recalls the solid, quiet gray paintings of several Dutch artists, and in *The Home Altar*, a young girl kneeling at a domestic shrine and lighting the candles, there is far more enchantment in the beautiful tones than in the sentiment. William Koller, a pupil of Baron Leys, suggests his master by an exaggeration of his faults, and one finds in Koller's pictures little more than formal poses, rigid and hard contours and feelingless composition, coupled with some good color;—an acquirement learned, but not felt out. To pass by Canon, with his too evident imitation of the old Italian painters, a multitude of small *genres* engages the attention, and in a review of the qualities that distinguish them all as a mass, prettiness is found to constitute the pre-eminent mark of their excellence. Almost every incident of social life had its illustration in the Austrian department, and as I have before remarked, there was nothing of a national character to distinguish these scenes from the same subjects found elsewhere. The battle scenes of Sigmund L'Allemand are of remarkable excellence. Quiet in color and effect, almost to a fault, they appeal as truthful representations of the events of modern war. A cavalry charge was especially noticeable. This picture is so full of incident, and so unconsciously true in the actions of the figures and expressions, that it may be ranked as the best of the battle-pieces shown in the Exposition. The natural variety of expression and marked individuality of pose, are accompanied by no dramatic, overdrawn situations but the scene passes before the eye in its truest aspect.

Lenbach exposed both in the German and the Austrian department, but he was better seen in the latter. His portrait of the Emperor Francis Joseph is too crude in color to be considered successful, though the artist has given much of the rugged picturesqueness of the face of his imperial sitter. The list of Lenbach's portraits embraces many types of face, and they are all painted with wonderful accuracy of tone. Some of them, hardly more than rough sketches, give the character of the sitter unexceptionally, and are among the highest examples of portraiture shown. Not less noticeable in Lenbach's portraits is the distinguished depth of tone and harmony in the ensemble. Everything is subordinate to the flesh, and while this fails often to give its rich and brilliant effect of color, even in contrast with a sombre background and well massed drapery and accessories, there is always the mark of originality and power of execution upon them. Lenbach seems to take in at glance all the characteristics of his model and to suggest as much as possible *au premier coup*.

After what has been said on German landscape painting there remains little to remark upon in the Austrian landscapes. In very much the same qualities that Lier differs from the majority of German landscapists, Charlemont holds place apart from his compatriots. The two pictures which ne exposed are delicately gray in tone and show a fine feeling of nature. Somewhat thinly painted, but strong in general effect, they were almost the only noticeable landscapes in the department. Robert Russ, a little more scenic in his manner, showed a series of pictures of merits as widely distinct as the localities that furnished the motives. A windmill in Rotterdam, not remarkable for truth of local color, and the ensemble broken by an injudicious repetition of brilliant lights, was, nevertheless, a relief to look at, attracting from its strong oppositions and vigorous touch. Schindler's landscapes are the reverse in treatment, being a trifle labored, but well studied and composed with skill. The animal painters are even less numerously represented than the landscapists, and nothing particularly strong or strikingly original was shown in this line. Ottovan Thoren, conceded to be the best artist of this class in Austria, does not seem to be so close a student of animals as his reputation would lead one to imagine. Several of his sheep pictures shown are not disagreeably defective, nor yet strong, and his *Cow Attacked by Wolves*, has the appearance of being painted faithfully after stuffed models; the animals are perfectly stiff and lifeless, and the wolf is fairly pinned upon the cow's back.

The Hungarian exhibit was in a separate room, and, though small, was representative, and contained some of the most boldly original conceptions and most powerfully impressive works in the Exposition. The larger part of the paintings were conventional in treatment, though the motives were in general drawn from the national customs and history, and the few grand exceptions to the rule gave a higher tone to the whole. It was gratifying to see evidences of national pride in the numerous attempts illustrating the peculiar customs of the Magyars, and the grand events of their history. To be sure, they were often weak attempts, but the spirit that prompted them was visible in them all. Munkácsy is a thoroughly original painter, individual in his motives as in his execution, finding the picturesque among the low, rude peasantry of his country, and, by the magic of his touch, making the simplest object interesting. His execution is broad and forcible, his color always gray, and often with masterly fine distinctions of tone and skilfully chosen oppositions. He is different from the Netherlanders in his perception of the values of the lights as lights, for his pictures are always marked by a quietness of tone and a strength of contrast much less prominent than that found in the Dutch pictures. With him, a sober half-tone takes the place of the brilliant, sparkling, flesh tones sought for by the Netherlanders, and his figures seem to be in a veiled sunlight, or under a cloudy sky. In his *Night Prowlers*, a squad of dirty, sullen-looking vagabonds are led along in fetters by the gen d'armes, and the people in the streets point curiously at the prisoners. There is hardly a contour in the picture, yet the figures are drawn with distinguished skill, and the expressions are strongly marked,—more by vice than by virtue, to be sure, yet true to the life. In this picture, Munkácsy is seen more in his element than in the *genres*, where there is little facial expression, and perhaps no particular display of passion. His rogues you do not pity, but despise, and his honest people have no varnish of imaginary perfection, in form or character. He does not impress by his poetical conceptions, but rather from his forcible and piquant manner of telling a story, leaving it to work its own effect on the spectator. He exposed one landscape, rather wanting in atmosphere, but rich in fine autumnal grays. The finest portraits were by L. Horovitz. One, of a young lady, was especially attractive, from its natural grace of pose and beautiful sweetness of expression, and all were delicate in tone and contour, characteristic in truth in rather a studied way. Unexpected and forcible arguments against Catholicism were the cartoons of Zichy,—the boldest conceptions and the most eloquently expressed ideas in this department. *Christ and the Priests* is an interpretation of a religious question rarely illustrated. The Saviour appears in a blaze of light, welcoming with his right hand the heathen, the Protestants, the persecuted, and the champions of freedom, among whom are seen Garibaldi, raising the Italian, and the typical American, freeing the negro. With his left hand, Christ repels the Pope, borne in state to meet him, and the priests and bishops turn amazed, and, in their terror, flee. Jesuits gather up their treasures with miserly eagerness, and shrink away from the radiance of the Saviour. Fully as forcible in expression is *Luther and the Vision*. The Pope on his throne, a dead body, with a dagger sticking in its heart, a nun, stifling an infant, the symbols of ecclesiastical power and rank; at this vision, Luther rises, and, with a gesture of the most violent indignation, raises his inkstand to hurl it at the apparition. The stern face of Luther is a study of expression, successful in a rare degree, and the force of the sermon is not lost by indecisive lines or weak execution. Very delicately given is *Raphael and his Model* in sepia, drawn with much of the grace of Raphael himself, and full of sentiment. The face and form of the model and the naked infant, the pose of the artist, as, in the warmth of his love, he embraces the beautiful woman, all is so full of refined grace, in delicate harmony with the delicate sentiment of the scene, that it seems an inspiration from the master. Two landscapes were shown by Mészoly, of an extreme simplicity of line, and equally unaffected quality of color, and these alone were of distinguished merits.

There lies before me, as I write, a human hand, delicately carved in alabaster. The workman has used his tools with the greatest skill; he has indicated the minute folds of the skin, has shown the prominences of the bones and the lines of the tendons, and has hollowed every dimple. With all this care, he has but feebly represented the human hand, and the ornament, instead of pleasing, shocks the eye. The reason is evident: the proportions are all wrong; the thumb bears no relation in size to the fingers, the phalanges are too long for the metacarpus, and the movements are false and stiff. In his religious observance of detail, the workman has failed in the one great point—character. The roughest sketch in clay, with the right proportions, and perfect movements, is more attractive, a thousand times, than this marvel of detail and finish. This hand illustrates perfectly the English system of art instruction. In all the English schools carried on after the South Kensington model,—and indeed in such other English art institutions as have come under my observation,—this same mistaken system is taught and employed. The professors begin to instruct exactly the wrong end first; they teach to finish, and insist upon details before the pupil has learned to mass a figure, or indicate by a few lines the character of the movement, and the just proportions. Their models for primary instruction are all after this plan, and their corrections of students' work all tend to the development of this petty manner of drawing. No arguments are necessary to prove the value of a general indication of the character, as opposed to neglect of grand lines and movements in the elaboration of minutiæ. A few charcoal lines, giving the direction of the members, and indicating, in the simplest way, the action of a figure, are more indicative of the impression the figure makes upon the spectator, than the most carefully studied drawing of the same object, where the grand lines fail and the action is faulty. Any one who has drawn the figure knows the value of the first few strokes, indicating, not the sum-total of the impression made on the mind, but the characteristics of it. Then, in teaching, show the beginner the grand movements of the body, the most characteristic contours, and the just relations of the masses; instruct him how the directions of the branches vary in different species of trees, how the foliage is massed in each, and everywhere insist on grand character and simplicity. The importance of detail is in general the uppermost idea in the beginner's mind, and the instructor will rarely have to insist on this quality in beginners' work. As for finish, this acquirement comes of itself; certainly enough skill in this direction will be gained by the pupil, long before he has learned the grand lessons of his profession. Another fault in English drawings—common, however, with the French—is, the absence of any indication of the relations of tone, and in the Belgian school alone is this commonly insisted on. This fault cannot be excused in a drawing where there is any attempt at effect of light, for this suggestion of color, and its accompanying tone, is so important a quality of drawing, that even by a simple contour one may judge whether the artist is a colorist or not. It is undeniable that the eye may be trained to distinguish relations of tone with great precision, even where there is no innate feeling for color in the artist, and this vital element may be, and should be cultivated.

This brief discussion of the English system of drawing was not induced by the study of the paintings shown in the Exposition, for the display was far from being a representative one, but from a series of academic drawings exposed in connection with the engravings and etchings. Among the latter were a number of masterly ones by Whistler, who,—an American, as every one probably knows,—is one of the strongest figures in the English school, if indeed he can be said, with his prominent originality, to rank there.

Among the English paintings exposed there were many old friends, familiar to every one by photographs and engravings, and the simple mention of these will recall their remarkable qualities. The English pictures, as a whole, are marked by a surpassing delicacy of sentiment, and the stories are told with a great deal of poetry. An execution at pace with the artistic sentiments and power of expression—qualities by no means rare among English artists—would add to the impressibility of their works. The faults of their execution lie not in the ability to finish, but in the lack of freedom and spontaneity, and labored and feminine treatment is often seen in the illustration of a most bold and masculine idea. Thomas Faed's *Last of the Clan*, and his *God's Acre*, were both shown, and the sight of them awakens ever new interest. In the former, a shaggy old Scotchman, mounted on a Highland pony scarcely more rough and more scraggy than himself, and surrounded by a crowd of genuine natives, their faces full of warm sympathy and anxious attention, stands on the pier to salute departing friends, so far as one can gather from the somewhat uncertain situation. There is a touch of nature about every figure, and so much individuality and unpretending character, that it is always new and ever attractive. The two little children in the latter picture, standing on the brink of a newly made grave, is quite as delicately expressed, and both are painted without pretence, but with extraordinary skill. Full of communicative humor is the face of the rough Irishman in *The China Merchant*, by Erskine Nicol, and the face of the daughter, as she chaffs with a customer, while her father displays the crockery, is a direct transcript from nature. O'Neil's *Eastward Ho!* the farewells of wives and sweethearts to the departing soldiers on shipboard is noticeable for similar careful study of type and almost irreproachable treatment. Turning to a class of pictures more serious in their nature, the *Last Sleep of the Duke of Argyll*, by Ward, with its fine effect of light, conceived and handled with honest feeling, gains on a fresh acquaintance. John Phillips' *Dying Contrabandista* has less of the unpretending simplicity of the works above mentioned, for the situation is dramatic, though finely rendered, and the complication of resources is extremely well managed. A class of paintings not to be ranked with those already spoken of, but to a stranger representing the generality of the English productions, is marked by an uncertainty of touch, a hesitating manner of execution, just the reverse of the solid and hearty Dutch method. Pool's *Spirit Hunter*, inspired from Decameron, is a good example of this class. The figures of a picnic party, terrified at the approach of the ghostly cavalier, are quite as thin and unsubstantial as the spirit that frightens them, and the landscape has the same vaporous, unreal appearance. J. C. Hook, who enjoys a wide reputation as a painter of fishermen, exposed some good, honest work, but his pictures are so awkwardly composed that they are not altogether attractive. A part of a sail, a section of a fishing-boat, and a fisher-boy trimming down the sheet, and this at an angle with the frame, neither deceives or pleases the eye. There is, however, much freshness in the water, and good, solid perspective of tone; then besides having these qualities, the pictures are freely touched. Neither intimately sympathetic with the fisherman, or conversant with the most poetical phases of his life, Hook should be called a painter of the sea rather than of fishermen, for the landscape is always the strongest part of his pictures, and his weakly-drawn figures are often completely subordinate to it.

Orchardson and Pettie have both found motives from Shakespeare, the former showing Falstaff and the latter Touchstone and Audrey. Remarkable more for delicate color than for force of execution, these pictures are charmingly felt and the figures well in character. Elmore is quite the contrary in his manner. His *Leonore*, with the galloping horse and his double burden, the crowds of spectre followers, and the weird effect, is more solidly painted, though monotonous in color. From this latter fault the artist has escaped in his *On the Housetops*, an oriental scene; but in this he is less hardy in treatment and weaker in expression. Leighton stands almost alone in his poetical feeling for color and the unobtrusive interest of his characters. *After the Vespers*, a simple, half-length study of a young girl, is as quietly appealing in sentiment as it is sober and delicate in color. In the way of liliputian figures, the *Ramsgate Sands* of Frith is quite as complete and perfect a work of this kind as one could wish to see, though not equalling his more famous *Derby Day*. The pleasure-seekers, multiplied to thousands, are each studied with conscientious care and in their petty way are amusing enough. Fortunately for the subject, the artist has not limited his study to the poses alone, but has given a wonderful individuality of character to each of the minute heads. Two oriental scenes by John F. Lewis, *The Suspicious Coin*, and *A Street in Cairo*, are exceptionally strong in color, but are a little glassy from their extreme finish. The camels, in the latter picture, appear covered with eel-skin, and the former, a Turkish bazaar, with its picturesque occupants and wealth of drapery, wonderfully vigorous and rich in color, loses from its almost metallic lustre.

In portraiture, Millais, with a full length of a little girl, and a group of three sisters, occupied the most prominent place. There is a great deal attractive about his representation of little Miss Lehman, but even the charmingly-caught, half-pouting expression on the delicate features is not a lasting offset to the unpleasant chalkiness of general tone, which grows, on acquaintance, into an evident fault. The pose is charmingly naïve and unconscious. Millais has found his model in the conservatory, and has painted her sitting on a large green porcelain jar, swinging one foot in true school-girl impatience, and both hands in her lap, idly playing with a rose. The drapery is all white, the floor is of white marble, and, relieved against it by a fine distinction of tone, are two white doves. The group of the three young girls is less pleasing as portraiture and richer in color; the faces are very refined and beautiful, and well drawn as well; but the arms are carelessly modelled, and arranged with a painful repetition of the right angle. Sir Francis Grant's portrait has little to recommend it in drawing or color, and the same may be said of J. Archer's portrait of a lady in white. *An Old Student*, by J. P. Knight, is a characteristic study-head, and James Sant's portrait of Master Wilson-Patten is a strong one. One can but regret the absence of better representative portraits, the existence of which is hinted at by those above noticed.

The landscapes numbered very few. It was not surprising to find Turner's *Walton Bridges* among them, and it was not encouraging to turn from this to the more modern works. P. Graham sent *A Freshet in the Highlands*, breezy and moist, with a fine cloud effect and well-painted water, and Vicat Cole was represented by *Evening*, a crudely yellow, unatmospheric twilight, not altogether wanting in feeling, but false in tone. R. Ansdell, who paints quite as conventionally as any one else, exposed a sheep picture, and as no exhibition would be complete without a Landseer, Queen Victoria and the Prince of Wales contributed *The Sanctuary*, *The Arab's Tent*, and the artist's portrait of himself. A large room was hung with water-colors, and most of the well-known artists were represented. Newton's *Evening Shades* was perhaps the most charming bit there, although the historical pieces by Sir John Gilbert, familiar through the engravings, are almost beyond reproach. Two of Harper's much talked of oriental scenes were also shown, remarkable only for a decidedly original pea-green general tone.

Italian art in all its frivolity, weakness and conventionalism, was represented by a large display of statuary and a tiresome number of paintings. The rooms of the pavilion occupied by the Italian exhibit, were hung with a succession of mediocre productions of almost endless variety of execution and subject, but of about the same relative merits. The main object of the Italian artists is evidently to cover as many canvases as possible during the dull season, in order to be ready for the next influx of visitors. The mercenary character of this sort of work was indelibly impressed on a large proportion of the pictures shown, and in the midst of so much indifferent material, the task of winnowing out the chaff and preserving the grain was a laborious one. To be sure it repaid the trouble, for there were some most excellent pictures with this mass of apprentice work; but the trade of artist is too easily learned in Italy to warrant the expectation of an exhibit of a higher rank than the one sent to Vienna. It may be that the proportion of meritorious works in the Italian department was not very much smaller than that in some other departments, but the range of mediocrity was much lower, and the evidences of artistic talent less marked in the general tone of the pictures. Motives were sought by the artists in the most trivial incidents, with here and there inspiration from modern history; and even the ancient divinities were resurrected to furnish themes for a feeble brush. The general quality of color was, as might be expected, more florid than in the most of other exhibits, and the finer qualities of color or tone were rare.

In the attempts to paint the nude, the Italians are less successful than the French, and there were a great many meaningless nudities in the Italian department more vapid and more shallow than the weakest of the French poses. *La Signora di Monza*, by Moses Bianchi, was an oasis in the waste of feelingless illustrations that surround it. A young nun, her face full of anxious supplication, sits with her hands clasped in an attitude of earnest prayer;—a very simple figure, delicate in expression, and a harmonious tone of rich sober grays in the picture. The powerful handling of the artist, and his fine feeling for color, was equally well shown in *The Prayer*, a church interior with figures, and *The Singing Lesson*, a stupid set of choir boys practising their singing parts under the direction of a snuffy old master;—a picture with a beautifully managed effect. Another light effect, artistically handled, was seen in the *Inspection of the Fiancée*, by Robert Fontana. It illustrates the custom prevalent in some parts of Russia, of submitting the intended bride to the criticism of a sort of committee of women. The graceful young girl stands naked in the full light of the window, before a bench-ful of official looking matrons;—a story told modestly and with taste. Antonio Rotta's contribution was not one of his best efforts, and, judging from the *Poor Mamma* alone, a young girl pawning the portrait of her dead mother, his reputation, which is a fortune to him, seems unfounded. It is treated in unmistakably German style. The pictures of Dominico Induno are marked by a rare facility of execution. His *Too Late* is beautifully painted, and the individual heads perfect in character. This picture is essentially a social one, and the subject not old. The young bride is in the hands of her maids, who put the last touches to her toilet. The anxious papa, watch in hand, is evidently muttering curses at the delay of the groom, while the mamma and the guests are more politely impatient. There is no affectation of expression in pose, and it attracts from its truthful simplicity. There is some excellent color in Capriani's courtyard, with monks and servants, and very skilful handling; also in the *Pigeon Feeding in Venice*, by Faecioli, a scene familiar to every one who has visited that city. The doves in their confusing movement are especially well indicated. There were a large number of portraits, and Victor Emanuel and the Princess Marguerite figured frequently in rigid poses and formal costumes. In landscape there was a great deal of the German influence visible. A twilight, by Pasini, with a good deal of feeling of fading light, and another by the Cavalier Formis, a boating party on a lake, were both noticeable. The review of the Italian landscape, without a mention of the Campagna, would be a rare anomaly. This ever-fertile theme was interpreted with an unusually strong touch and a hearty admiration for brusque oppositions, by Vertunni, who sent a series of broadly painted landscapes of varied subject, all with remarkable qualities of light, but a trifle scenic in the rudeness of the contrasts.

In Russian art, as seen at Vienna, there is a prominent national character. The influence of the French school was particularly noticeable in some cases, but the majority of the pictures were essentially Russian in motive and in expression. The artistic taste developed in Russia, seems to turn aside from the acknowledged channels, and to find the greatest pleasure in new and characteristic ideas. Especially is this true in ornamentation and the decorative art; the works of the best painters are not marked by eminent originality or national character, but the mass of artists have an unmistakable admiration for the peculiarities of type and costume of their people, and their productions are for the most part every inch Russian. The pictures of Wladimir E. Makovsky possess these qualities of national character in a superlative degree. The most prominent among them was *Butterweek*, a scene at the annual fair in Saint Petersburg. It is a cold winter's day, the ground snow-covered, the air full of frost, and the smoke hugging the earth and adding to the chill aspect of the streets. In the background are seen through the smoky atmosphere the outlines of large buildings, and a row of multi-colored booths runs back into the distance. In front is an immense crowd, all intent in the diverse amusements afforded by the shivering clowns and ballet-dancers, who can scarcely leave off hugging their fingers long enough to play their brief parts outside to attract the pleasure-seekers into the warm tent. The little stands of the sellers of hot tea are besieged by the thinly-clad showmen, and the steaming drink warms many a shivering body. Everywhere is present the pinching, piercing cold, and the accompanying love of warmth possesses each heart. In the multitude of people we find every class, from the coarsely-clad peasant to the noble in his rich robes, or the man of fashion ogling the ladies with the air of a true snob. Incidents are superabundant, and from this single picture one could draw a thousand motives. Aside from the general aspect of the scene, there is an endless source of interest in the multitude of figures, each of which is a masterly representation of type and national peculiarities. Another very typical illustration of Russian customs is *Towing on the Wolga*, by E. E. Riepin. A motley row of laborers, leaning on the broad bands that are attached to the tow-rope of a Chinese junk, march slowly along the flat river-bank with that listless patience common to their class. The landscape is dry and burning; the strong, hot light of a southern sun beats down upon the gang and casts cool shadows upon the dusty track. Each figure is marked by individuality of pose or gesture, from the shock-headed burly fellow in the front, to the tall, slim youth adjusting the belt across his chafed breast, and, though not strong in color, there are very good qualities of drawing in the group.

Karl Huhn is perhaps the most eminent artist who contributed to the display, but he was only feebly represented. One of his favorite subjects was shown, *The Evening of the Night of Saint Bartholomew*, a noble engaged in pinning the white cross upon his hat, and also by two small interiors. The skill of the artist is undeniable, his handling fully equalling and much resembling that of some of the best French and Belgian painters, but in the pictures shown the superior execution was their best quality. Among a large number of pictures, little remarkable for fine tones, the broadly painted *genres* of Charlamoff are pre-eminent for refinement and delicacy of color. His *Music Lesson* was a sweet melodious strain in itself, the key low but beautifuly harmonious, and the notes forcibly struck. These *genres* begin the list of a varied and interesting series — interesting, because illustrating the curious customs of the Russian peasantry, but little remarkable as works of art. It would hardly be expected to find such facility among the Russian artists as was seen in the numerous pictures of the liliputian size, finished with almost the skill of the old Dutch painters. Among these there were several interiors of monasteries with monks, and battle-pieces with thousands of minute figures, curiosities of patient labor and little else. Of portraiture several strong examples were shown. A Russian noble, in an overcoat lined with bearskin, is the best of the series exposed by Johann P. Koehler. The head is finely drawn and the fur painted with a skill rarely equalled.

Sweden, Norway and Denmark displayed all together quite a large collection of representative works, not particularly attractive as a mass, but with many productions of merit. The general character of the pictures differed very little from the German works, but here and there could be seen an example of pure French influence, and an occasional inspiration from the school of the Netherlands. The landscape and marine branches of art flourish in a most healthy manner, and the *genres*, and more especially the *salon* pictures, have comparatively few devotees. What there is of *genre* is generally serious enough, and if inspired by national peculiarities, is interesting more than picturesque. Few of the *genres* exposed were from home motives, and the best ones were not distinctively Scandinavian in their inspiration. The Danish display was the largest of the three. Several *genres*, by Professor Carl Bloch, were the most attractive pictures in the collection. For example, a girl sitting in the candle-light was painted with exceptional fidelity, and was remarkable for truth of the light effect. Two or three comical incidents in the life of the monks were also beautifully painted and full of expression. The marines, as may be remarked also in the displays of Norway and Sweden, were painted with more nautical knowledge than feeling for art, and, with one or two notable exceptions, were of little interest. In Anton Melbye's marines was seen strong color and well drawn wave forms, with a good sentiment of the picturesque. The quieter and grayer canvases of Carl Sorensen are painted with almost equal skill but less strength of effect.

A very large and gothic illustration, of an event in the life of King Erich XIV., inspired in treatment by the faults of Baron Leys, not strong in color but with a certain force of expression, occupied a prominent place in the Swedish gallery. The author, Count George von Rosen, exposed several other less pretentious canvases, almost the only noteworthy figure pieces in the collection. A very hard and somewhat crudely colored market scene in Düsseldorf, by A. Jernberg, with one or two smaller pictures, may be ranked as the representative *genre*. Alfred Wahlberg's landscapes were superior to anything shown in the pavilion, and were hardly rivalled by similar works in the other halls. His *Motive from Westgotland* is strong in color and abounding in a fine sentiment unique among his compatriots. Quiet water, with marshy islands, a clump of trees in the middle, with straggling birches stretching out their branches on all sides, a charming bit of hillside distance and a bright airy sky; this is the landscape briefly described. Broadly painted, with a firm drawn and well-massed foliage, the picture gives all the multitudinous twinkle of the trees, the complex reflections of sky and foliage and without a detail, yet all there with the freshness and brightness of nature. Wahlberg does not so much account for the phenomena of nature as suggest the same as they impress him. The qualities of light and its charming play among the foliage, this is his especial delight.

Totally unlike the generality of Düsseldorf landscapes are the pictures of L. Munthe, who, it is hard to believe, paints in that city of artistic conventionalism. After a study of his two strong landscapes, shown in the Norwegian section, one is forced to admit that much good can come out of Düsseldorf.

Both these pictures were inspired by a similar feeling for the mournful phases of the landscape. One of them, a winter scene, chill and drear, doubtless a motive from one of the plains of Norway, is especially strong in color. Half-melted snow covers the ground, and the footprints in the road are dark and full of water. The sky is sombre and dreary, and the snow has a sympathetic tone. A brilliant streak of chill light in the horizon makes the landscape still more sad, and faintly touches the cluster of low houses in the distance and the shivering figures fishing through the ice in the foreground. There is complete harmony of the tones with the subject. A hillside in autumn, peasants gathering potatoes, a network of bare branches and brown foliage against the sky. This is the other landscape full of mournful indications of coming winter joined with all the beauties of harvest-time.

In the marines there is less to commend than among the Danish pictures. H. G. Schanche contributed several sea-coast views, true in tone, but not altogether felicitous in composition. Two church interiors, by V. Lerche, were remarkable for luminous effect and good color. If exceptions be made in favor of the *Bridal Party in the Forest*, by Fidern, essentially German in every respect, there was scarcely a noticeable figure piece in the Norwegian collection.

Greece sent but very few pictures, and among them the works of N. Lutrax were the only ones having special merits. These pictures were surprisingly original in conception and in treatment. One of them illustrates the burning of a Turkish frigate, with a boatful of Greek sailors rowing away in the foreground. Although the position of the rowers is in the most difficult foreshortening, the drawing and modelling are excellent, and the color surprisingly rich. A thorough Greek in his likes and dislikes, the artist gave also a group of Greek children, singing to drum and fife accompaniment, painted with a strong hand and full of character.

It may be gathered from the preceding pages that with the exception of the galleries of France, the Netherlands and England, really impressive pictures were rare in the Art Hall. I come now to speak of a collection that must have appealed to every American at least, our own display of pictures. Impressive these works certainly were, but, unfortunately, disagreeably so. Very limited in numbers, the pictures sent represented art in America even in a less degree than our meagre display in the Industrial Palace gave an idea of the industries and trade of America. Without entering upon the history of the formation of this collection,—an experience it will be well to profit by in the future,—a brief review of the pictures sent will satisfy those interested in art, not especially as American art, but in universal art with its acknowledged standard of merit, that it would have been far better for our artistic reputation if we had not figured in the Art Hall. One of the wisest movements of the Commission under the charge of Mr. Schulz, was to declare the art exhibit unworthy a place among the other displays of pictures, and only at a very late hour, and after a great deal of persuasion, was the Commission induced to hang the pictures at all. Exceptions were, however, always made in favor of the landscapes of Bierstadt and McElkins, and of Healy's portraits.

Pius IX., by Healy, hung in the Belgian *annexe*, and compared very favorably with Gallait's portrait of the same personage. In the other portraits Healy was seen less favorably, for they were neither remarkable for richness of color or strength of line. T. S. Noble's *John Brown*, represents, as the name indicates, an event, or at least an imagined event, in the life of this patriot. On his way to the gallows, under a squad of soldiers, in the dress of Revolutionary times, he stretches out a rather unanatomical hand to bless a little negro child, supported by the very peculiarly constructed arm of its mother. It is unhappily conceived, weak and monotonous in color, awkwardly composed, and without the saving graces of a good drawing or passable relief. Still, by the side of the *genres* of Henry Mossler, *John Brown* is a triumph of art. These *genres* were from home motives; there is no question about the locality of the source of their inspiration. A companion pair, called *The Lost Cause*, was especially prominent from the lack of all good qualities. In the first, a young farmer is dancing along the road in a peculiar manner, with his gun upon his shoulder, waving good bye to his weeping family at the door of the log-house in the distance. In the sequel, dressed in the gray, he is leaning on his gun at the door of the deserted cabin, in a pensive attitude. Very pretentious in size, and painful in color, are both of these, but yet more pleasing than *Too Late*, a tardy boy under the hands of the stern schoolmaster, or a little girl playing cat's cradle with her grandpapa. The mention of these *genres* may be excused from the fact that the price set upon them was higher than that demanded for first-class European work. I have yet to learn that any American was so patriotic, or any foreigner so foolish, as to invest in them. Marcus Waterman's *Gulliver in Liliput* is not altogether devoid of interest. It amused thousands of children and nurses during the Exposition. Bierstadt's pictures, which, with Healy's portraits, were the only American artistic productions honored with a medal, were hung very high in the *Salon d'Honneur*, a position not calculated to improve them. By the *Emerald Pool* and the *American Landscape*, this artist was well represented in all the vagaries of his impossible perspective and want of masculine effect. The foregrounds are trivial, the distances impossible, the local color and general tone as false as the perspective. For all that is visible in their composition or treatment, they might as well have been painted in Düsseldorf. They are dry, tricky and conventional, and have no charms of color. In McElkins' *Mount Shasta*, there is at least a greater sense of the value of correct oppositions, and a hint of nature's grandeur in effect and line. The remarks about German landscapes apply equally well to those above mentioned, and besides these there were several small and passably meritorious bits shown.

PART II. SCULPTURE.

The Sculpture in the Exposition was a disappointment to every lover of true art; not that there were no good productions in this branch of art, but the proportion of even mediocre works to the whole mass was very small, and in this short list the really excellent examples may be counted on the fingers. The sculpture of the present day seems to be going hand in hand with the fashions, and cases are, unfortunately, far from rare where the artist has debased his material in the perpetuation of an idea, of a pose, of a costume, that would do no credit to the rudest clay that was ever worked by the hand of a sculptor. The same taste that inspires the florid decoration of every object that will bear ornamentation, that disfigures the human form by supplementing shapeless masses to its graceful contours, and entirely contradicts the first idea of drapery, the same taste that encourages and stimulates all that is artificial and imitative in opposition to the natural and original, bids for the representation of these ideas in the same material that has immortalized the grandest conceptions of the artistic mind. The sculpture is less distinctly divided into schools than the painting, and the differences are slighter, and there are more general resemblances between the productions of the different nationalities. In every department where the collection of statuary was of sufficient extent to warrant a judgment, the tendency seemed to be toward the trivial and the forced sentimental, while the serious ideas found only rare exponents.

The Italian list of statuary was by a great deal the largest, and in exactly inverse proportion its merits may be measured. Good cutting, perfect manipulation, the most skilfully imitated textures and modelling fine in a weak way, all this certainly was seen in the Italian works. No one can deny the skill of the practised marble cutters of Italy; Americans owe to this purchasable talent a great proportion of the statues that are received from Europe as the work of American sculptors, and we, least of all, should fail to pay tribute to this skill and facility. Unfortunately for both parties, the workmen have not the brain to sell with their hands. With this perfection of mechanical execution the merits of the Italian marbles stop. In the whole collection there was scarcely a work that would bear a second examination, and the majority disgusted the spectator at the first glance. There was a glitter, a *chic* about them that attracted the multitude as well-dressed dolls or wax figures would do; crowds gathered to admire a marble ballet-girl, dressed in the nondescript masculine costume of the *coryphée*, lounging about on the basin of a raised fountain, smiling the most meaningless smile and posed with all the artificial studied grace of this class of performers. The features were deftly carved; the lace was worked out with Chinese patience, and not a hair of the chignon was missing; the delicate French boots were fashioned to perfection, and even the stitches in the seams of the garments were to be counted. It was only too plain to see that the execution of these trivial details was the sole idea of the artist, and that he chose his subject from the great resources it gave him for the practice of his chisel, unconscious of the sickening spectacle he was creating for every person of refined tastes. A little girl, by some unaccountable freak nude to the waist, her flowing garment in all its perfection of texture and studied folds trailing behind, contemplates a bunch of flowers with a gesture of surprise and an expression of admiration. You can see that her dress is woollen, with a satin stripe; the head necklace is highly polished; the earrings shine like metal; the coiffure is irreproachable, but the brainless creation is unendurable for a moment. A nude female with modern ornaments and the latest style of head-dress, is walking unblushingly over a perfectly imitated piece of turf. It is called Eve, or Flora, or Clytemnestra, and it is always the same vacant head on the same weak shoulders. A half dozen artists exposed the same motive, a child studying from a book, the pages of which are carefully covered with printing. The joys and the troubles of childhood found frequent expressions in marble, and the same figures that pass for supports to a fountain or a candelebra were placed before the public as serious work. There were ranks of busts of every variety; platoons of heads differing individually only by a curl of the lip, a droop of the eyelid, or a change in the coiffure; all were pulseless, meaningless, vacant in expression, and this without an exception. It is a pitiful degradation of heroic marble to fashion it in such forms.

Nidia, the Blind Girl of Pompeii, by Jacob Ginotti, is not unattractive in the timid, hesitating pose and the sweet expression of the face. *Sira*, by Alexander Rondoni, a combination of marble and bronze, is full of character; not only is the negro seen in the well modelled features and the crisp hair, but the hands and arms exposed as she turns to see the wound on her shoulder, are supple and true to the peculiar forms seen in the negro race. The pose is graceful and the drapery well thrown. Cavalier Julius Monteverde sent *Christopher Columbus* and *Dr. Jenner*, the latter a work full of interest. The doctor is vaccinating for the first time. A lively little fellow, a couple of years old, is the patient, and is held as in a vise between the chin and the knees of the doctor, while one of the struggling arms is firmly grasped and the lancet applied. The group is well arranged, the modelling faultless, and the difficulties of modern costume and commonplace furniture well surmounted.

In the French department the tortured poses predominated. Nude corpses in attitudes horribly real, Paris tearing her hair and waving aloft the blazing torch, crazy boys with wild gestures—there were a great many similar motives shown. Flanking the main portal of the Art Hall were two bronzes by Auguste Cain, both grandly conceived. They are named, *A Tiger Slaying a Crocodile*, and *A Nubian Lion and his Prey*. The poses are majestic and full of dignity; the tiger with his great paw on the breast of his writhing enemy, snarls a warning to all who come to interrupt his meal, and the lion tramples under foot an ostrich, proudly raising his massive head to watch intruders. Of Emmanuel Frémiet's numerous contributions, *A Knight of the XIV. Century*, a life-size equestrian statue, occupied the vestibule in the place of honor, and was justly given the position, for the statue is of extreme simplicity, dignified in pose, firmly drawn and modelled, and well understood in every respect. Charles Gauthier exposed a young hunter playing with a panther cub, noticeable for freedom of action and beautiful flesh modelling. One of the best figures was *David*, by Antonin Mercié, firmly drawn and charmingly executed throughout. Carrier Belleuse sent but one statue, *Sleeping Hebe under the Wing of the Eagle*, like all this master's work, well repaying careful study.

The German and Austrian sculpture is marked by less freedom than that of either of the two nations above spoken of. In the German department was observable much formality and little attempt at action or great originality; but there were several examples of very clever modelling and fine drawing. The favorite group seems to be an adult with an infant, and this was several times repeated, now a faun and an infant Bacchus, and now a girl playing with a child. The works of Joseph Kopt marked the author as an artist of great versatility, and were the most noticeable examples of German sculpture, though many others in this department, as well as in the Austrian galleries, deserve special mention.

Of the host of marbles that filled the picture galleries to the discomfort of the visitors and the obstruction of the view of the paintings, limited space forbids a detailed description. The crowded state of the art halls was prejudicial to the careful study of both the sculptures and the paintings, and each lost from the injudicious arrangement.

F. D. MILLETT.

CERAMIC ART AT THE VIENNA EXPOSITION.

By WILLIAM P. BLAKE.

I. General Survey.

The potter's art, one of the most ancient and the most universal of all, connects itself on the one hand with geology and chemistry, and on the other with painting and sculpture. It is the outgrowth of one of the primal necessities of man's existence,—the preparation and distribution of food,—and is thus intimately identified with domestic and social life. Its productions, though so fragile, are perhaps the most enduring of man's handiwork. The objects that have outlived history are to be viewed not only as specimens of the condition of the art at the time of their production, but as exponents of the habits, the domestic life, and the æsthetics of races long since passed away. There is no other material which can be so readily impressed with the conception of the artist as "clay in the hands of the potter."

Progress and Capacity of the Art.

Such an art should progress measurably in the same ratio as civilization. That it has so progressed is evident to all who saw its representation in the halls of the great Exhibition at Vienna in 1873. The most general and striking impression produced by a systematic survey of what was shown there, was the *vitality* of the art and the high degree of excellence it has reached, not only in one or two countries, but in many. The rapid progress in the manufacture of porcelain and earthenware in several countries since the commencement of the era of industrial exhibitions, shows the capacity of the art for development in any country. Excellence is by no means confined to any section or to any special source of materials. Chemistry has so far unlocked the secrets of the manufacture that it is no longer confined in empirical hands or limited in its range or locality. A few decades ago the knowledge of the details of compounding the materials for porcelain-ware, or for the glaze and decoration, was centered in but few persons. It was guarded as a secret; and the death of a master was perhaps the death of his art in the range of his labors; but now principles survive individuals, the art is universal, and seems established on an enduring basis. Chemistry has also given pottery a new life, and has enlarged the range of its uses, and has extended its capacity for decorative and ornamental purposes.

The great capacity of the potter's art for advancement in many important directions is one of its greatest attractions. The increasing use of fictile productions for ornamentation, not only in the interiors of our houses, but in the exteriors, in the form of enamelled tiles, plaques, medallions, terra-cotta ornaments, and bricks of various forms and colors, is highly gratifying, and marks a new era in the modern development of ceramics. But the capacity and known possibilities of the art are far beyond the artistic sense and appreciation of the people.

Necessity for Instruction in Art.

What is now needed is not so much the possession of materials, of knowledge, or even of artistic skill, as the elevation of the public taste, so as to create an appreciative and large demand for the products of higher efforts and greater skill. The manufacturers need encouragement and appreciation. The industry requires an artistic sense among the consumers of its products. If the public will not buy superior goods, the manufacturer cannot make them without loss. It is true that to a certain extent manufacturers should lead public taste; and no doubt their duty in this respect is not always appreciated by them, but it is well understood by some of the great establishments abroad, and they are reaping rich rewards. Wedgwood, in striking out a new path, not only secured immediate support, but established a reputation of far greater value. Palissy's art survives him and is the basis of an extensive industry. But the people generally yet need to know more of pottery as an art to secure a fair appreciation of novelties and to stimulate progress. A great obstruction to progress is the servile following of others, the constant reproduction of old forms and old designs—imitations rather than novelties.

The high development and perfection of the ceramic art in Europe is due in a great degree to the establishment of porcelain works under government protection and favor, and the rivalries between them. Each establishment became a school of art, producing models for imitation, launching out into unknown fields, experimenting and perfecting without regard to the demands of trade,—being raised above them and independent of them. They became leaders of public taste, and their influence was strengthened by the patronage of royalty and court circles.

The Exhibition in 1851 revealed to Great Britain its manifest inferiority in artistic manufactures; and it did not take long to ascertain that the cause was the neglect of art education amongst the people, while the continental artisans were taught with the greatest care, and familiarized from their youth with the choicest productions of ancient and modern art. It was conceded that the art schools and museums of France exercised a great influence upon the manufactures of the country. England saw that to compete with such a rival great efforts must be made, and that the people must be educated. The government took the matter in hand; it was studied and reported upon by government commissions, money was freely appropriated, museums were founded, and a Department of Science and Art established as a branch of the government.

The favorable influence of these efforts was apparent in Paris in 1867; it was still more evident in the London Exhibition in 1871, and was abundantly shown at Vienna. Great Britain, from a position of mediocrity in 1851, has risen to a commanding position in the potter's art, standing to-day in the front rank, not only as regards excellence of materials and manufacture, but in artistic skill.

All this is full of teaching to the educators of the United States. Ceramic industry, as we shall presently see, is already established here, but, though in its infancy, gives promise of a great future. Its growth can be greatly and advantageously modified by a little well-directed effort. Art education is not only required by potters, but by all artisans, and by the people generally. It not only produces skilled specialists, but becomes diffused and raises the standard of public taste, increasing the appreciation of the public and the demand for really meritorious works, thus reacting beneficially upon the industries.

There is a great multiplicity of sources of designs for ornaments at the present day; and the facilities now afforded for copying and reproducing the most precious artistic works of the past should cause them to be seen everywhere. Every town should have its art-gallery and its classes for drawing and modelling. The children in our public schools should not lose such influences as may be exerted by the possession of sets of casts of architectural decorations, of sculpture and bas-reliefs, all of which may be procured for little above the cost of the materials and transportation. The general influence of art museums abroad is not to be lightly estimated. They are exerting a gentle and imperceptible, but a most powerful, influence upon the culture of the communities in which they are located. Who can estimate the influence exerted by the South Kensington Museum upon its millions of visitors? And we are not to lose sight of the influence, also, of the great exhibitions which bring together in friendly rivalry the master-efforts of the most skilful artisans of the time, and afford the conservators of museums their richest harvests of novelties and gems of excellence from all lands. These are the most powerful of all agencies in the education of the people, and they afford the most salutary stimulus to the artistic industries, especially when the producers have access to typical examples of the best efforts in their arts by the generations that have passed away.

The effect of museums and systematic art education in France is spoken of by the reporters on porcelain in 1871, as follows: "The tradition of past generations of art-workers still lives in France and is kept alive, not only by countless examples of their skill, happily preserved in many noble museums, but also by a systematized education of artists, which alone is capable of directing onward in its proper course and maintaining constant, a National School of Art." *

Museums of Ceramic Productions.

What we specially need, then, in the industry to which these pages are devoted, is a well-chosen collection of all the best examples of the potter's art, in all ages, and from every country. New York already has the nucleus or commencement of such a collection † in the Metropolitan Museum of Art, where the unrivalled collection of De Cesnola presents a great wealth of examples in earthenware and terra-cotta, of the Phœnicians, ancient Greeks and Romans. This is supplemented by a Loan Museum, chiefly from the private collection of Mrs. W. C. Prime, in which there are excellent specimens of new and old Sevres, Dresden, Austrian, and English porcelain, of delft ware and Saracenic tiles. A somewhat similar collection exists in the Athenæum, Boston, and contains some excellent examples of old Sevres, Chinese ware, *pâte-sur-pâte*, an imitation of Henri-deux ware, etc., some of which were obtained at the Vienna Exhibition.

These museums are already exerting an influence upon the public in directing attention to the preservation of old and curious pieces of porcelain and the formation of private collections. Although many such collections are made merely for the sake of getting together odd and rare bits of old china to which a fanciful value is attached, without any comprehension of the nature of the art, or its history, the weakness is by no means to be discouraged, for sooner or later the possession of the objects leads the owner to look beyond them to their origin, and to a comparison of the products in all their qualities of material, form, and decoration.

* Magniac and Soden Smith, On Porcelain, Lon. Exhib., 1871, I., p. 258.

† An important portion of this collection consists of over 4,000 earthenware vases, discovered in ancient tombs at Idalium, a Phœnician city which was conquered by the Greek colonists of Cyprus several centuries before Christ. These vases are perfect in form and fresh in color, and are ornamented according to the fancy of the potter, without any special regard to their size or capacity. The colors are generally only two: a dark brown, almost black, and a purple red. This last appears to have been produced by an oxide of copper, and the brown by umber, an earth which occurs abundantly in Cyprus. The decorative patterns are usually concentric circles and chequered designs, sometimes intermingled with the lotus.

Those who are disposed to make a study of this fascinating subject may derive great assistance from a collection of typical examples of modern productions that can readily be made by themselves at no very great cost. For such an undertaking, students in the United States have great facilities, in consequence of the very general representation of the chief manufactures abroad in the large stocks of ware kept on hand in our principal cities. There are, at least, two establishments—that of Mr. Richard Briggs in Boston, and of Messrs. Tyndale and Mitchell in Philadelphia—which may be regarded as museums of the art; for the proprietors, being enthusiasts in their specialty, take great pains to collect and retain examples of all varieties of manufacture and decoration, and even make visits to Europe to secure representative examples and novelties.

Commercial Value of Artistic Skill.

The United States are destined to become the best market in the world for artistic productions. This results from the very general distribution of wealth among the people and the desire to adorn their homes with the same class of objects sought and admired in communities of riper civilization and culture. Money, for a time at least, anticipates appreciation; but the latter, as already shown, is sure to follow. Economists should not lose sight of the expanding fields of industrial effort which are opened in every direction by increased appreciation of, and demand for, artistic productions amongst the people. It leads to a great variety of manufactures and a rapid increase of wealth. Whole communities are sustained abroad in the production of trivial ornaments. When we consider, also, the great increase in value with which the commonest materials may be endowed by a little artistic skill, we do not hesitate to recognize the commercial value of such skill to the country. The clay which is so abundant under our feet is transformed by the potter into an object of beauty. A single slab of earthenware, which may be produced for a few cents, becomes of almost priceless value in the hands of the artist. The enamels of Parvillée and the plaques shown by Deck in the exhibition are examples. The prices which such objects command are astonishing to those accustomed to the merely utilitarian view of things. The British artisan who reported upon the pottery, in mentioning Deck's beautiful plaques, says: "The most attractive were several large round plaques, about two feet across, painted with large female heads and other decorations. I saw one of them was bought by an English manufacturer. The price paid was £200. Here is an example of art workmanship! This dish, which realized such a large amount, could be made and sold by the gentleman who bought it for about two shillings; and the artist, with his labor, has made it worth £200!"

Influence of Japanese Art.

In the early periods of the introduction of oriental porcelain, and its attempted reproduction in Europe, Japanese and Chinese designs in decoration were closely followed. This is true to a great degree now. The great influx of Japanese forms in such quaint and novel variety, since the modern opening of that country to trade, has had a great influence upon the styles of decoration now in vogue. It is the new field for the decorative artists of Europe, and close attention and study have been given to the spirit of Japanese art. We find the results in the porcelains of the Royal Worcester works, in the *cloisonnée* enamels of the English and French sections, in the bronzes, and in the decorative pottery and porcelain of other countries. Meantime, we see the Japanese striving to imitate English and French forms and ornaments in table and toilet services, instead of more strongly developing and impressing their own peculiar and admirable styles upon their wares. This is one cause of the decadence of Japanese art; another, as pointed out beyond, is the demand for quantity and cheapness at the sacrifice of quality in their products.

Lithography and Photography Tributary to Decoration.

Lithography is now made subservient to the decoration of porcelain. A wide and inviting field is thus opened, especially to potters in the United States, it being possible to produce pictures in this way that few persons, even those familiar with the art, can distinguish from hand paintings. Such decorations may replace, and at no greater cost, the crude, grotesque daubs which have so long seemed inseparable from all low-priced decorated ware.

Photography also is now tributary to the decoration of porcelain. The beautiful examples exhibited by Julius Leith, of Vienna, may here be specially referred to. A series of plates were ornamented by photographs, apparently from life, as perfect as upon paper, and seemingly so well fixed on or under the glaze as not to be liable to injury by use. When we think upon what has been accomplished by the Woodworth process of relief printing from photographs, it seems more than probable that transfers in indelible colors of such pictures may be made upon porcelain at no greater cost than for ordinary crude engravings. All that appears to be necessary is to have a very fine metallic pigment and a surface sufficiently smooth to receive the most delicate films when transferred from the relief plate to a suitable paper, which can be impressed upon the porcelain, and then removed with water and friction, leaving the ink adhering to the ware, exactly as is now practised with copperplate engravings.

Pottery in the United States.

For the manufacture of pottery in the United States there is no lack of the best materials. Not only are extensive deposits of clay already known and worked, but it is probable that when attention is more generally given to the subject, other deposits will be brought to light.

The art in America is of extreme antiquity amongst the aboriginal tribes, especially in Mexico, Central America, and in the western part of the United States. At the Delaware Water Gap specimens of cups, of good form and rudely decorated, have been washed out, with stone implements.* The clay images of Mexico and the remarkable pottery of Peru are well known. It is important to note that in these examples, as in the ancient pottery of Arizona and Mexico, great attention was given to decoration.

In the early attempts at the manufacture of porcelain in

* The vessels found in the ancient mounds of the Mississippi Valley are considered by Professor Cox to be formed of a calcareous cement, and not of burned clay. They are not, therefore, *pottery* in the usual sense of the word.

Great Britain attention was directed to the American colonies as a source of the materials. In the year 1745, William Cookworthy wrote that he had seen samples of kaolin and petunse found on the "back of Virginia," and that the discoverer had gone for a cargo of it. In 1765, Caleb Lloyd, residing in Charleston, South Carolina, sent a box of porcelain earth to the Worcester porcelain works, saying that it had been obtained in the mountains some four hundred miles west, in the country of the Cherokees.* There appears to have been much interest manifested in this discovery, and the clay was pronounced to be superior to that obtained in Cornwall; but, being without the undecomposed portions of rock, it could not be made into porcelain.

Miss Meteyard, in her life of Wedgwood, mentions the custom of merchants and captains to take in samples of clay and other earthy bodies on their return voyages, particularly from the ports of the two Carolinas, Georgia and Florida.† Bently supplied Wedgwood with clay imported from Pensacola, a port with which he had trading relations. Wedgwood also received a sample of the South Carolina clay, and wrote that "it would require some peculiar management to avoid the difficulties attending the use of it."

As early as 1770 it became evident to the British potters that the pottery industry might be started in America to the detriment of their trade, and Wedgwood wrote as follows:—

> "The trade to our colonies we are apprehensive of losing in a few years, as they have set on foot some pot works there already, and have at this time an agent amongst us hiring a number of our hands for establishing new pot works in South Carolina. They have every material there, equal, if not superior to our own, for carrying on that manufacture. We cannot help apprehending such consequences from these emigrations as make us very uneasy for our trade and prosperity."

Porcelain works were soon after started near Philadelphia, but with little success in competition with the established manufacture in England, although some very good porcelain

* "Two Centuries of Ceramic Art in Bristol," pp. 8–13.
† Meteyard's Life of Wedgwood, p. 367.

was produced. Porcelain was made near Philadelphia as late as the years 1849 and 1850, but the works were not sustained. The manufacture is now reported at Phœnixville, Pa., and exists at Greenport, N. Y., where table and toilet ware is made.

The industry, especially in the direction of earthenware, and the common cheap pottery, such as Rockingham, yellow-ware and stoneware, has increased rapidly of late years, under the stimulus afforded by the tariff and the premium on gold. According to the last census there were 777 establishments for the manufacture of stone and earthen ware distributed through the several states, the highest numbers being 170 in Ohio, and 198 in Pennsylvania. Only fifteen are reported in Massachusetts. Eighty-two steam-engines, with an aggregate of 1,586 horse-power, were in use, besides eight water-wheels of 122 horse-power. Hands employed, 6,116; capital invested, $5,294,398; amount paid in wages, $2,247,173; materials are valued at $1,702,705; value of the products, $6,045,536. The number of persons reporting their occupation as potters is 5,060.

In the State of Massachusetts alone, the fifteen establishments, with twenty-three horse-power steam and forty horse-power water, employ 160 hands, and produce to the value of $244,493 annually.

The following are the chief points at which the potteries are located:—In New Jersey, at Trenton, Jersey City and Gloucester. In Ohio, at East Liverpool and Cincinnati; New York, in the city and at Flushing and Greenpoint, L. I.; Pennsylvania, Philadelphia and Pittsburg; Illinois, Peoria; Maryland, Baltimore; Massachusetts, Boston; and in Missouri, at St. Louis. In 1872, it was estimated that there were 148 kilns in seven States, capable of producing at the rate of $30,000 annually per kiln, which would amount to $4,440,000 per annum, and would use 75,000 tons of coal, and 75,000 tons of clays and other materials.

The industry has taken root firmly in New Jersey, at Trenton, and bids fair to thrive permanently. That locality offers the advantages of extensive deposits of the finest clays, cheap transportation by water, as well as by rail; and the proximity to the coal region and to two large cities, combine to foster its growth, and to make the locality the Staffordshire of the United States. The pioneers of the industry at Trenton were Mr. Steiner, a German, and Mr. Young, an Englishman.

In 1861, there were but five small potteries. In 1868, there were seventeen, with an aggregate of fifty-three kilns, with a capacity, if fully worked, of,—

Number of hands, ...	1,200
Tons of coal consumed annually, . . .	18,000
Tons of prepared clay, ...	20,000
Average production of each kiln, . . .	$25,000
Capital invested, ...	$1,250,000

Mr. Hattersley, one of the pioneers in the manufacture of pottery in Trenton, wrote in 1868:—

"The writer, after travelling over the States of New York, Connecticut, New Jersey, Pennsylvania, Delaware and Ohio, in search of proper materials and the best place for its manufacture, concluded that Trenton, New Jersey, was the place, situated, as it is, between the two great markets, New York and Philadelphia; healthy, and the State abounding with fine clays and convenient for the collection of all other materials, such as coal, kaolin, flint, sand, felspar, bone, etc., by canal or railroad."

There are now some twenty establishments and sixty kilns, producing crockery, chiefly white "stone-china," to the annual value of $1,500,000 to $2,000,000. When in full operation, they employ from 1,200 to 1,500 hands, and consume from 25,000 to 30,000 tons of coal. One of the largest establishments, the Glasgow pottery of Mr. Moses, covers about four acres of ground, and has six large kilns in operation. The manufacture is confined chiefly to the finer sorts of stone-china, fully equal to any imported; but, we regret to note, it is stamped with British marks, in order to meet the prejudice of the consumers in favor of imported ware. But this we believe is passing away, and the time will soon arrive when the trade-marks of American establishments will command respect and preference. It is altogether possible that the United States, holding the greater part of the available coal of the world, in contiguity with illimitable supplies of the best and most varied clays and potting materials, and having unusual attractions for skilled and ordinary labor, will soon commence the export to less favored regions. Meantime, the home market is expanding faster than the rate of supply from home sources.

Notwithstanding the gradual extension of the industry in the United States, the importation of pottery amounts to about $6,000,000 annually, and is steadily increasing, as will be seen from the following statement furnished for the report, at my request, by Edward Young, Esq., chief of the bureau of statistics, Washington.

Statement of value of Earthen, Stone and China ware, imported into the United States during the years ended June 30, 1869 to 1873, inclusive.

1869,	$4,372,607
1870,	4,388,771
1871,	4,681,376
1872,	5,270,785
1873,	6,015,945
Aggregate in five years,	$24,729,484

The value of the different kinds of pottery for three years in succession, with the amount of duties paid, has been as follows :—

*Statement of the Quantity, Value and Duty of Earthenware and Porcelain entered into Consumption in the United States.**

DESCRIPTION OF WARE.	Rate of Duty.	1871.		1872.		1873.	
		Value.	Duty.	Value.	Duty.	Value.	Duty.
Brown earthen and common stoneware, ...	25	$96,694 71	$24,173 70	$127,346 33	$31,836 59	$115,253 07	$28,813 28
China, porcelain and parian ware, plain white, ...	45	391,374 00	176,118 30	470,749 50	211,837 28	479,617 15	215,827 72
China, porcelain and parian ware, gilded or ornamented, . . .	50	571,032 12	285,516 07	814,133 52	407,066 76	867,205 77	433,602 89
Other earthen, stone or crockery ware,	40	3,573,254 38	1,429,301 74	3,896,664 45	1,558,665 78	4,289,867 85	1,715,947 15

* From Home Consumption and Impost Statements, etc., by Edward Young, Washington, 1874, p. 143.

We are to consider, however, the difficulties under which we labor; the possession of the coal, the clay, the transportation and an expanding market are not sufficient; we need the labor and the enterprise to bring these dormant sources of wealth together. As in Wedgwood's time, there are those who think this can be done but in Great Britain, and that we should send our clay, our sand, and our coal, over the ocean to be worked into objects for our daily use. The writer of Wedgwood's life, published in 1865, says:—

> "No country situated as America then was, and is now, with her civilization thrust centuries back by the curse of blind and intemperate party strife and internecine war, can hope to gain perfection in an art. A country in this condition gains most by the export of raw materials and the import of manufactured goods."

As yet we have barely begun to explore for and to understand the varied sources of potters' materials which are known to exist all over the country.

There is no need of looking about for anything connected with the art, unless it be the artistic inspiration to be gained by contact with older civilization and the artistic culture which is the inheritance of mankind.

American materials are more and more brought into use at the American potteries, to the exclusion of those formerly imported. In Chester County, Pennsylvania, and its vicinity, there are establishments for mining, washing and preparing kaolin or fine china clay, equal to any from Cornwall, in England. There are valuable beds of such clay in South Carolina, Georgia, and in Illinois in Pope County, at which last-named place a superior clay is obtained and is highly valued at the Ohio potteries and others.

There is an abundance of fine quartz and felspar rock throughout the Eastern and Middle States, and mines have been opened in Maine, Connecticut, Pennsylvania, Delaware, and Maryland. Mills to crush and grind these materials, with expensive machinery, have been erected at several points on the Susquehanna, at Trenton, and on the Connecticut, and in various places in the West.

Decoration of Porcelain and Earthenware.

The decorations of plain white china and earthenware, in colors, is a branch of the potter's art which is assuming considerable importance in the United States, chiefly in consequence of the protection afforded by the tariff, the duties being *ad valorem*, and, of course, much less upon plain white ware than upon the same with the costs of decoration added. It is not alone services for the table, plates, tea-sets, etc., which are thus ornamented, but toilet-sets, and especially set basins and other ceramic plumbers' ware and fittings. There are several establishments in New York, Boston, Philadelphia and the West, particularly in Chicago, where quite an extensive business is established in decorating and matching broken sets of china or stoneware. Some attention has also been given at the East to the decoration of tiles.

Mr. Staring, of Chicago, has successfully established the business of decorating porcelain in the West. He not only succeeds well with plain colors and gilding, but with flowers and fruit. Pieces of costly sets, that are accidently broken, are replaced by taking plain white pieces and decorating them to match the rest. Toilet sets, pitchers, mugs and dinner services, are decorated to order. A business of considerable proportions is being established in this way.

Some parties in New Haven and New York propose to decorate ware by machinery, on a large scale, under patents issued to S. J. Hoggson. An organization has been formed under the title of "American Enamel Decorating Company." The process consists in a rapid transfer of designs from rollers to the object to be decorated. It is claimed that the work can be done with great rapidity and accuracy, and at very little cost.

Ramifications of the Potter's Art.

The following list of trades engaged in the potters and connected arts in Great Britain, is suggestive and interesting:—

Brick and Tile makers.
Brown Stone potters.
Chemical potters.
Chimney Top manufacturers.
China and Earthenware manufacturers.
China gilders.
China menders.

China Riveters.
China and Porcelain Door Furniture makers.
China and Porcelain manufacturers.
China drillers.
China Figure manufacturers.
China Ornament makers.
China painters and gilders.
China Toy makers.
Drain Pipe and Tile makers.
Earthenware Figure manufacturers.
Earthenware manufacturers.
Egyptian Black-ware manufacturers.
Encaustic Tile makers.
Fancy Jug manufacturers.
Fire Brick makers.
Jug manufacturers.
Melting Pot and Crucible makers.
Muffle manufacturers.
Parian manufacturers.
Plumbers' Pottery makers.
Porcelain Letter makers.
Porcelain manufacturers.
Potters.
Potters' engravers.
Rockingham Ware manufacturers.
Stone Bottle makers.
Stone Mortar and Pestle manufacturers.
Stone potters.
Stoneware manufacturers.
Terra-Cotta makers.
Tobacco Pipe makers.
Vase manufacturers.

To these may be added the following occupations sustained in Great Britain by an active ceramic industry :—

Brick and Tile Machine makers.
Brick Makers' Implement manufacturers.
Brick Mould makers.
Grinding Mill makers.
Kiln builders.
Machinists in general.
Pug Mill makers.
Potters' Wheel makers.
Ash merchants.
Chert Stone dealers.
China Clay merchants.
Clay merchants.
Flint millers.
Manganese merchants.
Marble Clay merchants.
Pipe Clay manufacturers.
Zaffres refiners.

Classification of Pottery.

The word *pottery* in its widest sense, and as used in this Report, is a very comprehensive term, including all fictile productions of which clay is the chief material. This wide range of products may be grouped under two grand divisions —the *Earthy* and the *Vitreous*. Of the first, ordinary earthenware and faience are examples; and of the second, porcelain or china. The chief characteristics of the earthy division are, as the name indicates, an earthy substance, porosity, infusibility, opacity and comparative softness; of the vitreous, a vitreous substance, fusibility, translucency and comparative hardness.

The earthy group includes faience, terra-cotta, bricks, etc. Faience is also a comprehensive term, taking in all varieties of earthenware stoneware, etc., and comprises two chief classes, the *glazed* and the *unglazed*. The objects may also be grouped as hard faience, and soft faience, stoneware being an example of the former; but the classification according to the glaze, or superficial coating, is to be preferred. Of glazes, which consist of a composition much more fusible than the body of the ware, there are many varieties. All, however, have this in common, that they may become more or less fluid in the furnace, and cover the porous surface of the paste or body, giving a vitreous surface when cold. They are all more or less siliceous, but the substance giving the fusibility may be an alkali, or metallic oxide, usually oxide of lead, or of zinc, or oxide of tin. The alkalies and lead give a transparent glaze, and oxide of tin gives an opaque glaze or enamel, and objects covered with it are described as enamelled. A common and cheap method of glazing hard faience is by throwing salt into the kiln while the objects are hot. The soda combines with the silica in the ware, and a vitreous glaze, known as salt-glaze, results.

For this Report an arbitrary grouping is preferred, chiefly with a view to convenience of description. The objects are grouped according to their uses rather than by their material or manufacture. The faience and porcelains of the principal countries are first considered; next, the mural and floor tiles, as a distinct and largely represented branch of ceramic industry; third, terra-cotta, bricks, etc.; and fourth, the materials used and their distribution. In each of these divisions there was a profuse representation in the Exposition; and a thorough, critical, and explanatory description would have required much more space and time than have been at command. In general, only the salient features are touched upon. The writer has, as far as possible, brought prominently forward the names of the principal exhibitors, recognizing in this the discharge of a duty to them as well as to the public. Every exhibitor at a great exhibition, who makes a display worthy of the occasion, does so at no small outlay of time and money, and he is justly entitled to all of the advantages which such participation can give; and one of the greatest of these advantages is publicity through the reports.

It has been impossible to notice all that was interesting in this group. Many important displays have not been mentioned, partly for reasons already given, and, in some cases, from the difficulty or impossibility of obtaining any information concerning them. In the absence of exhibitors or their agents, and the presence of the notice,—"Visitors are not allowed to touch the objects,"—little can be learned that is afterwards available in a report. The reporter would here direct the attention of exhibitors in future exhibitions to the importance of preparing a concise printed statement of the chief facts concerning their products, for the information of those whose attention is specially directed to them. Such facts and descriptions can be verified by examination, and modified, if need be, to conform to the opinions of the examiner. With such information at hand, the exhibitor need not always be present, and will, in any case, be spared many questions while benefiting the public as well as himself.

Some idea of the great extent of the exhibition in the ceramic department may be gained from the fact that over one hundred and sixty awards were made. The number of exhibitors was of course much greater, but I have not been able to obtain it. In the British section alone, there were thirty-six.

II. Porcelain and Faience.

GREAT BRITAIN.

The ceramic productions were the most salient features of the exhibition from the United Kingdom. They occupied the most favored place in the grand transept, next to the superb metal work of the Messrs. Elkington. They gave the most gratifying evidence of the substantial growth of the artistic element in Britain. This advance, together with that shown in the metal-work referred to, in the furniture, carpetings, and decorative art generally, may be accepted as the result, in great part, of the efforts, since the Exhibition of 1851, for general art-education in Great Britain.

When, in 1762, the people of the pottery region petitioned Parliament in favor of an Act for a turnpike road, they set forth that in Burslem and the neighborhood there were nearly one hundred and fifty separate potteries for making various kinds of stone and earthen ware, employing and supporting nearly seven thousand people. Many tons of shipping, and seamen in proportion, were employed in winter carrying materials for the Burslem ware, and as much salt was used for glazing as paid an annual duty of £5,000 to the government.

In ten months of 1871 there were 90,412 packages of North Staffordshire ware exported from Liverpool. The total value of the exports of porcelain and earthenware from the kingdom—the greater part of which was produced in the Staffordshire potteries—amounted, in ten months of 1871, to £1,423,110 in value. This is about the same as in 1864 and 1865, the value of the production being in the latter year £1,442,000. The annual consumption of coal in the art, in 1865, was about 450,000 tons, and in 1870, according to official returns, 680,000 tons. To color the clay and print the ware, in 1865, about 67,000 pounds of oxide of cobalt were used, and 1,100 tons of borax and boracic acid in glazing, and 12,000 ounces of gold in gilding. About 4,500 tons of calcined bones from South America were consumed annually. In 1861, 40,697 persons were engaged in the manufacture.

English porcelain is said to differ from either the *pâte dure* or the *pâte tendre* of the French, and, to a certain extent, to combine the qualities of both. A high degree of translucency is obtained by the use of phosphate of lime. It is not as plastic as hard porcelain, but may be cast, moulded, or turned easily in the ordinary ways. It combines well with the frits of the *pâte tendre*, and with glazes adapted to colored decorations.

The exhibitors deserve great credit for their liberal representation of the industry, by sending to such a great distance so many bulky and fragile objects of great value. The more important of the collections will now be briefly noticed.

MINTON'S, *Stoke-upon-Trent, and 28 Walbrook, London.* —This well-known firm made a fine display of china and earthenware, dinner, dessert, tea, and toilet services; china, majolica, and parian vases, statuettes and other ornaments; enamelled tiles for walls, grates, hearths, and flower-boxes. To this enumeration must be added a novelty in British manufacture, *pâte-sur-pâte* decoration, a process which originated at Sevres in 1847, under Ebelman, though known long before in China. A series of plates and some vases gave satisfactory evidence of the complete success which has attended the efforts to introduce the process in England, by the aid of M. Solon, from Sevres, who removed to England during the Franco-German war. The nature of the process is indicated by the name: the design is worked upon the plate in paste or thin porcelain body, the same as the body of the plate itself. But the body of the plate or foundation for the design is previously colored a pale celadon green or a darker color (some were dark-brown or black), and the design, being worked over this, permits the color to be seen through the thin or depressed portions after vitrification, and thus deepens or forms the shades, while the thicker portions of the paste show less of the ground-work color, are higher, and give the lights an appearance of a higher degree of relief to the surface than actually exists. When the design is finished and the piece is fired and glazed, the translucency of the design is heightened, and the whole forms a homogeneous mass.

This series of specimens attracted great attention, and all were sold before the close of the exhibition to various museums, as high as $100 being paid for a single plate. One of these plates may be seen at the Boston Athenæum.

PÂTE CHANGEANTE.

The Messrs. Minton also make the peculiar chameleon ware, or *pâte changeante*, which appears of one color by solar light and another by artificial light. In the daylight it is a grayish or celadon-green, and at night is pink or crimson. This kind of paste was invented by the chemist Regnault, when Director of the Sevres establishment.

Henri-deux Ware.

The Mintons also exhibited specimens of another remarkable form of decorative ware—imitations of the celebrated faience of Henri-deux. These specimens were much admired, and commanded high prices from amateur collectors. They were copies of famous pieces. Among them were two tall salt-dishes or stands, one of which was purchased by a citizen of Boston and presented to the Athenæum, where it can be seen. The difficulty and expense attending the manufacture, make these objects very costly, but the price is doubtless high in proportion to the extreme rarity of the ware, and the limited demand for it. Of the original ware, there are said to be only fifty-five pieces known. There are twenty enumerated in the list of photographs of specimens in the collections at South Kensington, including two in the Louvre. Brongniart in his treatise says that about thirty-seven were known in France.* This ware has always excited great interest among collectors and connoisseurs, based upon its intrinsic beauty and novelty, and its extreme rarity. The pieces have sold for fabulous prices. An aiguière, or ewer, belonging to Mr. Magniac was purchased for £80 at the sale of M. Odiot's collection in 1842, and shortly after was sold for £96, and has since been valued at £2,000. A circular plateau in the South Kensington Museum, purchased originally by M. Espoulart, of Mans, for £3 4*s.*, was bought in 1857 for £140. At the sale of the collection of the Comte de Pourtalès, in March, 1865, the "Bibernon" was purchased, by Mr. Malcolm, for the sum of £1,100. This Biberon is one of the best known specimens of the ware. A capital figure is given in Brongniart, pl. xxxvii. It stands a little over ten inches in height, and bears the arms of France with a coronet, and the initials and emblems of Diane de Poitiers. The ciphers and armorial bearings, which appear on so many specimens, indicate, beyond doubt, that this ware was the favorite at the brilliant court of Francis I., and Henry II. Its origin was for a time in doubt, and has been the subject of much specu-

* At that time the most interesting specimens were in the possession of M. Saurageot, M. Odiot, M. Preaux, and M. Count Pourtalès. The Ceramic Museum at Sevres had only two.

lation, but it is now conceded that it was made at Oiron, in the south-west of France.

In composition it is a faience of superior quality, the paste, according to an analysis by M. Salvetat, of the Sevres laboratory, consisting of,

Silica, ...	59.
Alumina, ...	40.24
	99.24

without lime or magnesia, and only a trace of iron. It withstands high firing without change, and is quite white. M. Salvetat was also satisfied that the glaze did not contain tin. Brongniart notes the fact that this white earthenware body was made in France long before the first attempts to manufacture white earthenware in Great Britain, which dates from the end of the seventeenth or the beginning of the eighteenth century. But the distinguishing peculiarity of the Henri-deux ware remains to be described. The ornamentation is inlaid, filling incisions or depressions in the body, though flush with the surface. For this filling, pastes colored with ochre were chiefly used, and the designs in general appear of an ochrey brown or yellowish color on the white groundwork. But black, blue, pink and green colors are known. It is believed that this inlaying was accomplished by means of moulds, the intricate interlacing designs being first carved upon a model from which casts were taken. The paste pressed in the moulds so formed, received the designs in intaglio, and the spaces were afterwards filled with a soft, colored paste, the whole operation being similar to that of making encaustic tiles.*

Royal Porcelain Works, *Worcester*.—These works, now under the management of Messrs. Phillips & Binns, with Mr. R. W. Binns, F. S. A., as the Art Director, made a most attractive display of the specialties of their production, notably of ivory-porcelain in Japanese forms and decoration;

* For details with figures, reference is made to Brongniart's treatise, ii, pp. 176-178.

of porcelain, majolica, enamelled terra-cotta, vitreous stoneware and fine earthenware.

The principal branches of manufacture at the present time are fine porcelain and stoneware, for services of all kinds; also fine earthenware, parian for useful and ornamental objects, terra-cotta, and the novelty "ivory porcelain." The decorations include all the usual styles for useful wares, paintings of flowers, birds, landscapes, figures, etc., etc. The ornamental works consist of enamels on royal blue ground, Raphaelesque embossments, majolica, painting of all kinds on vases, etc., majolica and the ivory porcelain. This last is a new article having the color and lustre of ivory, and it is especially well adapted to the imitation of the remarkable objects in ivory for which Japanese artists are unrivalled. These objects, so successfully imitated by the works, consist generally of vases formed of sections of the tusk of the elephant, of jugs, bottles, flasks, etc., and of tablets, all embossed or carved in relief, or deeply incised and variously decorated in colored laquers, and with bronze and gold. In these reproductions of Japanese forms and decorations, the Worcester artists have been remarkably successful. They are not servile imitations, but the true spirit of Japanese decorative art appears to have been acquired and to be well understood. In this ware there are at least three points of merit: first, composition of the body, its successful imitation of the softness of ivory harmonizing completely the material with its carved appearance; second, the perfection of the forms; and third, the mastery of the spirit and the color of the decoration. Plaques made in this way would be agreeable additions in the decoration of cabinets and furniture, or wherever ivory tablets would be appropriate. The material gives a new and pleasing basis for graphic decoration in any style.

The manufacture of fine porcelain was commenced at Worcester in the year 1751, and the first royal patent was given in 1789. The undertaking originated chiefly through the exertions of Dr. J. Wall, a physician with chemical skill and artistic tastes. As early as the year 1763, the productions of the establishment were highly esteemed. Dr. Wall, at an early date, applied the process of transferring printed designs to a glazed surface to the decoration of his porcelain. The earliest known date of this printed ware is 1757, upon a jug now in the collection of the Museum of Practical Geology, London. The design is in black, *over* the glaze; and the pieces so decorated were exposed to the heat of the enamel kiln only. The invention of under-glaze printing soon followed, the designs being transferred to the unglazed biscuit. Robert Hancock, who had studied under Ravenet at the enamel works at Battersea in 1750, was the engraver of the early designs for transfer.

The earliest Worcester porcelain, according to Mr. Binns, * was made of a frit body, and he thinks that the following formula is similar to that used by Dr. Wall: sand, 120 parts; gypsum, 7; soda, 7; alum, 7; salt, 14; and nitre, 40. After fritting, it was crushed, and 75 parts were mixed with 15 of whiting and 10 of pipe-clay. The glaze used contained 38 per cent. of red-lead, 27 of sand, 11 of ground flints, 15 of potash, and 9 of carbonate of soda. For common ware an inferior paste was made, containing steatite. This gave a body less dense than the other, and of a yellowish color.

Attention was early given to the imitation of Chinese and Japanese wares, induced by the high estimation in which oriental porcelain, or china, was then held. And with that depraved pandering to public prejudice, which seems to be one of the great vices of the ceramic art, false marks were sometimes affixed, especially to these early imitations.

A crescent is one of the earliest ordinary marks, as, also, a script *W*, and afterwards the name or initials of the firm, either stamped in or printed. A Chinese fretted square, marked in blue, was frequently employed. Oriental characters were also marked in blue on some of the pieces, and a specimen in the Geological Museum has the Dresden mark of two crossed swords in blue under the glaze.

Specimens were shown of the beautiful tea-set presented to Lord Dudley on his marriage. The decoration consists of turquoise blue enamel, put on in drops near together, so that

* "A Century of Potting in the City of Worcester, being the History of the Royal Porcelain Works from 1751 to 1851," by R. W. Binns, F. S. A., 1865, p. 40. Also, in De La Beche, "British Pottery and Porcelain."

the surface appears to be *thickly* set with turquoise. Each cup and saucer is carefully mounted in a stuffed morocco case. The small set of six pieces was valued at about $6,000.

WEDGWOOD, JOSIAH & SONS, *Etruria, Staffordshire.*—This well-known establishment, identified with the growth of artistic pottery in Britain, was worthily represented by some of its best productions of the jasper or Wedgwood ware: white bas-reliefs on colored grounds, unglazed imitations of the famous Henri-deux ware; art-pottery paintings by M. Lessore; paintings on raw enamel, by M. Bean; majolica vases; dessert and fancy articles. Also by enamelled, printed, and cream-colored earthen ware; chemical and telegraphic, and sanatory and plumber's ware. Wedgwood's basalts are dark porcelanous biscuits of great hardness, and capable of receiving a high polish. They resist acids, and bear a high degree of heat without injury. The white porcelain biscuit has similar properties. The jaspar bodies are peculiarly adapted to cameo portraits and all bas-relief decorations, as the ground may be of any desired shade of color, while the raised figures are white. The basis of many of the medallions and plaques is the white body overlaid by a coating of the dark. I have tested the hardness of these tablets, and find them scarcely inferior to quartz, or about 6½ on the mineralogical scale, being superior to felspar. They are still made at the works from the original moulds by Flaxman. According to the chemist Salvetat, Wedgwood ware consists of—

Silica, ...	66.49
Alumina, ...	26.00
Oxide of iron, ...	6.12
Lime, ...	1.04
Magnesia, ...	0.15
Alkalies, ...	0.20

The "jaspar ware" may be regarded as a vitrified stoneware of fine quality. The vitrifying substances added to the clay body are flint, ground glass, felspar, sulphates and carbonates of lime and of barytes. White jaspar contains from 15 to 30 per cent. of plastic blue clay, 0 to 15 per cent. of kaolin, 0 to 15 of Cornish stone, or 40 to 50 per cent. of these clay materials, to which is added 25 to 45 per cent of sulphate of barytes, 0 to 10 per cent. of flint, and 0 to 2 per cent. of gypsum. Twenty per cent. of calcined bone is sometimes added. Half of one per cent. of cobalt gives this body a blue color; one per cent. of chrome, a dark green; nickel, a light green; copper, bluish green. Basalts and the Egyptian ware are made by introducing some forty per cent. of burnt ochre, and sometimes ten per cent of mill iron cinder.* In addition to the bas-relief unglazed, and jasper ware, the establishment now turns out annually large quantities of the ordinary stone-china glazed ware, plain and decorated. Full dinner-services, ornamented with fern leaves, flowers, or autumn leaves, can be had at the works for between £10 and £11. The printing of armorial bearings, crests, or monograms upon the ware from engraved copper-plates, is an important branch of the decorative work. Plates so ornamented to order, and with a single band of color at the edge, can be had at 7*s.* 6*d.* the dozen.

No porcelain is now made. Its production was carried on for a short time about the year 1808 by the nephew of Mr. Wedgwood. A small amount of majolica is manufactured, and some ornamental objects, among them examples of the "*email ombrant*," which consists of depressed designs, chiefly of human figures and animals, into which transparent colored enamel is allowed to flow.

The following list of pieces, composing complete dinner and dessert services, and a scale of prices for services and for pieces separately, at Etruria, will be found useful for reference and comparison:—

* Beckwith's Pottery, etc., p. 24.

Earthenware Table Scale. (Gilding of Covered Pieces extra.)

RATE.	GILDING. s. d.	s. d.	C.Color, marked Nursery. s. d.	Br.Lines marked Nursery. s. d.	s. d.	s. d.	s. d.	s. d.
Plates, 9 in. and 10 in., doz.,	Price of Gilding Enameled Patterns.	Price of Gilding Printed Patterns.	2 6	2 9	2 3	2 6	2 9	3 0
" 8 in., "			2 0	2 4	1 9	2 0	2 4	2 6
Muffins 7 in., "			1 9	2 0	1 6	1 9	2 0	2 3
" 6 in., "			1 6	1 9	1 3	1 6	1 9	2 0
Flat Dishes, 22 in., each,			4 6	5 0	4 6	5 3	6 0	6 6
" " 20 in., "			3 0	3 6	3 0	3 6	4 0	4 3
" " 18 in., "			2 0	2 6	2 0	2 6	2 9	3 2
" " 16 in., "			1 3	1 6	1 3	1 6	2 0	2 2
" " 14 in., "			0 11	1 2	0 11	1 2	1 4	1 6
" " 12 in., "			0 8	0 10	0 8	0 10	0 11	1 0
" " 10 in., "			0 4½	0 6	0 4½	0 6	0 7	0 8
" " 9 in., "			0 3½	0 4	0 3½	0 4	0 5	0 6
Round Dishes 1 size higher.								
Fish Drainers same as the dishes they fit.								
Gravy Dish, 22 in., . each,			–	–	6 0	6 6	7 0	9 3
" " 20 in., . "			–	–	4 6	5 0	5 6	6 3
" " 18 in., . "			–	–	3 6	4 0	4 6	5 0
" " 16 in., . "	–	–	–	–	3 0	3 6	3 9	4 3
Soup Tureen and Cover, 11 in., ... "	2 4	2 6	3 6	4 0	4 0	4 0	4 6	5 0
Soup Tureen Stand, . "	0 8	1 0	1 0	1 3	1 3	1 6	1 6	1 8
" " Ladle, . "	0 6	0 6	1 0	1 3	1 0	1 0	1 2	1 2
Sauce Tureen and Cover, "	1 0	1 2	0 8½	0 10	0 8½	0 10	1 0	1 2
" " Stand, . "	0 4	0 6	0 3½	0 4	0 3½	0 4	0 5	0 5½
" " Ladle, . "	0 3	0 4	0 3½	0 4	0 3	0 4	0 4	0 4½
Coverdish, 12 in. 3 div.	–	–	–	–	3 6	4 0	4 6	5 0
" 12 in. . . "	–	–	–	–	2 0	2 4	2 9	3 3
" 11 in. . . "	1 6	1 9	1 6	2 0	1 6	1 9	2 0	2 3
" 10 in. . . "			1 3	1 9	1 3	1 6	1 9	2 0
" 9 in. . . "	–	–	1 0	1 4	1 2	1 4	1 7	1 9
" 8 in. . . "	–	–	0 10	1 0	1 0	1 2	1 5	1 6
" Drainers, half-price of Coverdish, each.								
Salad, 11 in., . . . "	1 3	1 6	–	–	1 6	1 9	2 0	2 3
" 10 in., . . . "			–	–	1 3	1 6	1 9	2 0
Oval Bakers, 12 in., . "	–	–	0 8	0 10	0 11	1 0	1 3	1 4
" " 11 in., . "	–	–	0 7	0 9	0 9	0 10	1 0	1 2
" " 10 in., . "	–	–	0 6	0 8	0 7	0 8	0 9	0 11
" " 9 in., . "	–	–	0 4	0 6	0 6	0 7	0 8	0 9
" " 8 in., . "	–	–	0 3½	0 5	0 4½	0 5	0 6	0 7
" " 7 in., . "	–	–	0 3	0 4	0 4	0 4½	0 5	0 6
Round or Deep Bakers one size higher, each.								
Cheese Stand, 11 in., . each,	–	–	–	–	1 9	2 0	2 3	2 4
" " 10 in., . "	–	–	–	–	1 3	1 6	1 9	2 0
Boats and Pickles, . "	0 4	6d. / 4d.	0 3½	0 4½	0 3½	0 4	0 4½	0 5
Boats and Stands, . . "	0 4	0 6	0 7	0 9	0 7	0 8	0 9	0 10
Hot Water Plate, 10 in., "	–	–	1 4	1 6	1 4	1 6	1 7	1 8
" " " 8 in., "	–	–	1 0	1 2	1 0	1 1	1 3	1 6
Beef Steak Dish, 14 in., "	3 0	3 6	5 6	7 0	5 6	6 0	7 0	8 0
" " " 12 in., "	6	3 0	4 6	5 0	4 6	5 0	5 6	6 0
Hash Dish, 14 in., . . "	3 0	3 6	–	–	4 0	4 6	5 0	5 6
Root Dish, 12 in., . . "	3 0	3 6	5 0	5 6	5 3	5 6	6 0	6 6
" " 11 in., . . "	2 6	3 0	4 3	4 6	4 3	4 6	5 0	6 0
	£ s. d.	£ s. d.			£ s. d.	£ s. d.	£ s. d.	£ s. d.
Dinner Service for 18 persons, . .	0 15 7	0 18 8			2 13 8	3 2 2	3 11 7	3 19 3
Dinner Service for 12 persons, . .	0 13 7	0 16 4			2 1 1	2 7 8	2 14 11	3 0 11

Earthenware Dinner Service

FOR EIGHTEEN PERSONS.	FOR TWELVE PERSONS.
54 Plates, 10 in.	36 Plates, 10 in.
18 Soups, 10 in.	12 Soups, 10 in.
36 Plates, 8 in.	24 Plates, 8 in.
1 Dish, 20 in.	1 Dish, 18 in.
1 " 18 in.	2 " 16 in.
2 " 16 in.	2 " 14 in.
2 " 14 in.	2 " 12 in.
4 " 12 in.	4 " 10 in.
4 " 10 in.	1 Soup Tureen and Stand.
4 " 9 in.	2 Sauce Tureen and Stand.
1 Soup Tureen and Stand.	2 Sauce Boats and Stands.
4 Sauce " "	4 Vegetable Dishes.
4 Vegetable Dishes.	1 Salad Bowl.
1 Salad Bowl.	1 Fish Drainer.
1 Fish Drainer.	1 Pie Dish, 11 in.
1 Pie Dish, 11 in.	2 " 9 in.
2 " 9 in.	1 Cheese Stand.
1 Cheese Stand.	

Earthenware Dessert Service

FOR EIGHTEEN PERSONS.	FOR TWELVE PERSONS.
18 Dessert Plates.	12 Dessert Plates.
4 Low Comports.	4 Low Comports.
4 Tall "	2 Tall "

Earthenware Toilet Service

DOUBLE SET.	SINGLE SET.
2 Ewers and Basins, 6's.	1 Ewer and Basin, 6's.
2 Chambers, 6's.	2 Chambers, 6's.
2 Soap Boxes.	1 Soap Box.
2 Brush Trays.	1 Brush Tray.

John Mortlock, *Oxford Street, London*, exhibited china, breakfast, dinner, dessert, and tea services, of Minton's manufacture, with stone-china dinner-services of Minton and of Wedgwood's ware, decorated by the artists Solon, Mussill, Coleman, and others.

Daniell, A. B., & Son, *46 Wigmore Street, London*, exhibited pottery and porcelain, dinner, dessert, breakfast, and tea services, besides toilet ware, majolica vases, and ornamental objects of various makers. This firm offered decorated iron-stone china dinner services at from 60 to 80 florins the set ($30 to $40) ; a fern pattern set for six persons for 85 florins ($42).

Doulton, H., & Company, *28 High Street, Lambeth, London*, exhibited an interesting and important series of "blue metallic clay goods" for pavings, copings, ridge-tiles, channellings, and curbings, and for use in buildings where extra strength is required. Also, a collection of artistic stone-ware mugs, jars, flagons, etc. These last were especially interesting as examples of what may be accomplished with the cheapest and commonest materials in artistic hands. The objects were very pleasing, and the prices moderate. Each article is hand-made, and, while it is soft, designs are drawn upon the surface with a sharp-pointed style, leaving a deeply-incised line, into which the faintly-colored salt glazing flows and fills it flush with the surface. The designs consist chiefly of birds, animals, and flowers. Twenty or thirty artists are employed, and the articles produced are in great demand. For this manufacture, the clays of Devonshire and Dorchester, with the sand of Woolwich and of Charlton, are chiefly used. The clays are simply dried and broken up, and mixed with the sand in proportions determined by the quality of the ware desired. The paste, after kneading and beating to secure complete mixture and solidity, is passed between cast-iron rollers. The objects are burned with coal in open kilns of the Staffordshire pattern, and are glazed with salt.

A good collection of this pottery can be seen at the rooms of the Household Art Company, Boston.

FRANCE.

The French section afforded an excellent *aperçu* of the condition of the ceramic art in that country. There were many exhibitors, each producing some special forms or characters of ware. Although there was an abundance of decorated porcelain, there was a stronger and more striking representation of artistic enamelled faience, majolica, highly-colored wall tiles, and imitations of the ware of Bernard

Palissy. The lovers of artistic decoration lingered over the display made by Deck, admiring not only the high chimney-piece, but the large plates and ornamental objects decorated by paintings from the hands of masters in the art. Their names, well known to connoisseurs, displayed on a large mural tablet in enduring enamels, are as follows: Messieurs Anker, Bennier, Collin; Mademoiselle Escallier; Messieurs Gluck, Hirsch, Jullien, Legrain, Rannier, and Rieber.

Parvillée, Leon, *Paris, 1 Rue Neuve-Fontaine-St. Georges, at the angle of the Rue de Douai*, exhibited a variety of decorative objects, vases, plates and platters in enamelled terra-cotta, in Persian patterns remarkable alike for brilliancy of colors and the sharp-dividing lines of the designs, the enamels being in high relief. The basis of these wonderfully-fine enamels is the red terra-cotta or earthenware. The designs have been obtained directly from Persian work and manuscripts. The specimens attracted much attention from connoisseurs, and most of them were sold early in the season to the agents of the art museums of Europe. One of the finest examples—a vase of peculiar form, with tall narrow neck and sculptured handles—was secured by a citizen of Boston for the Art Museum in that city.

Interior Decoration in Enamel.

M. Parvillée has executed many important works for interior decoration in the oriental style, and exhibited a portfolio of manuscript designs in colors of the apartments which have been decorated by him with his enamelled plaques and tiles.

The enamels of M. Parvillée are opaque and have considerable relief. The colors are extremely pure and clear, and are laid on with care,—the same precaution of drawing a dark dividing or marginal line between each color, as in the specimen described from Choisy-le-Roi, being taken. In Parvillée's specimens, however, the enamels appear to have been put directly upon the white earthenware paste without glaze, which, apparently, was added afterwards for the interior and edge of the vessel.

If the large pieces of interior decoration are carried out with the accuracy of detail characterizing the ornamental objects, they must be extremely costly. They are very different from the bolder and rougher work on terra-cotta, designed chiefly for exteriors. One of the chief works, by the celebrated Luca della Robbia,—reputed to be the discoverer of stanniferous enamels in Europe,—was the decoration, in enamelled terra-cotta, of a room—a writing-cabinet—for Piero di Cosimo Medici, about the year 1464. It was lined throughout, walls, ceiling, and pavement, and the parts were so perfectly fitted together that it appeared to be all in one piece. It has been suggested that the remarkable medallions illustrating the seasons, now in the South Kensington Museum, originally formed a part of the decoration of this cabinet, which, unfortunately, no longer exists, and is known only through tradition and the writings of Vasari.*

Choisy-le-Roi, H. Boulenger: *Dépôt in Paris, Rue de Paradis Poissonnière 4.*—Objects of utility and ornament, in faience, "granite," and "half-porcelain." A great variety of objects are made at this establishment, and were on exhibition, such as articles for the toilet, for perfumers, pharmacists, plumbers, and decorators; dessert sets, candlesticks, flower-pots, tiles for jardinieres, clock-stands, match-boxes, vases, etc., etc. They also imitate the faience of Rouen, Italy, Nevers, the enamelled plaques of Persia, and the porcelain of China and old Sevres.

A round plaque, in Persian style, is remarkable for the relief of the enamel and the distinctness and brilliancy of the colors. It is ten and a half inches in diameter, and has a projecting annular support below, giving greater strength to the piece without adding much to the weight. The basis or ground-work is ordinary earthenware, of white body, glazed in white, like stone-china. The upper surface is highly decorated, with opaque colored enamels laid upon the white enamel covering the whole. There

* Luca della Robbia was born in the year 1400, and is distinguished for his meritorious artistic productions in marble, terra-cotta, and bronze. The frieze of the singing boys, in the Museum of the Uffizii at Florence, and the bronze gates of the sacristy of the Duomo in Florence, are examples of his labors in these materials. He is supposed to have introduced the use of stanniferous enamels in Italy in the year 1438, with a view to the execution of indestructible paintings.

are eight different colors. The design appears to be carnation pinks, treated conventionally, quartering within an arabesque border of brilliant yellow dividing the area of the flowers from an outer margin of a beautiful deep blue color. The ground-work of the central portion is white, being the general glazed surface upon which the enamels are laid. The great element of beauty in such a plaque is the relief, with a curved surface, of the design. It may be said to *catch* and reflect the light. The design is visible and brilliant, when viewed obliquely, in any position. There is no one *best* light in which to view it. Instead of the blinding glare of a plain mirror-like surface, the design stands out clearly and brilliantly, looking as if the flowers were laid upon the plate. This remarkable relief, in some portions to the extent of one-eighth of an inch, appears to be due, in the first place, to the composition of the enamel and management of the heat, which permits incipient fusion without flowing. It is evidently not very fluid in the fire, and does not seem to have any special affinity for the ground-work glaze, for it does not spread upon it. The differently colored enamels would, however, unite, where they are placed side by side, were it not for a narrow dark line of a brown, earthy character, which is traced around every part of the design, isolating each patch of colored enamel, and apparently preventing the flow by sinking into and *drying up*, so to speak, the soft vitreous surface of the glaze. It also serves the purpose of "setting off" each part of the design, and adds to the general effect. It is a dead, earthy surface, without lustre or relief. Girard, in reporting upon the beautiful enamels of Collinot in the Paris Exhibition of 1867, says that the absolute neatness of outline is obtained by tracing around each flower a cupreous composition, which, being modified by the fire, gives a metallic cavity, retaining the enamel in its place. This suggests *cloissonée;* but the border in the Choisy-le-Roi specimen, and in Deck's enamels, has no metallic appearance and does not form any cavity. It simply presents a surface repellant to the flow of the enamel, as a line of wax or oil repels water.

Thierry-Poulin, *manufacturers of porcelain and faience: dépôt, 48 Rue Caumartin, Paris.*—This establishment, among other objects, exhibited dinner-services in white faience, decorated in brilliant colors with flowers and leaves of the natural size, such as passion-flowers, branches of currants, lilies, convolvulus, and hazel-nuts,—all remarkable for fidelity to nature in the drawing and coloring. The price of such sets complete is 400 francs.

Sergent: *dépôt Avenue d'Orleans 106, Paris.*—Manufacturer of artistic faience and paintings upon faience, imitations of the Pallisey ware, relief plaques and majolica.

Barbizet.—Majolica and imitations of Bernard de Palissy's works.

Geoffroy.—Yellow and blue enamels, etc.

Slabs for Furniture.

Houry, Jules, *Paris.* A specialty by this exhibitor is slabs of porcelain, with figures in relief covered with a transparent blue glaze. They are designed chiefly for setting in furniture, the tops and sides of caskets, and for tables. The glaze is thin on the high lights and collects in the depressions, thus enhancing the effect of low relief. The process is like that for producing *émail ombrant*, but the design is the reverse, being raised instead of depressed. The British artisan (Locke) in describing this work says: "The slabs are modelled in stems and leaves in low relief and then covered with a beautiful blue glaze; the color is wiped off the high parts of the modelling and looks as if the light had fallen across it and the blue falls into the shadows. It must not be compared with the majolica made in England, which is similar in treatment, for the tone of the blue was bright and pure and the design suited the purpose. It gives us an idea of what good things can be done without much labor. * * * I should like to see the English use their decorated porcelain in objects of use more than they do, for this exhibitor shows what can be done with it."

The jury made Honorable Mention.

LUSTRED WARE.

BRIANCHON I. AINÉ, *Paris*. This exhibitor confined his display to a variety of specimens of ornamental objects, covered with a very brilliant pearly or nacreous glaze, semi-metallic in appearance, and to the eye of a chemist, evidently due to the partial reduction of oxides in the glaze to a metallic state. There is a great variety of tints, from pearly white to a rose pink; and some of the objects, such as shells, where the iridescent surface is peculiarly fitting, are very pleasing to the eye.

This is a modification of an ancient art, which was long kept a secret. Its revival in France is due to M. Brianchon, who has succeeded admirably, making his pieces with more certainty and brilliancy than the old masters of the secret could attain. The early invention is attributed to the celebrated maestro, Georgio Andreoli, whose lustred wares are so highly prized by collectors. The purple or silver-lustred ware of Staffordshire is similar. The process was introduced there in Wedgwood's time, but has never made great progress. M. Brianchon's process consists in making enamels of nitrate of bismuth, iron, uranium, nickel or cobalt, and adding a reducing agent, such as resin or essential oils. Objects of this nature have also been made at the Royal Porcelain Works, Worcester, and by the Beleek Company in Ireland.

This exhibitor received a Merit Medal.

SEVRES MANUFACTORY.

There was no formal exhibition of Sevres products, but the celebrated porcelains of this noted establishment were not unrepresented. Amongst other pieces and collections the dessert service of Sevres *pâte tendre* should be noticed. It dates from the year 1765, and is a beautiful turquoise blue in color. It was exhibited by Prince Nicolas Repine, of Kiev, Russia.

The scientific as well as the artistic development of the ceramic art, owes much to the laborious investigations and experiments pursued, for a long series of years at this establishment, under the direction of such savans as Brongniart, Regnault, Ebelman and Salvetat. Chemical science was needed and was freely used to throw light upon the great empirical art. Results of great practical value to ceramic industry followed. The composition of foreign porcelains, of clays and mixtures, was ascertained. The principles of the art of combining were established, and the secrets of glasses and enamels, and colors, were unlocked and discovered to the world. We can scarcely measure the influence upon the potter's art of such an establishment. And in judging of the quality of productions of private manufactories as compared with its productions, we should remember the superior advantages enjoyed by the union of science with the accumulated experience handed down through generations, and preserved by royal patronage.

Sevres as a School of Art.

At the London Exhibition of 1851, the jury unanimously assigned the first place to the products of the Sevres manufactory, and awarded the Council Medal.* They, however, very justly point out the fact that the light in which these products should be regarded is wholly different from that in which the productions of commercial industry should be viewed. The Sevres productions are rather those of a richly-endowed school of design, and in the French exhibitions they have not been placed in competition with the results of private enterprise. The influence of Sevres as a school of design has extended over the whole of Europe, and many of the most beautiful objects in porcelain produced, elsewhere are imitations, or slight modifications, of the old productions of the Sevres school.

As early as 1698, the porcelain products at Saint Cloud were thought to be equal in quality to those of China. The manufacture was continued, in 1708, by the Brothers Dubois, under the protection of the Prince de Condé. But they did not succeed at Saint Cloud or at Chantilly. They removed to Vincennes, but failed again. In 1745, a company was formed, under the royal patronage, with special privileges for thirty years; but, in 1753, this was revoked, and the king became interested to the extent of a third, and the establish-

* Reports of the Jury, p. 542.

ment was removed to Sevres. The first success is said to date from 1768.

Hard and Soft Porcelain.

From 1753 to 1768, only the *pâte tendre*, or soft porcelain, was made; but, from that time, both the soft and the hard were made. About 1804, the production of the soft porcelain ceased, M. Brongniart, the director of the works, deciding to give his attention wholly to the hard,—the *pâte dure*. But the use of the soft paste was resumed in 1847 by M. Ebelman, he taking some of the old paste, which had rested undisturbed in covered tanks for forty-five years. The peculiarities of these two varieties of porcelain are described by M. Arnoux in his report on the pottery and porcelain at the Paris Exhibition of 1867, as follows:—

"France furnishes the largest amount of hard porcelain, and it is there, also, that it is best manufactured. France is highly favored for its production from the quarries of kaolin which abound in the centre and south. This material suffices, without any addition, to constitute the body; it is white, easy to work, and takes, in firing, a fine transparency. The glaze, which is fired at the same time as the paste, is also entirely composed from felspathic rocks, and vitrifies on the surface by the sole intensity of the heat required in the firing. Such a product presents, after cooling, great consistency, and the hardness of this glaze will defy the best tempered steel instruments. But defects arise from the very excess of these qualities. This hardness leaves little resource for decoration; the fine colors for grounds are banished, and the painting, unincorporated into the glaze, lies upon the surface and looks hard and unfinished. This is so thoroughly acknowledged that the Paris decorators now often prefer to paint upon French cream-color ware instead of porcelain.

"The manufacture of soft porcelain has always been limited, for it is the most difficult of all pottery. Its inventors, persuaded that Chinese porcelain was a kind of glass, persisted in composing a paste of the same ingredients. Sand, lime, and some alkaline materials were therefore vitrified in the proportion considered desirable to give a white half-translucent substance. But, as after being ground it had not the least plasticity, and could not be worked, they added as small a quantity as possible of the calcareous earth found in the plaster-quarries in the neighborhood of Paris, so as not to injure the whiteness or transparency. We cannot describe here all the difficulties that the manipulation of such a mixture presented. It could neither be thrown nor pressed into moulds in the ordinary way; and the shapes were got by casting it in thick plaster moulds, and carefully turning and pushing it by hand afterwards. Moreover, as in the process of firing this porcelain, so properly called *pâte tendre*, the pieces were very apt to sink and lose their shape, the way of propping them was of the utmost importance; but when the biscuit stage was safely attained, the rest was comparatively easy. From its composition, this biscuit had the greatest affinity for combination with the vitreous mixture forming the glaze, and the result was that this glaze, not being hardened by the biscuit on which it had been melted, retained all its softness and so thoroughly incorporated the colors of the painting that, after firing, they looked sunk into it. An equal advantage was, that the alkaline nature of the biscuit and the low temperature required enabled those soft and beautiful ground-colors to be used which are not to be met with on any other pottery: the green, made from copper of an unequalled transparency; the turquoise, so attractive to the eye that a single piece placed in a room seemed to take all the light to itself; the bleu-de-roi, so well named from its richness; and that warm, delicate color, the rose du Barry. We purposely mentioned the low heat required to incorporate the colors with the glaze, because the experienced potter knows their richness decreases with the rise of temperature, and this is the reason why, for grounds in hard porcelain, hardly more than two colors can be depended on,—the blue from cobalt, and the opaque, heavy-looking green, from chrome."

A large number of vases in hard porcelain, of Sevres manufacture, were exhibited in 1867, and M. Arnoux said of them that the forms recently adopted were less beautiful than in 1851 and 1855, when Messrs. Dieterle and Klagmann gave their assistance to the establishment. Among the best were a large vase from Dieterle, the figures painted by M. Roussel, with the decorations by M. Avise, and all those executed by M. Barryat.

Sevres pâte-sur-pâte.

And of that variety of hard porcelain known as *pâte-sur-pâte* (paste upon paste) to which great attention has been given at Sevres, Mr. Arnoux observes:

"The name of *pâte-sur-pâte* explains sufficiently the process, which consists in staining the body of the hard porcelain in celadon, or other color, by the addition of a colored mixture, of which oxide of chrome is generally the chief ingredient; and then, when the piece is still in the clay state, to paint or rather model upon it with a brush, using white porcelain body as the pigment, and taking advantage of the transparency it will acquire when fired to produce an effect similar to that obtained in the Limoges enamels, by working the semi-transparent enamel on a black ground. Consequently the artist will increase the thickness of the white clay for the high lights, and decrease it where the color of the ground is to be seen through. Much experience is required to calculate the effect, the white clay before firing being equally opaque in the thin as in the thick parts. Of course any mistake is irremediable, as it can only be seen after the piece is fired. It was from studying the Chinese celadon that Mr. Ebelman started this kind of porcelain. The colors used on account of the high degree of temperature are extremely limited." To chrome, as a foundation color, must be added cobalt, nickel and uranium, which are also used to stain the clays when some other tint is wanted in addition to the white.

During the late Franco-German war, the Messrs. Minton, of England, secured the service of M. Solon, the artist by whom a great success in the *pâte-sur-pâte* process had been achieved; and we now find the results in the beautiful specimens displayed by the firm at Vienna. *Vide* p. 235.

Reference has been made to the impossibility of moulding or working the soft paste porcelain by throwing, in the ordinary way, owing to its want of plasticity.

Casting Porcelain Body.

Since the year 1850, the method of casting, rather than of moulding objects, has been in use. The paste being made thin, so as to flow like water, is poured into the plaster moulds, which absorb a part of the water and cause a thin film of the paste, or body, to adhere to the sides. The excess is decanted. This gave lightness and perfection of form to the objects, such as cups and small vases, but the process did not succeed with large objects, inasmuch as in the decantation the paste, adhering to the upper part, became deformed by its weight, drawing it away from the sides of the mould. To overcome this difficulty the large moulds were encased in an air-tight jacket of sheet iron, within which the air was exhausted previous to the decantation, thereby causing the deposited film to adhere firmly to the sides of the porous plaster. This improvement was cited in 1867, by M. Dommartin, as one of the advances made in the art of manufacturing hard porcelain.* A large vase made in this manner was exhibited at Paris in 1867.

Extent of the Industry in France.

The following data regarding the pottery and porcelain industry of France are drawn from the report by Messrs. Salvetat and Dommartin in 1867. Clay, for pottery purposes, is found in almost every part of France. The best china clays are found at St. Yrieix, near Limoges; but the kaolins of the Pyrenees, the Cher and the Allier are largely used. The manufacture of porcelain is carried on in three districts. 1. Limousin, which comprises Haute Vienne and the Creuse. At Limoges, in this district, there were more than thirty white china works. 2. Berry, including the works of Cher, Allier, Nievre and Indre. These works produce chiefly white china and articles of common use. 3. Paris and its environs and Champagne. The productions of Paris are varied. The fancy articles known as *Articles de Paris*, such as flowers, cups, baskets, etc., are made by several small makers. Others produce biscuit-ware, or articles for mounting in ormolu, bronze or carved wood, such as lamps and tazzas. Many persons receive white porcelain from the trade, and decorate it according to the demand of the day. Although not confined to Paris, it may be regarded as essentially Parisian.

Earthenware is made in Paris, at Beauvais, and in some parts of Normandy. Fine faience is made chiefly at Creil, Montereau, Sarreguemines, Choisy le Roi, Gien and Bordeaux. Artistic faience has its centre in Paris and its environs. In 1867, Messrs. Salvetat and Dommartin pointed out that in the manufacture of faience, steam power tended to

* Rapports du Jury Internationale, iii. 171.

replace hand labor; and the introduction of English methods had transformed the manufacture. Also that, as regards porcelain, the softening caused by the high temperature required for the baking, deforms pieces made in any other way than by hand; and that up to that time no mechanical assistance had been found available; but there was good reason to hope that in the shaping and preparation of the material, mechanical art might eventually lend its aid.

Workmen were paid by the piece. No less than 1,362 men and 458 women were employed in decoration of china alone, in Paris, in 1867. The greater number of the potteries have agencies, or depots, at Paris, or send their ware there for sale. Paris is the great centre of the trade, and Limoges is next in importance. From this last named place, ware is sent to all parts of the empire, by the aid of travellers and agents. The annual value of the product of fine faience was estimated, in 1867, at 10,000,000 francs, and of porcelain at 20,000,000 francs.

French Stone-China.

At the Paris Exposition, in 1867, the various brands of stone-china ware were carefully examined by M. Aimé Girard, with reference to their hardness, porosity, and price. To ascertain the hardness of the glaze upon a plate, for example, he used a small platform of wood, sustained upon three points resting upon the plate, one of them being tipped with a diamond. This platform was then drawn back and forth over the surface, and the weight required to be added to the platform to produce a scratch was the measure of the hardness. He found that a pressure of more than one kilogramme was required to make as much of an impression upon hard porcelain as one hundred and twenty grammes would give on lead-glazed stone ware. His results are given in the following table.*

* From Rapports du Jury International, III., p. 136.

Comparison of the principal kinds of fine quality Faience, as shown at the Exhibition in Paris, in 1867, as regards their quality and price.

DESCRIPTION OF FAIENCE.	Hardness	Grain.	Price.	Price.
1. SUPERIOR QUALITY.			Francs.	Francs.
Sarreguemines China, France, . . .	0^k.625	8.25	2.0	3.10
Minton & Company's white glaze, . .	0^k.530	12.35	2.95	3.25
Rörstrand, Sweden, ...	0^k.440	9.43	-	3.00
Gustafberg, Sweden, ...	0^k.480	11.24	2.20	-
2. SECOND QUALITY.				
Choisy-le-Roi, "Granite China" (France),	0^k.420	11.23	1.95	3.15
Stoneware of Villerry and Boch (Prussia),	0^k.415	13.14	2.20	3.80
Stone-China of Pinder Bourne (England),	0^k.485	10.00	2.75	2.95
3. ORDINARY WARE.				
Opaque of Sarreguimines, France, . .	0^k 620	13.25	1.50	-
Opaque porcelain of Gien, France, . .	0^k.375	14.50	1.55	2 60
Cream colored ware, Minton & Co., Eng.,	0^k.400	8.20	1.58	-
Opaque porcelain of Creil, France, . .	0^k.505	10.14	1.55	-
Opaque porcelain of Montereau, France,	0^k.450	15.40	1.55	2.50
Half-porcelain of Choisy-le-Roi, France,	0^k.390	11.31	1.55	2.25
Cream colored ware, Copeland & Co., Eng.,	0^k.340	8.64	2.60	3.15
Cream colored ware, Wedgwood, Eng., .	0^k.320	8.57	2.10	2.95

The column representing the hardness shows the weight required to produce a scratch with the point of a diamond. The "grain" or degree of porosity is expressed by the weight of water which was absorbed by one hundred grammes of the ware. The prices were furnished by the manufacturers or their agents; and in the first column are for a dozen white plates, eight inches in diameter (twenty-one centimetres); in the second column for the same number and size of decorated plates. The three divisions or qualities are based upon the degree of whiteness; the third all having more or less of a yellowish tinge.

PRUSSIA.

Royal Prussian Porcelain Factory, Berlin.

This famous establishment, which has been notably represented at all of the great exhibitions,* sustained its reputation at Vienna, by its display of vases and ornamental porcelains of various kinds, plastic work in biscuit, services, and in decorative figures, etc. Plain white porcelain is also made.

The works were established in 1763, and are sustained chiefly for the promotion of the industry, technically and artistically. In the year 1871, the production amounted to 500,000 pieces, worth 160,000 thalers, from raw materials costing 11,050 thalers. The greater part of the product is for home consumption. Three hundred and three workmen are employed and two steam-engines of 40 horse-power.

The Royal Saxon Porcelain Works, producing what is known as Dresden porcelain, are established at Meissen, a few miles above Dresden. The establishment was founded by Augustus II., the Elector of Saxony. Tschirnhaus and Böttcher, two alchemists in his service, commenced to make experiments about 1706; and the credit of making the hard porcelain for the first time in Europe is accorded to Böttcher. He made a red or jaspar-like ware, which could be cut and polished by the lapidary, and a glazed, brownish red ware.

* Gold Medal at Paris, 1855; at Paris, 1867, *Hors du Concours.*

He discovered the method of making white porcelain in 1709, and he was appointed Director of the Meissen works in 1710. Five years later, white porcelain of excellent quality was commonly made, and in 1720, under the direction of Horoldt, excellent paintings with gilding were produced. Groups and figures were modelled in 1731, and, in the succeeding twenty-five years, the productions attained their greatest perfection. The varied productions of the establishment at the present time were conspicuously displayed upon the crimson-covered canopied stand in the main transept, adjoining the rotunda. They consisted chiefly of the finer sorts of vases and decorated ware, and fully sustained the high reputation of the works. The productions, however, include ordinary dinner-services and ware for domestic use, much of it decorated in cobalt blue, and artificial ultra-marine; colored enamels, and other materials for the production of porcelain. About 600 workmen are employed, and the value of the product annually is about 400,000 thalers (in 1871, 370,000 thalers). The market is chiefly abroad. For the blue decorated dinner-services there is a great demand, so that the works are two years in arrears of the orders.

C. Tielsch & Co., *Altwasser, Schlesien, manufacturers of porcelain, stone-china, aud fire-brick.*—The consumption of raw materials by this establishment amounted to 324,483 thalers in value, and the production to 20,000,000 pieces, worth 750,000 thalers, the greater portion of which was for home consumption. Forty-five officers and foreman, and about 1,700 workmen, in two establishments; seven steam-engines, with an aggregate of 158 horse-power. Founded in 1845. Progress Medal awarded.

Carl Krister, *Waldenburg, Schlesien*, exhibited table-services, clocks, vases, etc. There are two establishments, founded in 1831, manufacturing not only porcelain articles, but bricks, fire-bricks, and tiles. They make a specialty of table and coffee services. The consumption of raw materials, in 1871, amounted to 220,000 centners, and the production to 639,000 thalers worth, mostly for home consumption.

Thirty-two officers and overseers, 1,475 workmen; 6 steam-engines, with 126 horse-power. Merit Medal awarded.

C. Heckmann & Rappsilber, *Königszelt*, *Schlesien*, exhibited toilet-services, table-services, mosaics, etc. Established in 1864. Make a specialty of table, coffee, and toilet services. Value of the productions in 1872, 270,000 thalers; sold in Germany. Four hundred workmen, 2 steam-engines, 32 horse-power. Diploma of Honor awarded.

Waechtersbacher Steingutfabrik, *Schlierbach*, *Hessen-Nassau*.—Coffee and tea services. Established in 1834. Two hundred and twenty-eight workmen, 1 steam-engine, 5 water-wheels.

Villeroy & Boch, *Mettlach*, *Wallerfangen*, *Septfontaines* and *Dresden*. This establishment, well known from its productions and as the largest in existence, probably, for the production of fine faience, made an attractive display of its products in the rotunda. This display comprised dinner and dessert, coffee and tea services, toilet ware, vases and ornamental objects in faience and in terra-cotta, of superior quality and decoration. The terra-cotta plates, platters and tablets, were ornamented by incised designs, filled in with the same material as the base or groundwork, but of a darker color, as encaustic tiles are made. This, and the manufacture of tiles by pressure from pulverized materials, constitute specialties of the establishment.

The productions amount in value to 1,000,000 of thalers annually. In 1871, the total value was 1,170,000 thalers. Nearly the whole of Germany is supplied with faience from this establishment, and at such low prices that foreign manufactures cannot profitably compete for the trade.

The works were started at Wallerfangen in 1789; at Mettlach in 1810; at Septfontaine in 1767; and the tile works in 1868. There are 1,848 workmen, 36 officers, 7 steam-engines, 217 horse-power. Medals were awarded at London in 1851, and at Paris in 1855 and 1867. The jury awarded the Merit Medal.

The firm also have four establishments at Dresden for the manufacture of stoneware, especially stove tiles, stoves and paving blocks. They made about 320,000 thalers' worth of ware in 1871. Six hundred and ten workmen, 19 officers, 3 steam-engines, 145 horse-power.

Macheleidt, Triebner & Co., *Volkstedt bei Rudolstadt Schwarzburg-Rudolstadt.* Exhibited porcelain figures, groups and medallions. The establishment, which was founded in 1760, makes a specialty of medallions for wall decoration. In 1871, the works used 6,100 centners of raw materials, worth 3,300 thalers. Half of the product is exported. Four hundred and twenty-eight workmen, one water-wheel. Diploma awarded.

Actien Gesellschaft für Telegraphen-Bedarf, *Berlin.* Manufacture and exhibited telegraph materials of porcelain, gas retorts, etc. Merit Medal.

Thallmaier, Fr. X., *München.* Establishment founded in 1849. Exhibited services, dishes, vases, etc., beautifully decorated. Special mention should be made of a service with chrome-green groundwork, ornamented with arabesques and flowers, and of the artistic cabinet of porcelain paintings; original copies after modern masters. Merit Medal.

Dressel, Kister & Co., *Scheibe, Schwarzburg-Rudolstadt.* Groups, statuettes, busts and porcelain figures. The market for these productions is about half at home and half abroad. Nearly 610 workmen are employed. Six water-wheels, 24 horse-power. Merit Medal.

Also at Passau, Bavaria, established in 1853, for the manufacture of porcelain figures, fancy articles, and stone-china ware. This establishment makes a specialty of crucifixes, basins for consecrated water, etc. Consumed, in 1871, between 50,000 and 60,000 florins' worth of porcelain earth. Two hundred and sixty workmen, five water-wheels.

Thewaldt, J. Höhr, *Nassau.* Stoneware and porcelain for chemical laboratories and culinary purposes. Established in 1792. Consumed, in 1871, 2,100 thalers' worth of raw materials. Market in Germany. Twenty-three workmen, 1 steam-engine of 12 horse-power. Diploma awarded.

WINGENDER BROTHERS, *Höhr, Hessen-Nassau.* Exhibited clay pipes, cigar-holders, etc., of which they make some 5,000,000 pieces of all kinds annually, valued at 18,000 thalers. A market for one-half of their production is found in Germany, the balance is exported. They employ 68 workmen. Works established in 1798.

SCHLESISCHE THONWAARENFABRIK, *Tschauschwitz Neisse, Schlesien.* Stoves, majolica building ornaments, refractory ware, etc. A specialty is made of majolica building ornaments. The chief market for the products is found in Germany. There are 204 workmen, 1 steam-engine of 24 horse-power. Value of products in 1871, 90,000 thalers, out of clay worth 8,500 thalers.

H. J. NYGEN & CO., *Duisburg, Rhenish Provinces.* An interesting series of refractory blocks, shaped carefully for the various parts of high furnaces, cast-steel furnaces, reverberatory furnaces, etc., was exhibited by this firm, as also gas-retorts, crucibles, etc. The productions, in 1871, amounted in weight to 360,000 centners, and in value to 200,000 thalers. Two hundred and sixty-six workmen employed, The greater portion of the product is used in Germany. Progress Medal.

MAGDEBURGER BAU-UND CREDIT BANK, *Magdeburg.* Exhibited clay goods, glazed and painted stove tiles, stoves, glazed terra-cotta ware, building and paving bricks, fire-stones, etc. In 1871, they produced 85,000 thalers' worth of goods, using 30,000 centners of clay, 216 workmen, 4 steam-engines of 19 horse-power, 14 ordinary burning ovens, 1 Mendheim's gas ring-oven with 18 chambers, and 1 Hoffmann's ring-oven with 16 chambers.

RUSSIA.

Imperial Porcelain Manufactory. This imperial establishment, founded in the year 1744, and located near St. Petersburg, exhibited products comparable with the finest of Sevres, Meissen or Berlin, consisting of vases, services, platters, jardinières, bouquet-holders, biscuit-figures, etc. They were all remarkable for perfection in form, color and exquisite painting, but a few of the most striking objects will be mentioned. In biscuit, nothing could be finer than the large bouquet of flowers and leaves, showing a quality of paste unsurpassed for whiteness and working capabilities. Every petal was perfect, and almost as thin as in nature. Lace pattern dishes bore equal testimony to the perfect control of the form of the paste in firing. A tea-set, antique Chinese pattern, decorated with flowers, attracted much attention. Among the large objects, the most notable were the porcelain table-top, three feet in diameter, snow-white in the centre, with a wreath of flowers forming the border, perfect in drawing, color and every detail; and a magnificent vase six feet high, painted with twelve cupids, dancing, holding a string of ivy. This vase was valued at $2,500.

This establishment was founded in 1744. It employs 230 workmen, and has a steam-engine of 12 horse-power. It has 4 furnaces and 6 muffles. The annual production is valued at 100,000 roubles.

Repine, Prince Nicholas, *Kiev*, exhibited a beautiful dessert-service of old Sevres, of the year 1765–1766: color, turquoise blue. See "Sevres."

Stépanoff, Michel, *Varsiliéro, Bogorodsk District*, exhibited refractory tablets and bricks, alembics, gas-retorts, etc. The establishment was founded in 1871; it employs 100 workmen, 14 horse-power steam-engine, and the production is valued at 200,000 roubles. Diploma.

There was also in the Russian section a fine series of earthenware, domestic utensils, and liquid measures, remarkable for excellence of form and cheapness; but no information concerning them could be obtained.

AUSTRIA.

Imperial Porcelain Works, *Vienna*.—The manufacture of porcelain was established in Vienna, in 1717, by Blanquièr. In 1746, the works were purchased by the Empress Maria Theresa for 45,000 florins, and Blanquièr was made director. In 1750, forty men were employed; in 1761, one hundred and forty; in 1770, two hundred; and in the year 1780, three hundred and twenty. In the period from 1760 to 1790, under the sculptor Niedermayer, the production of figures and groups was most developed. More attention was then given to decoration of the ware by painting, under the direction of the chemist Leithner, who produced the beautiful blue color known by his name, the reddish brown, and the superb gilding.

The first artists of the day were engaged to furnish sketches; and amongst the artists we find the names of Watteau, Sancret, Boucher, and Angelica Kauffmann. In 1827, Director Niedermayer died, and the establishment gradually declined in importance until 1864, when the Reichsrath refused further sums for its maintenance and stopped operations. The models were destroyed, and the buildings were turned into an imperial cigar factory.

Private porcelain works, *zum Eisgrübl*, had been established in 1702, and this firm came into possession of most of the stock on hand in the imperial works, and has since continued the manufacture on a smaller scale.

Fischer, Moritz von, *Herend, near Weszprim, Hungary*.—This famous establishment has its chief depot in Vienna, and made a very extensive display of all its reproductions of celebrated manufactures of porcelain, chiefly of old Sevres, Meissen, old Chinese, and old Japanese. Here could be seen counterparts of the raised flower-work of Saxony, of the open perforated basket-work ware, of old Vienna porcelain, and of the Italian Capa di Monti. These imitations are much sought for, and are the basis of an extensive business. Most, if not all, are distinctly marked with the maker's name and place of manufacture, so that no deception or mistakes can result. Some ordinary Chinese and Japanese ware is tolerably well imitated; but there is a notable failure in the attempts at the finer and distinctive peculiarities of the best pieces from those countries.

Two large portraits on porcelain, by this exhibitor, merit special mention: one of Humboldt, with a porcelain frame about three feet by two feet, and another of Paul Esterhazy, sixteen inches by twelve. Another example of a portrait, with a frame of porcelain, and all in one piece, is to be found in the Japanese section.

A perforated tea-set, in Chinese style, attracted the attention of the Prince of Wales, and was purchased by him. A large vase, with Chinese decoration, is also worthy of mention. The jury decreed a Progress Medal.

FISCHER, IGNAZ, *Buda-Pesth, Hungary*, exhibited specimens of painting on porcelain, to which the jury decreed a Diploma of Honorable Mention.

ALOIS KLAMMERTH, *Znaim.*—A collection of quaint and cheap pottery, in red, black, and yellow enamels, and mostly of articles for common domestic use, kitchen utensils, etc. The forms were simple, but elegant, and the quality was excellent. They are, withal, sold at a very low price. Some of the ware is decorated by turning or scraping off the dark-colored glaze before firing, so as to expose the light-colored body below; and an excellent effect is produced. Progress Medal.

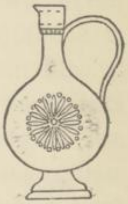
FRANZ SCHLEISS, *Gemunden am Traunsee*, exhibited quaintly colored faience and majolica blue, white, yellow, and green; also, kitchen ware and drinking-mugs, all of odd patterns and coloring. Merit Medal.

HAAS & CŽJŽEK, *Schlaggenwald and Chodau, near Carlsbad, in Bohemia.*—This firm made a fine display of choice porcelain in the rotunda. It comprised dinner and dessert services, tea-sets and ornamental vases, etc. Some of the tea-sets were exquisite in form and decoration. Price, 124 florins. A superb dinner-service, for twenty-four persons, was ticketed 1,560 florins. The exhibition made by this firm at Paris, in 1867, received the silver medal, and at this exhibition receives the Progress Medal.

DEUK, ALBIN W., *Vienna*, exhibited some beautifully decorated porcelain and imitations of French, Meissen, and Chinese ware. The firm exports to Russia and the Orient alone, over 10,000 cwts. annually. Merit Medal.

ERNDT, BERNARD, *Vienna, ix, Pramergasse, 25.*—Among the many attractive displays of stove tiles from Austria, Hungary and Bohemia, the exhibition made by M. Erndt stood preëminent. A description of the various patterns and colors would fill a small volume; but no adequate idea of the tiles can be conveyed without plates. Most of them are in high relief, and are colored rich dark brown or green, or are plain white. They are about eight inches square and three to six inches thick. They constitute a specialty in ceramic manufactures, differing greatly from paving or mural tiles or household pottery. The use of such tiles is enormous in Austria and Germany, nearly all the apartments being warmed by the "porcelain" stoves. The great merit of this exhibit was recognized by a Progress Medal.

GEBRUDER SCHÜTZ. Stiermark and in Bohemia; Earthenware. A very interesting exhibition of quaintly formed pitchers and jugs, with long narrow necks and flattened sides, as shown in the annexed outline, standing about sixteen inches high, and colored bright blue, vermilion and green. Upon the same stand there were plates and a coffee service of earthenware, with a rich chocolate brown glaze, very attractive not only in color but in form, and very cheap, the whole coffee set being marked at only four florins, about two dollars. The jury accorded a Merit Medal.



HARDTMUTH, L. & C., *Budweis*. This firm made an extensive display of peculiar styles of porcelain and faience, designed especially for export to the Orient, with which it would appear there is an extensive trade in this class of ware, the chief excellence of which seems to be its conformity in shape and decoration to old-fashioned, obsolete styles. Merit Medal.

SWEDEN.

There were two principal exhibitors of porcelain and earthenware in the Swedish section, both showing the possession of excellent materials and skill in the manufacture. Feldspar, one of the principal materials used in porcelain, is obtained abundantly in Sweden, and is exported in quantities to England.

RÖRSTRAND PORCELAIN WORKS, *Stockholm*. The display from this establishment was very interesting, consisting of porcelain vases, urns, dinner-services, plates, cups and saucers, etc. The tea-cups especially were well-formed and decorated. The handles were delicately formed and well attached. Some dark blue enamels with gilding, and a set in black enamel with raised designs in white of flowers and grasses, repaid close examination. White iron-stone china, parian, biscuit and majolica, are made at the same establishment.

These works were founded in the year 1726, and they now employ over 500 persons and a steam-engine of 70 horse-power. The production in the year 1872 was valued at 830,000 rix dollars. The greater portion of the product is sold in the country; but some is exported to Norway, Denmark, Finland and Russia, and small quantities to France and England. There is in connection with the establishment a hospital for the sick and infirm, a school for the children, a Sabbath school and a library.

GUSTAFBERG WORKS, *Stockholm*. (W. ODELBERG.) This establishment also made a fine display of porcelain, faience, parian and majolica ware. The dinner-services were excellent in form, color and decoration. Sets of cups and saucers, of good pattern and well fired, glazed in single colors all over, except the interiors, and the central parts of the saucers were noted as worthy of mention. The colors, such as red, purple, blue and lavender, were very even and bright, and produced a fine effect.

Some very good specimens of majolica were shown by this and by the Rörstrand establishment, characterized, however, by the apparent abundance of oxide of copper, for a vivid green was the predominating color of the glaze.

The Gustafberg works were established in the year 1826, and now employ about 400 persons and 4 steam-engines, with a total of 91 horse-power. Raw materials to the following amounts were used in the year 1871 :—

40,500 cubic feet of clay, from England ;
20,000 cubic feet of "fire-stone," from France ;
800,000 lbs. of feldspar, from the neighborhood ;
34,000 lbs. of bones, from Sweden ;
24,000 lbs. oxide of lead ;
22,000 lbs. of borax, from France and England ;
160,000 cubic feet of stove coal ;
700 cubic feet of wood.

The value of the products reaches the sum of 702,000 rix dollars.

PORTUGAL.

Several exhibitions in the Portuguese section give evidence of the growth of ceramic industry in that country. The manufacture of porcelain is carried on at Vista Alegre, Aveiro, and at Sacavem, Lisbon. It has long been established at the former place, and the products are held in high estimation. Modern improvements have been introduced, and a variety of artistic and ornamental objects, such as vases, statuettes, etc., are manufactured. Pinto and Tilho exhibited toilet and tea-sets, apparently modelled after British patterns, but without special merit.

There was considerable ordinary pottery and majolica, rather crude in form and coloring, but not uninteresting; green and brown coloring predominated. Some red, unglazed jugs, from the manufactory of G. Mafra, deserve mention for the peculiarity of their form. They are evidently a modified form of alcarazza, intended to hold and

cool drinking water, by suspending them in a cool and airy place. The top is closed over, the only opening being the spout, through which the vessel is filled by immersion. A curved handle at the top is convenient for carrying, and one at the side for tipping it.

In the year 1870, the importations of glass and ceramic products were valued at 150,522,000 reis, and the exportations at 36,911,000 reis. Of faience, in the same year, 132,688 kilogrammes, valued at 24,077,000 reis, were imported from England.

DENMARK.

Royal Porcelain Manufactory, *Copenhagen*, exhibited in the Rotunda and in the Danish court decorated porcelain of all kinds, especially works in biscuit, consisting of medallions, busts and bas-reliefs, after Thorwaldsen, Bissen, and others. Thorwaldsen's "Night and Morning," and the medallion portraits, deserve special mention for their excellence in form and composition of the paste, and their pure whiteness. The works also make a specialty of imitations of the old Saxon and Danish ware.

The list of premiums received at former great exhibitions is a long one, and at this exhibition the works fully sustain their reputation.

The fine terra-cotta ware of this section, consists of choice vases, urns, tazzas, etc., in imitation of the old Etruscan and Greek forms. These are black in color with figures in red, and the reverse. Others are decorated with sprigs of ferns and flowers on the plain black surface. They are exquisite in execution and color, and were much admired. All this ware is remarkably perfect in form, and is burned without distortion. The prices are moderate.

ITALY.

MAJOLICA.

Although specimens of majolica ware, as usually designated, were to be found from all the principal countries, it is chiefly to the Italian and Spanish sections that we should look for the typical specimens.

The name majolica is believed to be derived from Majorca, the Spanish island from which it is supposed the first specimens were taken or exported to Italy. The island, according to Fabio Ferrari, was called Maiolica by ancient Tuscan writers, and Dante writes, "Tra l'isola di Cipri e Maiolica." Pottery was made there by the Moors from an early period in the Middle Ages, and it became famous. There is a statement, considered mythical by some, that, at the conquest of the Balearic islands by the Pisan fleets, in 1115, part of the spoil consisted of the famous Majorca ware, and that it was used for the decoration of the towers and façades of the Pisan churches. The term majolica, or maiolica, appears originally to have been restricted to the lustred wares,—those in which there was a nacreous chromatic effect, due to the partial reduction to the metallic state of the oxides forming part of the composition of the glaze. This lustre, though easily produced when the cause is known, was doubtless one of the great secrets of the art for a time, though doubtless produced, in the first instance, unintentionally by the imperfect combustion of the fuel in the kilns giving a smoky atmosphere containing free carbon, or carbonic oxide gas. A coarser ware, of potter's earth, covered with a white slip, upon which the designs were painted, and glazed with lead, was known as *mezza-maiolica*. The true majolica was probably tin-glazed, though it does not appear by any means certain that this constituted the distinction. Towards the middle of the sixteenth century, the terms seem to have been applied to all varieties of the glazed earthenware of Italy. Mr. Fortnum, with M. Jacquemart, M. Darcel, Mr. J. C. Robinson, and others, think that the word majolica, or maiolica, should be again restricted to the lustred wares, although in Italy, and elsewhere, it is commonly used to designate all varieties of earthenware, excepting "terraglia," in distinction from porcelain.*

It has also been maintained, that although Majorcan wares were known in Italy, the art may have been derived from Persian potters reaching the eastern ports of that country. This view is supported by the fact, that the style of decoration of the early Italian wares is more Persian than Moresque.† Again, it is suggested that after the conquest of Majorca and of the province of Valencia, at the end of the thirteenth century, Moorish potters emigrated to Italy and introduced their practice of the art with the tin glaze ‡ and metallic lustre.

In England and in the United States it is the habit to designate as "*majolica*" any pottery covered with a colored glaze. The term should be restricted to ware coated with opaque enamels. The ornamental ware, especially when modelled after natural objects, and coated with transparent glazes of various colors, is more correctly described as *Palissy ware.*

Capo-di-Monti Ware.

Ginori, *The Marquis of: porcelain manufactory, Doccia, near Florence.*—This establishment, founded in the year 1735, now produces many varieties of artistic and domestic porcelain and decorative objects, in majolica and faience. It is celebrated especially for its reproductions of the famous Capo-di-Monti ware, the pieces being made from the old moulds, and so well colored as scarcely to be distinguished from the old examples preserved in collections. The peculiarity of this ware, as is generally known to connoisseurs, consists in the decoration of the surface by groups of male and female figures in relief, covering the surface on cups and saucers, vases, plaques, boxes, jugs, etc. Most of the figures are in a nude or semi-nude condition, and are tinted with flesh color, and are surrounded by flowers or wreaths, of which pink or rose color is the prevailing color. Many of

* Fortnum's Maiolica Hispano Moresco, Persian, Damascus, and Rhodian Wares, etc., page xxxvii. of Introduction.

† Jacquemart, cited by Fortnum, ibid., p. xxxix.

‡ With regard to the origin of the tin glaze, usually attributed to Luca della Robbia, see *infra*, Part "Ceramic Clays and Materials."

the specimens are no doubt as good, or better, than the old. They attracted much attention and command a high price. As examples of skill in sculpture or modelling, they are certainly not remarkable. They do not bear comparison with the exquisite relief figures of Wedgwood's establishment. They lack sharpness and distinctness of outline, and have a half-fired look, partially blended as they are with the background, evidently forming a part of the body of the ware, all being moulded in one piece and of the same material. Considerable attention has also been given at this establishment to the imitation of the celebrated productions of Urbino, Castel Durante, and of Gubbio.

The productions have been conspicuous at most of the great exhibitions, and have received many medals, notably at Paris in 1855, London in 1862, Paris in 1867. The proprietor was also honored in 1867 by appointment to membership of the Legion of Honor of France.

Torquato Castellani, *Rome*. This exhibitor appears to devote his energies to the reproduction of choice examples of old Italian majolica and decorated pottery, chiefly bottles and urns. One of these, with massive twisted handles, is represented in outline. It was about 12 inches by 15 inches high, and was purchased by the St. Petersburg Museum for £7 15s.

Monaco. In the small building outside the Industry Palace, set apart for the products of this State, there were many specimens of decorated faience, in the old Dresden style. They were chiefly vases and baskets covered with colored flowers in relief.

Incised or Sgraffiato Ware. This name is applied to a species of decoration practised in Italy by the potters of the Renaissance period, or towards the beginning of the fifteenth century. It is also known as Perugia ware, having originated in the province of Perugia. The design is scratched out of a thin layer of light colored clay over a darker body beneath. The object is then glazed, and colors are sometimes added. The art has been revived by the Messrs. Minton & Maw.

It suggests, also, the style of decoration so effective on the stoneware of the Doulton's, Lambeth, British section.

INDIA.

The list of the ceramic contributions from India fills several pages of the Descriptive Catalogue, but consists chiefly of earthenware and glazed tiles.

Dr. Leitner, Lahore, sends a tea-cup of Lhassa porcelain, and specimens of the Lahore porcelain, the last attempt at the manufacture, which will soon die out unless encouraged. Peerano, of Tatta Sind, forwarded ninety-five variously colored specimens of domestic pottery, including floor-tiles and specimens of the materials and implements used in the manufacture and glazing of pottery. Similar collections were sent by other persons from various parts of India.

For a notice of the tiles, etc., see Tiles.

JAPAN.

Japan entered fully into the spirit of the great Exhibition, and made the most systematic and comprehensive display of the varied industries of the country yet seen by Europeans. The ceramic products were a salient feature, and illustrated the manufacture of porcelain faience and terra-cotta from many of the provinces. When we reflect that this country, with China, is the birthplace of the art of porcelain, and consider the numerous separate establishments for its production, its general use among the people and the extent of the manufacture, not only for native use but to please the taste and meet the requirements of foreigners, we shrink from attempting a critical review of the industry, or even a description of the representative examples accumulated at Vienna.

The fertility of the people in design and modifications of the potter's art surprises every one, and none more than those who have in vain striven to exhaust the novelties of the manufacture in materials, form and ornamentation. There is an unceasing variety, and, apparently, no end of surprises in store for amateurs and collectors. But it is not in porcelain alone that the Japanese potters attain excellence and variety. They produce faience and ware resembling the finer sorts of terra-cotta, plain and enamelled. The exquisitely decorated faience of Satsuma was a surprise to connoisseurs at Paris, in 1867. It was admired in London, at the Exhibition in 1871, and appeared in still greater variety of forms and decoration at Vienna. The potters seem also to be copying European "masters," for they are making this ware into forms to suit foreigners. Certain it is that, as the demand for any one of these varieties of ware increases and large orders have to be filled, the care and detailed labor diminishes, and we lose that painstaking and exquisite finish which is freely bestowed on a few select objects. Thus it is that older specimens of ware are generally the most desirable. The same is true of the metal work and the ivory carvings. Quality must be sacrificed to quantity.

The Japanese Commission, however, who had the responsibility of securing a proper representation, made judicious selections and placed some of the choicest, as well as the more ordinary objects, before the jury.

The list includes vases, white and blue, in red color, and in the deservedly admired celadon green; perforated work, enamelling in relief, egg-shell ware, monochromatic and polychromatic decoration, decoration with flowers and figures, and with laquer and gold. There were not only vases, but plates, bowls, sackie-bottles, sackie-cups and tea-pots in great variety; tiles, large decorated slabs, a fire-place and mantel, and dinner, breakfast and tea services, after European patterns.

The Japanese porcelain, it is well known, is the *hard*, or *pâte dur* variety. It is, in general, highly vitreous, compact and hard, but is tough and resists heat well.

Amongst the many porcelain-making establishments in Japan, those of Sai-kio, Inari, Kutani, Owari* and Awadji,

* Owari is in the Second District, Tokaido, and Awadji in the Seventh District, Nankaido.

are held in the highest esteem. Most of the potteries are small. The production is not centered in extensive works, and this accounts for the diversity of patterns, the differences of paste, of glazing, and of colors.

A pair of large vases, of modern make, attracted attention. They are about five feet high and twenty inches in diameter ($1^{m}\cdot623$ and $0^{m}\cdot495$). These are decorated around the tops with groups of peonies, others with dragons modelled in low relief between birds and flowers, on the flat in blue, under the glaze. A flower-vase also commands mention. Size $0^{m}\cdot484$ in diameter at the top. Blue enamel, ornamented with figures of peacocks and peonies. One of the large plates represents the four seasons by four groups of flowers. The outside is ornamented with butterflies and arabesques. Diameter, $0^{m}\cdot984$.

Miaco Faience.

A cheap buff-colored earthenware, resembling the Satsuma, is made at Miaco. It was exhibited at Vienna, and is now abundant in the shops. The forms are various and quaint, particularly where the taste of the Japanese is left free to assert itself. Foreign samples of tea-cups, saucers, and plates have been supplied to them, and much of the ware we receive is made after these patterns. The decoration is pleasing, consisting generally of flowers, grasses, etc., mingled with gilding; but it is generally rude, and not carefully executed, in comparison with the best Satsuma. The gilding, instead of being in compact, distinct points, is in smooth, diffused patches. Some of the ware is formed in imitation of sections of bamboo, with great fidelity in the details. Insects, drawn and colored with accuracy, are sometimes substituted for flowers in the decoration. A very interesting collection of this ware has been imported by Mr. Vantine, in New York.

CHINA.

The representation from this country, as from Japan, is very large, and includes almost every variety of hard porcelain, in the purely Chinese styles, and much that has been made in imitation of European forms, particularly dinner and tea sets, coffee-cups, etc. The vases are very numerous, and many of them of great size and elaborate decoration. Crackled ware and specimens of *pâte-sur-pâte* are not wanting, and the whole is made the more interesting by a collection of old porcelain, bronzes and cloissonée enamels, sent by Archdeacon Gray.

Amongst the vases we find several of the beautiful red color, so much prized in China, particularly if old, as indeed is the case with all old specimens, whether of china, bronze or enamel. Very old specimens command enormous prices, and are frequently counterfeited. Among other objects to be noted are garden-seats, in celadon, with raised ornaments in white,—*pâte-sur-pâte*,—admirably executed.

One great seat of the porcelain manufacture in China is on the Poyana Lake, the outlet for the goods being via the Yan-tse-Kiang.

Most of the ware exported to Europe and America, chiefly the highly decorated dinner and tea services, is from Hong-Kong.

According to Julien, the manufacture of porcelain in China was commenced in the country of Sinping, Honan, under the Han dynasty, and, therefore, some time between B. C. 185 and A. D. 87. In the year 60, porcelain was in common use. Marco Polo saw the process of manufacture in the thirteenth century.*

Specimens of Chinese porcelain had reached Europe before the Portuguese doubled the Cape of Good Hope in 1497, after which it became more abundant, through the importations by the Portuguese and the Dutch, who traded in it largely.

Cloissonée Enamels.

The Chinese section, as indeed the English, French, and Japanese sections of the Exhibition, was very rich in displays of this peculiar ware, which may be regarded as a connecting link between porcelain and bronze. It is an ancient art in China and Japan, but is now receiving increased attention there, owing to the foreign demand, and pieces of great size

* Catalogue Museum Practical Geology, 1871.

and beauty are produced. In this art the design is first marked out upon the metallic or porcelain surface by thin strips of brass, bent and folded, so as to mark all the details of an intricate pattern. These are fastened to the surface on edge by soldering, and the cavities or *cloissons* thus formed are filled in with fusible enamels of different colors. The piece is then baked, the enamels fuse into the cells, and, after cooling, the whole surface is ground off smooth, bringing the enamels and the thin brass partings to a flush finish. Dark blues and greens, with a sprinkling of red and white, are the usual colors.

Imitations are now made extensively in France and in England. Some of these productions are remarkable for their beauty and perfection of finish. Special mention should be made of specimens shown by Barbedienne and by Elkington.

There is one variety of cloissonée enamel on porcelain which is rare, only a few specimens having been seen in the United States. Porcelain body is substituted for metal, and the brass partitions seem to be inserted directly in the porcelain body. A cup in the writer's collection is so enamelled over the whole exterior, while the interior is ordinary white, translucent porcelain.

Some of the choicest specimens of Chinese cloissonée were obtained at the sacking of the summer palace of the emperor, and, together with wonderfully wrought specimens of jade and other decorative objects, were distributed from thence over Europe.

III. Floor, Wall, and Ornamental Tiles.

The Exhibition contained a rich assemblage of decorative tiles of several countries, notably from Great Britain, where the art has attained its greatest perfection. Little, in fact, remains to be desired in respect of excellence of materials, perfection of form, and beauty of design. The highest skill of the potter and the best efforts of decorative artists are called into requisition in this manufacture, and the resources of the chemist's art, applied to enamels, are taxed to their utmost in the production of the most brilliant colors. Graphic and chromatic decorations in ceramics find in this field their legitimate basis of application and their greatest possible expansion in the future. The great object of the tile is decoration; and the flat surface in the wall or on the floor is more appropriately the basis of ornament than a plate or dish on which, when in use, the decoration is obscured. The antiquity of the art of decorating with tiles is well known, and the perfection which it attained in several countries is shown by the specimens which have been handed down to us unchanged,—not even dimmed by age. The tiles of India, Persia, Arabia, and Spain, the mosaics of the Romans, and the walls of the Alhambra, are familiar examples. Glazed decorated tiles were used in Egypt, and among the Assyrians and Babylonians. They were introduced in Spain by the Saracens and Moors. In China they were employed in remote periods for both exterior and interior decoration. The Exhibition contained specimens of antique tiles from India and from the mosques of Samarcand, of the fourteenth and fifteenth centuries; and thus a retrospective glance of the art and its application in this place is fully justified.

The Indian tiles were brought by Dr. Leitner from Lahore, where they were taken from old monuments; but the colors are as vivid as they ever were. The art, which was connected with the Mogul architecture, is now almost dead, as it is no longer sustained.

Manufacture of Tiles in Great Britain.

The manufacture in Great Britain dates from mediæval times, and is supposed to have originated in the Roman mosaics,—the transition from tesseræ to the tiles, with impressed designs, being gradual,—the difference in the first place being in the size of the pieces only. Evidences of the gradual modification of the size have been found, and in Spain, small tiles, intermediate between British tiles and tesseræ, are now in use. Recent excavations at Chichester have brought to light mosaic pavements and Roman tiles.

It is highly probable that the convenience and greater rapidity of laying larger tiles led to their adoption, and the requirements of the details of design led to the quicker and cheaper method of stamping the figures upon the clay. For a long period after the use of the red or Samian ware, introduced by the Romans, ceased, tiles appear to have been the only branch of the decorative fictile art in Britain. They were applied chiefly in ecclesiastical decoration, about the altars and choirs, and for memorial purposes. The excellence of this mediæval tile-work is regarded as having stimulated and led the way to improvement in decoration of household pottery. Some of the earliest specimens of the art, preserved in the British Musem, are from ruined churches in Norfolk. The neighborhood of Great Malvern appears to have been one of the chief centres of production in the thirteenth and fourteenth centuries, and few churches in Great Britain can show a greater variety of ancient tiling than the Priory Church of Great Malvern, the interior of which abounded with encaustic tiles in the floors and forming panels in the walls.

The manufacture in Britain has been assigned to two periods. The most ancient tiles are believed to have been fabricated between the years 1290 and 1380, and those of the second period during the prevalence of the perpendicular style in building. Numerous kilns have been unearthed at Malvern Hills, and it is believed that Tewkesbury Abbey and Worcester and Gloucester Cathedrals were supplied with tiles from these kilns. The manufacture is supposed to have been continued in Worcester County down to about the year 1640, and to have been repressed, if not stopped, at that time through the influence of Puritanism. In that year visitors were appointed to visit the ecclesiastical structures of the kingdom and destroy all ornaments of a "superstitious nature."* The designs upon the tiles at that time were largely formed of sacred symbols and inscriptions, of memorial letters and monograms, and of heraldic devices, chiefly in connection with tombs. These mediæval tiles have been classed according to their decorations, as follows * :—

1. "Sacred symbols; inscriptions, consisting either of verses of the Scripture or pious phrases.

* Antiquarian and Architectural Year Book, 1844, p. 128.

2. "Armorial bearings of the sovereign or individuals connected with the monastery by benefactions or otherwise; personal devices or mottoes.

3. "Ornaments conformable to the style of architecture or character of decoration prevalent at the period, but devoid of any special import."

Some of the emblematic figures, of which examples characteristic of these old ecclesiastical tiles are here given, consist of lions, dragons, and adders, and have been supposed to have reference to the text, "Thou shalt go upon the lion and the adder: the young lion and the dragon shalt thou tread under thy feet."

The tiles of the earlier manufacture generally measure five inches square, and the later, six inches. Some have been found nine inches square and two and a quarter inches thick. A specimen in the writer's collection, probably from the Malvern kilns, is a little over five inches square and three-quarters of an inch thick.

The material is ordinary coarse red clay, such as is used for making brick, and the design appears to be formed by a lighter colored clay filling incisions or impressions in the surface, and subsequently glazed. The design is supposed to have been impressed by a stamp while the clay was still moist, and the depression so formed was filled by the lighter clay in the condition of thin paste, for the cavities are frequently seen to be but partially filled.

Prosser's Method.

But tiles are no longer made in Great Britain in this manner. Prosser's method, patented some thirty or forty years ago, and perfected by Mr. Minton, marks a new era in tile manufacture, and has contributed greatly to the advance of this branch of artistic decoration. It consists chiefly in the use of powdered clay, instead of the wet, plastic mass. The paste being duly compounded of the proper clays and silex, and strained through cloth, is dried and then ground to powder. This powder, when slightly damp, is pressed in steel moulds by a powerful screw. The size and form of the moulds determine the size and shape of the tile. Tiles so formed are more perfect in shape, are denser, stronger and more uniform in wear, than those made from clay in its plastic state. There is less shrinkage in firing, and little or no distortion. Most of the cheap tiles upon the Continent are made by the old methods, and are by no means so exact in their forms, and sharp in their edges and angles, as those made from the damp powder under pressure, in accurately formed moulds.

The exactness and uniformity of size obtained by the new method greatly stimulated the industry, and it has been steadily increasing in importance to the present time. Many firms are now engaged in the manufacture in Great Britain, particularly at Stoke-on-Trent, and Burslem in Staffordshire. The establishment of Messrs. Minton, Hollins & Co., now carried on by Mr. Hollins, is one of the oldest, and is occupied exclusively in the production of all varieties of tiles.

The rapidly increasing demand for tiles of all descriptions of late years is remarkable, not only in England but throughout Europe. They are used in almost all modern buildings of any pretension. They make the most serviceable and ornamental floors for public buildings. In the South Kensington Museum alone there are some 40,000 square feet of pavement laid. They are used in railway stations, on shipboard, and for decorating walls and pavements of churches. For this latter purpose, great numbers are required in the work of restoration of old cathedrals. At Worcester, the cathedral which has lately been restored, chiefly through the munificence of the Earls Dudley and Ward, who gave equal to $350,000 in gold for the purpose, has a tiled chancel of most elaborate design, a part of which is over four hundred years old. The dilapidated portions have been renewed with tiles made in exact imitation of the ancient tiles, and at a cost of not less than $10,000, under the direction of Sir Gilbert Scott, the architect.

One firm alone (Minton, Hollins & Co.) cite the following among the principal places for which they have furnished the tile pavements :—

"The Royal Palaces of Windsor, Osborne and Marlborough House; the Palace and State Yachts of the Sultan of Turkey; the Royal Residence of Prince Dhuleep Sing; the New Houses of Parliament, Westminster; the New Foreign Offices; the New Government Buildings in India; the South Kensington Museum; the New Albert Hall; the Senior and Junior Carlton Clubs; the Cathedrals of Ely, Lincoln, Litchfield, Gloucester, Wells, Glasgow, Armagh and Sydney (New South Wales); the New Capitol at Washington (U. S. of America); and many of the principal Ducal Mansions, Government Buildings, Churches and Public Institutions in Great Britain," etc., etc.

Varieties of Tiles.

The varieties of tiles as now made may be classed according to their manufacture, irrespective of form or use, as follows:—

1. Plain tiles, unglazed, glazed or enamelled, in colors.
2. Encaustic tiles, unglazed or glazed.
3. Majolica tiles.
4. Enamelled, decorated or painted tiles.

The plain tiles are usually made from natural clay mixtures, selected with reference to their colors when burned; or coloring substances may be added. The color pervades the whole tile like a brick, not being, as in the case of an enamel, merely superficial. The addition of a transparent glaze makes the color more brilliant, and gives a smoother surface. The general colors of both the plain tiles are black and white, red, chocolate, salmon, drab and buff. But almost any desired color can be given to plain tiles, by enamelling them upon the surface with opaque enamels. For this process the plain white, buff or red tiles are taken. Bright reds, crimson, purples, blues, greens and browns may thus be obtained. These enamelled tiles, like the glazed, have a smooth glassy surface, and are more appropriately used upon walls than in pavements, where the attrition would soon destroy the gloss of the enamel and produce scratches. The smooth surface is also rather slippery and dangerous to walk upon. For these reasons the plain unglazed tiles are to be preferred for pavements.

Besides the use of the glazed and enamelled tiles in mural decoration for dados, panels, etc., they are especially applicable, and are largely used abroad, for lining the walls of dairies (the dairy farmers finding them superior for cleanliness and keeping the milk pure), for larders, kitchens, around sinks and cooking-ranges, in bath-rooms, water-closets, and in stables. For such places the six-inch plain white glazed tile is in general use. Another very important application of wall-tile is in hospitals, for completely lining the walls of wards for fever patients. The new St. Thomas hospitals (erected in London opposite the Houses of Parliament) have the fever wards lined with six-inch white glazed tiles, which, it is believed, will prevent the absorption of the germs of disease which it is well-known penetrate porous plaster walls, and are even absorbed by bricks, so that after a time whole wards of hospitals and entire buildings become unfit for occupation. The same is true of rooms in dwellings, hotels, and dormitories in colleges. An impervious tile-wall, which can be thoroughly cleaned by wiping with a sponge, is a great sanitary improvement, and deserves the attention of physicians and architects. A thoroughly vitrified body like porcelain, would be better for the purpose than a porous earthenware base with a glazed surface, though the latter would, no doubt, be far better than even the hardest painted plaster wall.

Another important use of the plain white glazed, or enamelled tiles, is as reflectors in lining dark passages, staircases and entrances, especially in basements, or wherever there is liability to dampness or a smoky atmosphere. They are largely used about the stations of the underground railway in London, particularly around the window-openings, or wherever light is admitted through thick walls. Most of the lavatories and retiring-rooms of the railway stations in England, and on the Continent, are lined with white glazed tiles.

Encaustic tiles may also be either with or without a glaze. In this class the design upon the tile is not merely stamped or painted on the surface, but is impressed to considerable depth. The tiles are *inlaid.* The process in Britain is as old as the mediæval tiles of Malvern, already noted. In the ancient tiles the design was impressed in the moist clay. In the modern it is equally impressed, but at the time of forming the tile out of the dust, leaving a sharply formed design, which is subsequently filled by a powder of another color. The whole being pressed together forms a homogeneous mass. The impressed design is also filled, in some cases by a liquid slip, as in the ancient tiles, and when dry the excess is scraped off before firing.

The design being impressed to a depth of one-eighth or one-quarter of an inch, and filled solidly with body of a different color from the groundwork of the tile, is not obliterated by wear until the whole substance of the tile has been cut away to the full depth of the design. The brilliancy of the design and of the colors of the tile may, as with plain tiles, be heightened by a simple glaze; but the surface is made slippery, and is not so well adapted to pavements as the simple unglazed surface. Some of the colored bodies, such as blue, green and white, are sufficiently vitrified in burning to give a vitreous semi-glazed appearance. But glazed inlaid tiles are suitable for hearths where not exposed to much wear, and are now largely used abroad for this purpose. Their thickness and strength renders them secure from breakage.

Encaustic or inlaid tiles are usually one inch thick, twice the thickness required for plain wall-tiles. They are especially suitable for pavements in halls, corridors and vestibules, or wherever they would be exposed to attrition and wear by the fire-irons, etc.

Encaustic and Enamelled Tiles in Decoration.

Another important application of the encaustic, and also of the enamelled tiles, is found in decorating the walls of buildings, especially those of brick, either grouped in large panels, or set singly about the window-frames and cornices.

The glazed encaustic tiles are generally used in mural decoration and in fire-places, for lining the jambs and back, where movable or basket grates are used. They not only have the merit of beauty, but of cleanliness, as all smoke, soot or dust can be easily wiped off the glazed faces.

Majolica tiles are ornamented with the design in relief, produced generally by the insertion of an open-work metallic plate when moulded, giving them an embossed surface, which is variously colored by enamels, and is highly glazed. This kind of tile is extremely rich and brilliant in appearance, and is suited to mural decoration, such as the walls and dados of dining, smoking-rooms, libraries, offices, stairways, entrance halls, for inlaying cabinet work, and for mantels and fire-places. For this latter purpose, there were some fine examples in the exhibition of dog-grates and fire-place fixtures. They are particularly applicable to church-wall decoration, grate-cheeks and for flower-boxes. So also the enamelled ornamental tile may be used for the same purposes, but more especially for the walls of dairies, bathing and retiring rooms, and for baths. The ornamentation is added either by hand, or is transferred from lithographic prints, but is all upon the plain surface, not extending into the substance of the tile, as in the encaustic varieties, or raised above the general level, as in the embossed varieties. The elaborately painted tiles and slabs belong to this class, as also those which are enamelled in various opaque colored enamels.

The use of tiles for flower-boxes for windows has become general, and has raised a demand for such as are peculiarly adapted to the purpose. They are usually eight inches square, half an inch thick, and are inserted side by side in a simple wooden or zinc frame-work, grooved so as to receive and hold the edges of the tiles. The majolica and painted tiles are generally preferred.

An important application of tiles is for inscriptions of all kinds, street names, signs, numbers, especially where dust accumulates, and frequent brushing or dusting is necessary. They are largely used in the underground railway in London, for the names of the stations. Messrs. Minton, Hollins & Co. manufacture every kind and all sizes of these tiles for forming inscriptions, dates and texts, and direct attention especially to their letter-tiles, manufactured expressly for street names, and assert that such tiles have been fixed in several towns for more than twenty years without being impaired in distinctness. They are affixed either by bedding in Portland cement against the wall, with the edges covered so as to exclude water, or by metal frames secured to the wall by screws, or by cutting out a recess as broad as the tiles, and as long as the name requires. The tiles are then secured in this recess by cement, and the joints are pointed.

Memorial and Mortuary Tablets.

For memorial and mortuary purposes, encaustic tiles, bearing inscriptions, monograms or heraldic devices, seem to be peculiarly appropriate. They have the advantage of being comparatively indestructible by the weather, and of holding their colors unchanged by time, so that inscriptions on them remain legible long after those cut in stone have disappeared. The material is far more enduring than porphyry and granite or marble, especially where exposed to the weather; and even if lost sight of and buried for ages in the earth, tiles, if properly made, will retain their inscriptions in perfection, and may become of great value in antiquarian researches. Being formed in moulds, duplicate copies can be made at little increased cost, and they could be freely used, not only in tombstones, but as memorial tablets in the walls of churches. Inscriptions may be made in small but distinct letters, so that a tile of ordinary size may contain all that is usually placed upon a tombstone. The compactness of such inscriptions renders it possible, if desired, to group a number in a small space, and they could be inserted side by side in the walls of vaults, or upon tombstones specially adapted to the purpose.

The memorial tablets now made and exhibited by Messrs. Minton, Hollins & Co., are twelve inches square, and are designed chiefly for insertion in the walls of churches or chapels. They bear heraldic devices or simple inscriptions, and are variously ornamented and colored. Designs are furnished by them at the works, and any inscription to order. I see no reason why such tiles should not be inserted in ordinary tombstones, in place of the chiselled inscriptions, a recess being cut into the stone to receive the tile, securely bedded in cement.

Early examples of the use of tiles for mortuary purposes are numerous and interesting. Red tiles of this nature, inlaid with black clay, have been found in Devonshire, Somersetshire and Surrey, England.* It is known that inlaid tiles were used to mark the site of graves in Worcestershire far into the seventeenth century. In Malvern Priory church, which contains some of the finest examples of heraldic tablets, Richard Corbet, a knight templar, who died in the thirteenth century, has a plain table monument, the sides and ends of which are covered with tiles, $5\frac{1}{2}$ inches square and $1\frac{1}{2}$ inches thick, decorated with the arms of the Corbet family.†

In the same ancient church, there were examples of monograms, the letters impressed in the clay and then filled in with white earth, and of pious inscriptions in black-letter in connection with them. Inscriptions formed with small tiles, each bearing a separate letter, have been found there, and the grave of Vicar Edmund Rea, 1640, was marked by a border of such tiles, chronicling his death.

In the pottery districts of Staffordshire, earthenware slabs or gravestones were not uncommon. Several examples, with drawings, of specimens in the Mayer collection are cited in Meteyard's Life of Wedgwood. One is a tablet one foot high, nine inches broad, and two inches thick; another, two feet three inches high, one foot seven inches broad, and three-fourths of an inch thick. One is formed of seggar clay, and the other of dark red clay, and both are inscribed, one with raised white letters, and the other with the letters sunk, and covered with a glaze. All of the inscriptions are remarkably clear.

Building-Tablets.

Another example of the use of tiles is found in the building-tablets set into the front walls of houses to show the date of construction, and the name of the builder or owner. The custom was an old one, and was very generally followed in the pottery region. Some of these were made of light brown clay, with the ornaments in relief in yellow clay. Others are glazed white, with the date and armorial bearings painted in

* Life of Josiah Wedgwood, Meteyard, I., 55.

† Antiquarian and Architectural Year Book, 1844, p. 147.

blue. It is in this direction that tile-making connects itself with the industry of terra-cotta, especially in the department of mural decoration by slabs ornamented in relief, either plain or enamelled.

Large numbers of tiles are now used for decorating furniture, being set in the woodwork of cabinets, tables, wardrobes and bedsteads. There were several fine examples at Vienna, particularly in the British section. For such purposes specially decorated tiles are desirable. Plain white or buff tiles may be decorated with figures or flowers, by painting upon the glaze. There are artists who devote their efforts to this work, and the variety of subjects is great. Cottier & Co., the celebrated decorators of interiors, publish a list of classical and allegorical figures, among them such as Pomona, Flora, the Seasons, Industry, etc., and a series of heads of poets, painters, composers of music, discoverers and philosophers.

Sizes and Shapes of Tiles.

The sizes and shapes of tiles vary in different countries and with different manufacturers. At the establishment of Minton, Hollins & Co., and with other British manufacturers, 6×6 inches square is the size in most common use. Four of these make one square foot of surface. But 5×5 inches and 3×3 inches are also made, and borders to correspond. The following table shows the range of sizes for plain, unglazed tiles :—

Squares. —	6×6	inches.	Bands. —	$6\frac{1}{4} \times 3\frac{1}{8}$	inches.
	5×5	"		$6\frac{1}{4} \times 1\frac{1}{2}$	"
	$4\frac{1}{2} \times 4\frac{1}{2}$	"		6×4	"
	$4\frac{1}{4} \times 4\frac{1}{4}$	"		6×3	"
	4×4	"		6×2	"
	$3\frac{1}{8} \times 3\frac{1}{8}$	"		$6 \times 1\frac{1}{2}$	"
	3×3	"		$6 \times 1\frac{1}{4}$	"
	$2\frac{3}{4} \times 2\frac{3}{4}$	"		6×1	"
	$2\frac{1}{2} \times 2\frac{1}{2}$	"		$4\frac{1}{2} \times 2\frac{1}{4}$	"
	$2\frac{1}{4} \times 2\frac{1}{4}$	"		$4\frac{1}{2} \times 1\frac{1}{2}$	"
	2×2	"		$4\frac{1}{2} \times 1\frac{1}{16}$	"
	$1\frac{3}{4} \times 1\frac{3}{4}$	"			
	$1\frac{1}{2} \times 1\frac{1}{2}$	"			
	$1\frac{1}{4} \times 1\frac{1}{4}$	"			

Of each of these sizes there are diagonal halves and quarters, also octagons, hexagons, pentagons, lozenges, and other regular geometrical shapes. The very small tiles or "tesseræ" range from $\frac{1}{16} \times \frac{1}{16}$ inch to 1×1 inch, and are used in mosaic work. There are larger sizes of the enamelled, ornamental, and the majolica tiles. The largest of the former are 12×12 inches; 9×9 inches and 8×8 inches are also made, besides 8×4 inches, 7×7 inches, 6×6 inches, 6×3 inches, 6×2 inches, and 6×1 inch.

The tiles in France, and on the Continent generally, are made in fractions of the metre, and are larger than the six-inch tile. The Dutch tiles measure $5\frac{1}{4} \times 5\frac{1}{4}$ inches, and are less than half an inch thick. The old Saracenic and Persian tiles are generally larger, being nearly one foot square.*

MINTON, HOLLINS & Co., *Patent Tile Works*, *Stoke-upon-Trent.*—The plain and encaustic tiles of this celebrated establishment have been rendered familiar to our citizens by their liberal use in the Capitol at Washington and in many of our public and private buildings. But these fail to give an adequate idea of the variety and richness of the designs which are now produced and largely used abroad for decoration.

The firm made a very complete and interesting exhibition of all their varieties of tiles, whether for paving, mural decoration, or other purposes. One of the broad wall spaces between the columns, in the main transept of the Vienna building, nearly opposite the beautiful display of Minton's majolica and porcelain, was set apart for their use, and was completely filled with tablets, painted slabs, and specimens of pavements. The series of tablets hung upon the wall gave a square yard of surface to each different pattern. The greatest novelties were the Persian and Moorish patterns, of great beauty of design and coloring; copies from a series of ancient tiles recently obtained in the East. There was also tiles in imitation of embossed leather. Altogether, it was the most brilliant and complete display of tiles in the Exhibition, and merited the great interest with which it was regarded by all classes of visitors.

* Some interesting and peculiar varieties of form are noted beyond in the description of the exhibition in the Spanish and the Portuguese sections.

The complete descriptive list, to be obtained from the firm, will be more satisfactory than any general notice, though nothing except chromatic illustrations can give an adequate idea of the beauty of the designs and perfection of coloring, nor of the slabs, with groups of ferns and flowers from nature, painted under the glaze, by the artists permanently engaged in the art studio of the firm. The list comprises more than one hundred varieties of tiles. We give below a page from the catalogue, which will give an idea of its contents :—

Descriptive List of Tiles.

No. 1. Embossed Majolica Tiles, ½-inch thick, of Persian design, for the purpose of lining walls, for sides and back of fireplaces, and for mural decoration generally.

2. Embossed Majolica Tiles, ½-inch thick, design and adaptability same as No. 1.

3. Embossed Majolica Tiles, ½-inch thick, of Renaissance design, interspersed with plain glazed tiles, suitable for walls and dados generally, including chancel walls.

4. Embossed Majolica Tiles, ½-inch thick, design and adaptability same as No. 1.

5. Embossed Majolica Tiles, ½-inch thick, design and adaptability same as No. 1.

6. Embossed Majolica Tiles, ½-inch thick, design and adaptability same as No. 1.

7. Enamelled and Painted Tiles, ½-inch thick, Fables, etc., for the purpose of lining the sides of fireplaces, inlaying with cabinet furniture, and for mural decoration generally.

8. Embossed Majolica Tiles, ½-inch thick, of Renaissance design; adaptability same as No. 1.

9. Embossed Majolica Tiles, ½-inch thick, of Persian design (unglazed ground, the ornament enamelled and gilt), for the purpose of lining walls, and for sides and back of fireplaces; suitable also for chancel walls, etc.

10. Embossed Majolica Tiles, ½-inch thick; adaptability same as No. 1.

11. Embossed Majolica Tiles, ½-inch thick, of Grecian design, for the purpose of lining the sides of fireplaces, and other mural decoration.

12. Enamelled and Gilt Tiles, ½-inch thick, of Gothic design, suitable for lining walls and dados.

13. Enamelled and Gilt Tiles, ½-inch thick, of Grecian design, suitable for lining walls and dados.

14. Enamelled and Gilt Tiles, ½-inch thick, of Gothic design, suitable for the sides of fireplaces, inlaying with furniture, and for other mural decoration.

The manufacture of encaustic tiling was commenced in 1840 by Mr. Herbert Minton, and is now carried on by Mr. Hollins in a new establishment, built upon the old site at Stoke-upon-Trent. The business has increased enormously. Aside from the ordinary demand for paving tiles, there is a constantly increasing consumption of plain white tiles for stables, sculleries, closets, walls, etc. The plain white, glazed tiles are sold at the works as low as $2\frac{1}{2}d.$, equal to about five cents each; and, considering how superior they are to any other material, perhaps not even excepting marble, for facing walls, which it is important to cleanse often, the large consumption is not surprising. But the demand has also increased enormously for the encaustic and ornamental tiles, owing not only to the greater number exported to the United States, Australia and other countries, but to the more general appreciation and increased use of them in England.

The great expansion of the industry required increased facilities for the manufacture, and led Mr. Hollins, now the chief owner and the manager, to erect new buildings specially arranged for the rapid and economical manipulation of the large quantities of material. By the courtesy of Mr. Hollins, I was allowed to inspect the whole establishment, and to see every detail of the manufacture. It may be considered a model. The clays are landed at a commodious wharf on one side, and the finished goods are delivered on the other side. The movement of the materials is in *one* direction forward from the clay heaps through the mixing and moulding rooms, to the furnaces, and from the furnaces to the packing rooms, without carrying back and forth. The materials are selected and combined with great care, so as to insure the greatest possible strength and perfection in the product. For the red tiles and the buff tiles, clays are obtained in the vicinity, and are remarkably well adapted to the purpose. The white body is formed of a mixture of the Cornish clays and calcined flint. As much care is taken in the preparation as is bestowed upon the manufacture of the body for stone-china. The basis of the colored enamelled tiles is equally white and strong. Skilled artists of reputation are constantly engaged in the decoration of slabs and large tiles for special purposes. The risk of breakage or distortion of the large slabs in the successive firings to which they must be submitted, is so great, that they are now usually made in three or more parts, or tiles, and are fitted together after the last firing.

Great labor is expended upon the finer qualities of encaustic tiles. They are made chiefly by hand, of moist clay, and are finished by scraping. Such tiles cost from 1*s*. to 2*s*. 6*d*. each, and are too costly for general use.

Eleven or twelve large kilns are required for the burning. An engine of sixty horse-power suffices to do the grinding and mixing of the materials. An average of 700 persons is employed.

Other exhibitions of the encaustic and enamelled tiles were made in the British section by Robert Minton Taylor, and by the Mintons, the latter being chiefly enamelled tiles and slabs for grates, hearths and flower-boxes. Messrs. Maw & Son did not exhibit, but manufacture tiles in great variety from designs by distinguished artists.*

Simpson, W. B., & Sons, *London*, exhibited a chimney-piece of art tiles and walnut wood, with tiled sides, arranged for an open grate.

Dutch Tiles.

Gebruder Ravesteijn, *Westraven*, near *Utrecht*, made a very complete display of the cheap tiles of Holland, arranging them upon the sides of a tall pyramidal column. They are characterized by crude and quaint designs, usually in blue or purple upon white enamelled ground. There were also yellow, black and marbled tiles in great variety, but no data as regards production and cost could be obtained.

These tiles are designed chiefly for wall decoration, being thin, about one-quarter of an inch thick, and with a smooth, glazed surface. They measure five and one-quarter inches square, and are not very strong. Their use about old-fashioned fireplaces is well known, and there is more or less

* Most of the larger tile works of Great Britian are represented by agents in the United States. Messrs. Miller & Coates, of New York, have long represented Messrs. Minton, Hollins & Co., and the public are indebted to them for great efforts to extend the use of tiling for decorative purposes. The establishment of R. Minton Taylor is represented by Mr. Thomas Aspinwall, 39 Murray Street, N. Y.; and Maw & Son, by Anderson, Merchant & Co,

demand for them at the present time for the same purpose. An agency was established for these tiles in Boston a few years since, and they can now be obtained there at a moderate price.

Vast quantities of the Dutch tiles were imported in England about the middle of the last century for fireplaces, but after the discovery of the method of transferring designs by printing from paper to earthenware, about the year 1752, the manufacture of imitations commenced, and the demand was in part supplied by home-made printed tiles.

Ancient Tiles—Samarcand.

For the exhibition in the Russian section, of a suite of the curious enamelled tiles of the fourteenth and fifteenth centuries, from the mosques of Samarcand, we are indebted to the Museum of the Society for the Encouragement of Arts, at St. Petersburg. The specimens consisted of capitals, parts of columns and cornices, and of brickwork and tiles. The tiles or plates vary in size from 8 × 10 inches to 12 inches square, and 12 × 16 inches, and even larger. They are heavily and boldly incised, so as to form the designs to a depth of an inch or more, and were evidently moulded, probably in cement or plaster moulds; but some parts of the designs, especially Arabic letters, are undercut, apparently by hand-trimming after the clay had partly dried. The designs and inscriptions are all remarkably sharp, and appear as if carved out. The sections of columns are 15 to 18 inches long, and 3 inches in diameter, half round, with raised spiral ornamentation. The principal colors of the enamelling are dark blue, white, light green and a bluish green. Light buff-colored bricks were combined with short pieces of glazed torquoise blue tile set between them, producing an excellent effect.

French Tiles and Plaques.

In the French Section, the beautiful mantel by Th. Deck, Paris, and the mural tile decoration, by Callinot, were the chief attractions to be noticed under the head of Tiles.

Deck's mantel, or rather chimney-piece, of enamelled earthenware, is formed of tiles about nine inches square.

Each tile bears a part of the general design. A *jardinière*, lined with a movable zinc or copper tray, takes the place of a mantel-shelf, and is designed to be filled with cut or growing flowers. The whole stands about twelve feet high, and is valued at 10,000 francs.

E. Collinot, *Paris*, made the most complete and varied display of enamelled faience imitations of Persian and Oriental. The prominent objects were the broad mural panels of the pavilion, or canopy, within which the smaller objects, such as vases, plaques and dishes, were arranged. Even the columns supporting the canopy were formed of the same material as the vases, and all were highly decorated in Persian designs, laid on in brilliant but thick enamel, so that each color stood out separately and in relief, without running into or blending with the next. This was the characteristic style of the enamel decoration, and resembled the remarkable work by Parrillez, upon dishes and vases. The tiles, or plates, for panels in the walls of apartments, were about one metre long and half a metre wide, several being grouped together to form one panel some ten feet long and three feet wide. One of these panels, decorated in boldly-drawn figures of rocks, leaves and flowers, in Chinese style, attracted much attention, and was sold to the Grand Duke Vladimir of Russia. Another panel was decorated with branches of the Japanese flowering peach, of full size and excellent in color, and with showy aquatic plants, all upon a groundwork or background of canary yellow enamel. Work of this kind, for walls of apartments, is furnished at 450 francs per square metre; the great cost being in the artistic decoration, for the basis is cheap clay ware, which seems hardly worthy of such expensive and beautiful additions. The raised, embossed form of the enamel, obtained doubtless by successive additions, is peculiarly favorable to the distinctness of the flowers, giving them a decided relief above the surface, while their outlines are sharply set off from the groundwork. The productions of this artist have received gold and silver medals at the successive great Exhibitions, and he has been honored by an imperial decoration in recognition of his services to art, in reviving Persian ceramic designs.

Reference should here be made to the notice in a previous portion of the Report of the display made by Deck, and to the section upon Enamelled Terra-cotta, etc.

Tiles from India.

Several collections of ancient tiles were forwarded from India, most of them being taken from tombs at Tatta, and from a ruined fortress near the same place on the Buggar, a western branch of the Indus, built in the year A. D. 1421. The following account of the method of making tiles is taken from notes sent on by the Local Committee in India.

Tiles are prepared in moulds, and when dried are rubbed over with a piece of wet cloth, and beaten with an earthen maul for the purpose of smoothing the surface. They are then kept for two or three days, or more, till they become sufficiently firm; and, after having been cut to the proper size, are piled in layers in the sun to dry.

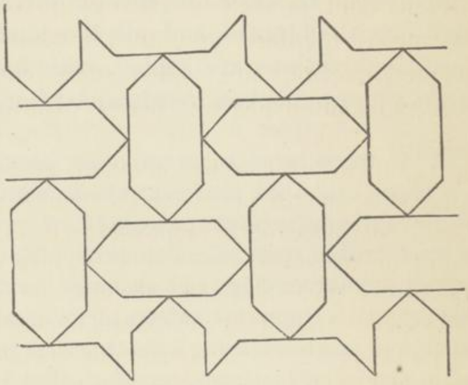
The tiles, having been sun-dried, may then be sent to the kiln, after which the required pattern is traced upon them in the following manner: "A perforated paper pattern is placed upon the surface and powdered charcoal is sprinkled over it. On removing the paper the pattern remains on the earthenware, and is then brushed over with a solution called 'Sahree.' When this is dry, glaze of the required color is prepared and poured over it; the article is then allowed to dry again, after which it is placed in the glazing kiln and fired." The "Sahree" appears to be a colored clay differing from the body of the tile.

The use of colored tiles in Indian architecture is referred to the third period, beginning with the *Sur* dynasty in 1540, when colored decoration was first introduced with boldness.

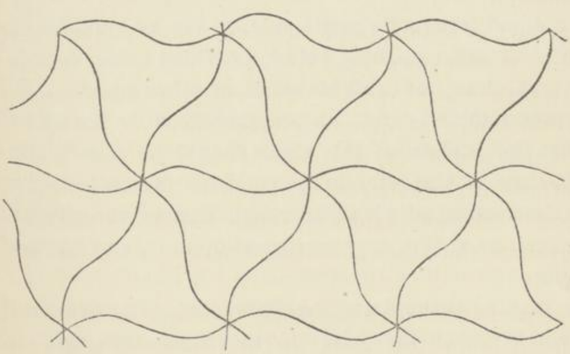
"The system of encaustic tiling had been introduced about the end of the thirteenth century in Persia, where the ruined mosque of Tabreez is said still to glow with a most elaborate pattern and hue. The first fine specimen of this art in Upper India seems to be the Killa Kona mosque, in the Poorana Killa, which was the citadel of Sher Shak's city, just outside the Delhi Gate of the modern town."* Fergusson says that colored tiles were then freely employed.

Spanish Tiles.

Soleria, A. Y., *Tarragona*. In the Spanish section there were some interesting forms of tiles and mosaic work, glazed and encaustic, but chiefly glazed or enamelled, on a basis of brick clay. The largest square tiles measure $7\frac{3}{4}$ inches on a side, and are five-eighths of an inch thick. The tiles, of which two of the forms and combinations are here shown



in outline, are much smaller, the hexagons being about $2\frac{1}{2}$ inches long and $1\frac{1}{2}$ inches wide. The colors are black and green, and the star between is white.



The peculiar curved triangular tile, about two inches broad and enamelled in different colors, produces a pleasing though somewhat bewildering effect.

Laying and Setting Tiles.

One great drawback to the general use of tiles in the United States, especially in private residences in the coun-

* H. G. Reene, in a "Note on the Stone Industries of Agra."

try, has been the supposed difficulty of setting them properly. In the large cities the agents usually keep experienced men in their employ, who can lay down the tiles if desired. A few simple directions will, however, enable any skilful mason to fix them properly.

The foundation must be firm and secure in all cases, so that there shall not be any settling or absence of equal support under all parts of the pavement. Cement mortar, without sand, is used in setting the tiles, so that a perfect bearing is obtained and all the joints are filled. The following directions are copied, with only slight modifications, from those published by Messrs. Minton, Hollins & Co :—

1. If there is no cellar or other opening underneath the space intended for the tile pavement, the foundation may be brought up to within three inches of the proposed surface of the pavement with brick, gravel, broken stone, clean stone clippings, or other solid waste substances free from chips and shavings, so that complete solidity may be secured. Upon this substratum a mortar of gravel and cement should be spread, leaving a depth of one inch for half-inch tiles, and of one and a half inches for one-inch tiles. A floating of cement and sand, in equal proportions, should then be spread one-quarter of an inch thick, over the cement and gravel layer. Upon this, when hard, the tiling may be fixed.

2. The above method is equally applicable, as far as requisite, to places above a cellar or other opening below, provided a firm foundation is given by an archway of brick or stone, or other equally solid substance. But when there is only an ordinary floor or floor-joist, it is necessary that the surface of this floor should be four inches lower than the surface of the intended pavement. There being, at that depth, a strong flooring of plank or rough boards, the mixture of cement and gravel, as above, may be spread upon it, and finished in the same manner.

3. Where it is required to replace boarded flooring by tiles, and it is impracticable to lower the joists to the necessary depth, as mentioned in 2, the floor boards may be lowered by "cutting in" between the joists, securing them below by strips nailed to the sides of the joist, so as to leave a space three inches deep above the boards, and below the top of the joists. The space so obtained is then to be filled in between the joists with the cement and gravel mortar, raising it slightly above the joists, and finishing off with cement and sand, as described in 1. A flat, level surface of this last coating may be secured by striking off with a straight edge, sup-

ported at each end upon parallel strips either fixed to the walls, or otherwise secured on a level.

4. It is not advisable to lay tiling upon a floor of boards, as it yields so much as to loosen the tiles.

5. For affixing tiles to walls, it is best to remove the plastering, and replace it by a coating of cement mortar, upon which, after setting, the tiles are imbedded with cement. A space, one-quarter of an inch in depth, should be left for the purpose.

6. Placing the tiles. It is best to work from the centre of the space, and if the design is intricate, to lay out a portion of the pavement according to the plan, upon a smooth floor near by, fitting the tiles together as they are to be laid. Lines being stretched over the foundation, at right angles, the fixing may proceed, both the tiles and the foundation being previously soaked in cold water, to prevent the too rapid drying of the cement, and to secure better adhesion. The border should be left until the last. Its position, and that of the tiles, are to be obtained from the drawing, or by measuring the tiles when laid loosely upon the floor. The cement for fixing should be mixed thin, in small quantities, and without sand. It is best to float the tiles to their places, so as to exclude air and fill all the space between them and the foundation.

For fixing tiles in grate-cheeks, sides and backs of fireplaces, etc., equal parts of sand, plaster of Paris and hair mortar may be used. These materials should be mixed with hot glue to the consistency of mortar. The tiles should be well soaked in warm water.

Tiles may be cut in the following manner: Draw a line with a pencil or sharp point where the break is desired; then, placing the tile upon a form board, or imbedding it in sand on a flag-stone, tap it moderately with a sharp chisel and a hammer along the line, back and forth, or scratch it with a file. The tile may then be broken in the hand by a gentle blow at the back. The edges, if required, may be smoothed by grinding, or by rubbing with sand and water on a flat stone.

Cement should not be allowed to harden upon the surface of the tile if it can be prevented, as it is difficult to remove it after it has set. Stains of cement, or the thin coating which is almost unavoidable, upon the surface of the tiles after laying, may be removed by a dilute solution of hydrochloric acid, to be obtained of any druggist, and then washing with warm water.

Mosaic Pavements and Pictures.

The finest example of mosaic paving, at least upon a large scale, was to be seen in the vestibule of the Imperial Pavilion, laid down by Italian workmen.

In the Russian section, Alexander Froloff exhibited a picture of St. Catherine, and Jean Bouroukhine one of St. Anastasius, and of Jesus blessing little children. All of these mosaic pictures are from the original, by Professor Neff, and are intended for the Isaac Cathedral. The same artists, and others of the Imperial Mosaic Works at St. Petersburg, contributed largely to the Paris Exposition in 1867. The tesseræ are more vitreous than ordinary tile material, and are made at the Imperial Glass Works. The mosaic establishment was started in Rome in 1846, and was transferred to St. Petersburg in 1856, and connected with the Academy of Fine Arts.

MINTON, HOLLINS & COMPANY, exhibited three or more mosaic pieces, Nos. 85, 86, and 87, suitable for church or domestic pavements. They were in the form of slabs, with encaustic (inlaid) centre-pieces.

A considerable quantity of smaller mosaic tiles (tesseræ) were shown, but no information concerning them could be obtained. The form was triangular, about an inch on a side, and the colors chiefly blue and yellow. There were also large blue and white tiles, some with raised Moresque designs.

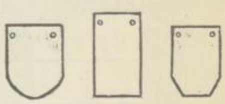
The art, as we have seen, was carried into Britain by the Romans, and appears to have been the forerunner of the tile pavements. It is not surprising, therefore, that the most perfect tesseræ are now made in Great Britain, and of the same materials used for the encaustic tiles. The colors and the methods of manufacture are the same, the difference being in the size. The sizes, as made by Messrs. Minton, Hollins & Co., vary from little cubes, one-sixteenth and one-eighth of an inch square to one-half of an inch square, and even larger for some purposes. They are made square, triangular, and of various shapes, and in all shades of color.

The difficulty and the cost of setting these tesseræ depend upon their size and the nature of the design. A given design being furnished, and the size of the mosaic when finished, the Messrs. Minton, Hollins & Co., form it in slabs, each measuring about one yard square and two and one-half inches in thickness, convenient to handle and transport and to place in the intended position. This is the method usually followed for large pieces of work, such as the frieze at the Albert Hall. This firm has rooms with broad platforms, specially fitted up for this kind of art work, and, when desired, appropriate designs are furnished for any position or size of the intended mosaic.

This is an important branch of art, which is destined to occupy a much larger share of attention than has been hitherto given. The mosaics are especially adapted to reredos friezes, chancel pavements, entrance halls, doorways, porches, and in panels for mural decoration. A number of pictures and figures, worked at the rooms of Messrs. M., H. & Co., are exhibited in the South Kensington Museum. In the frieze of the Royal Albert Hall there are over five thousand square feet covered with mosaic, and the average size of the tesseræ does not exceed half an inch square. In the London International Exhibition of 1871 there was an interesting variety of specimens of mosaic work by Maw & Co., W. B. Simpson & Co., and Minton, Hollins & Co. The objects embraced such designs as the Lord's Supper, head of Isaiah, emblems of the evangelists, etc.

Roofing Tiles.

This firm also manufacture a very ornamental roofing tile, of three shapes, as shown by the figures, and of a variety of colors, — either those of the plain, unglazed body, such as black, chocolate, or red, or enamelled with opaque glaze, in blue, green, orange, or white. Such



tiles are suitable for ornamental cottages where the roof is a conspicuous feature, for school-houses, boat-houses, turrets, conservatories, etc. They are very strong and indestructible, and make a good roof. The plain are sold as low as twopence each; the glazed at threepence, and the enamelled at fourpence each, all at the works. The large roof of St. Stephen's Church in Vienna is one of the finest examples of the use of colored tiles for roofing.

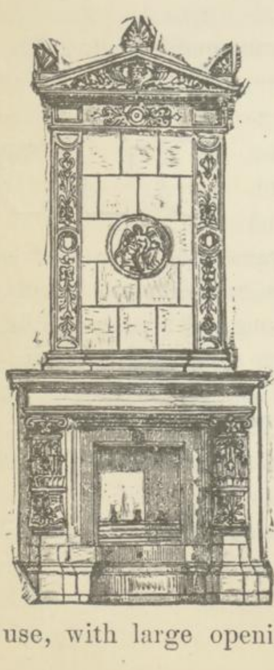
Some green bottle-glass tiles were seen in the Hungarian section, about 16 inches long, 5 inches wide, and $\frac{3}{8}$th inch thick. Each tile has a projection on the under side, which serves to hold it upon the roof.

Porcelain Stove Tiles.

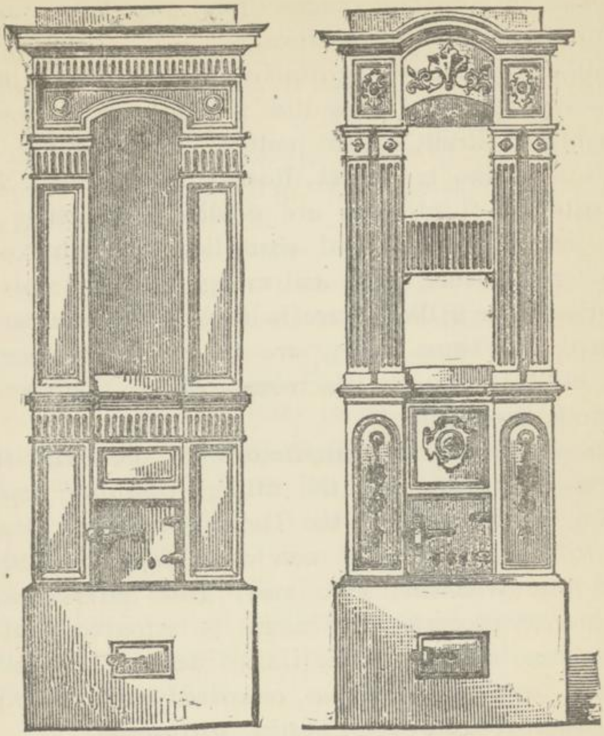
The so-called "porcelain" or German stoves, familiar to those who have resided in Germany, Austria or Hungary, were extensively exhibited in the Austrian and Prussian sections. The material is not porcelain, but earthenware, moulded into tiles or hollow bricks about six or eight inches square and several inches thick. They are made in a great variety of ornamental forms, and are generally glazed on the outer or exposed face, either white,—which is most common, —or brown, red, green, or black. Besides the ordinary flat-faced tiles, they are made with incised or raised designs, or are moulded in high relief, so that when combined they form recessed panels or projecting fillets and mouldings, in a variety of architectural patterns.

The back portion of the tile exposed to the fire or heated gases rising from it, is perforated and peculiarly shaped, so as to expose a large surface and make a series of tubular openings favorable to the absorption of the heat in the body of the tile.

The shape of the stove formed of these tiles varies with the taste of the fabricant and the demands of the consumer.



The annexed figure, from one of the stoves made by J. Fischer of Pesth, Hungary, and the succeeding illustrations, will give a good idea of the general appearance of such stoves. They are generally from six to eight or ten feet high, with a breadth of three or four feet. Usually there is a deep recess above the fire-space, or an opening quite through, the stove being divided in that portion, into the parts united above by an entablature and cornice. Cylindrical or columnar stoves are also made; indeed, the modifications are numerous, to conform to the varying taste or fashion of the time. Lower and broader stoves are now coming into use, with large openings in front, so that the fire may be seen and enjoyed as in an open fireplace, while the heat is much better utilized. The accompanying figures are from



the designs exhibited in the Austrian section by Joseph de Ceute of Vienna, but give only a faint idea of the variety and beauty of the stoves which he manufactures. The lower and broader forms are from four to five feet across the front, and much resemble the modern low mantels for grates. The fittings in front, to close the openings, are of brass, highly polished. The exhibitor gives the following schedule of prices for the ordinary sizes of stoves, gray and white, delivered at the establishment in Vienna :—

Height, Inches.	Breadth of Base, Inches.	Price in Florins.		Height, Inches.	Breadth of Base, Inches.	Price in Florins.	
		Gray.	White.			Gray.	White.
61	18	35	38	74	26	80	90
65	20	42	45	78	26	90	100
68	22	50	55	82	28	100	120
72	24	60	65		30	120	140

The dimensions are given in inches, and the price, in Austrian florins, equivalent to about fifty cents in currency. The price of packing ranges from six florins upward, according to the size of the stove.

Another very interesting display of stoves of this description, and particularly of the tiles in great variety, was made by Bernhard Erndt, (court potter) Vienna, whose manufactory is in the ix. *Bezisk*, Rossau, Pramergasse, No. 25. The patterns of his tiles are peculiarly attractive, many being deeply recessed and enamelled in bright colors,—brown, green, blue, white and variegated. The stoves and stove-tiles made in Berlin are in high repute, and are even imported to Vienna. They are to be seen, among other places in that city, in the rooms of the Engineers and Architects' Association.

It is evident that the manufacture of "porcelain stoves," the tiles for them, and the fitting, constitute important branches of industry in the German speaking countries. Such stoves, especially as now made, and susceptible of further improvements, have many great advantages over other heating apparatus, and might be introduced with success in some sections of the United States. The following are some of their merits, as compared with the ordinary cast or sheet-iron stoves for heating apartments.

1. Not being good conductors of heat, they radiate it slowly and without sudden changes; and being bulky they retain heat for a long time, and maintain an equable, moderate temperature in the apartment, even long after the fire has burned out.

2. They do not scorch and "burn the air," or the floating particles of dust in it, as is the case with highly-heated metallic stoves.

3. They combine to a great degree the advantages of an open fireplace and of a stove, giving ventilation, permitting the fire to be seen, while most of the heat is utilized, being stored up in the mass of the tiles and slowly radiated. Doubtless such stoves would fail to satisfy those who require a red-hot surface, super-heated air, and little ventilation; but many improvements might be made, so that

all the heat which wholesome conditions require can be obtained without difficulty and with great economy.

Reference should here be made to the highly ornamental tile stove exhibited by Messrs. Minton, Hollins & Co., No. 107 of their list, already referred to. It was specially designed for the cabin of a yacht, and was an example of the use of tiles for *overlaying* metal stoves, or frames, rather than as constituting the body of the stove or chief repository of the heat.

IV. Terra-Cotta—Brick.

At each succeeding great Exhibition, the importance of the industry of brick appears to be more fully recognized and represented. Always interesting to constructors, it becomes more generally so to the public as attention is more and more directed to ornamental forms and colors. This tendency happily exists, and, as we shall see, has already resulted in Europe in the production of a variety of very useful forms of building brick, of enamelled brick, and of elaborate decorative work in terra-cotta, both plain and enamelled, in colors.

Brick Industry—United States.

An idea of the magnitude of the brick industry in the United States may be obtained from the statistics collected for the last census. According to the reports, there are 3,114 establishments for making brick, with 372 steam-engines, aggregating 10,333 horse-power; 19 water-wheels, 218 horse-power, and 43,293 persons employed. Capital invested, $20,504,238; wages paid, $10,768,853; materials used valued at $7,413,097, and value of the product $29,-028,359.

Massachusetts has 107 establishments, 2,901 hands employed. Capital invested, $2,435,310; value of materials used, $978,508, and value of product, $2,251,984. Of brick and tilemakers together, 26,070 are reported; and the total value of the products, $29,302,016, against $12,263,147 in 1860.

Of common brick, 2,801,832,000 were made, and 37,-428,000 pressed brick and 60,072,000 fire-brick. In the city of Philadelphia alone, the product is commonly believed to exceed one hundred millions (100,000,000) annually.

Terra-Cotta.

In the industry of architectural terra-cotta we have a revival of a most ancient art, practised by the Egyptians, Assyrians, and the Chaldeans; familiar to the Greeks and Romans; and not unknown in Europe in the middle ages. Terra-cotta enamelled decorated surfaces in colors are also ancient. Beckwith says: "The distinctive feature of Babylonian architecture is the profuse employment of colored decoration. The temple towers of the Chaldeans were built in many stories, faced with enamelled bricks of colors corresponding to the planets. In the Temple of the Moon at Mughier, bricks or tiles, glazed with a blue enamel, were fastened externally to walls of burnt brick. The domestic dwellings of the Chaldeans were ornamented externally by diapered patterns of colored bricks, and internally with colored cones of terra-cotta." * The colors used in ancient Egyptian decoration were red, yellow, blue and green. Black and white were added.

The greatly increased use of terra-cotta dates from the commencement of the last decade, and it has been steadily finding favor with architects and the public. When properly made it has great strength,—even greater than many kinds of stone used for building,—and, as regards durability, it is superior. Mr. Henry Cole says: "It is more durable than even ordinary granite, as may be seen on the lodge in Merrion Square, Dublin, which was built about 1786. The granite mouldings there are cut in stone from the Wicklow mountains; they are all worn away and rounded by the action of the rain, while Coade's terra-cottas, dated 1788, are as sharp as when they were first placed on this lodge." † Another example is found in Sutton House, in Surrey, which is covered with terra-cotta, ornamented about the year 1530

* Pottery, Terra-Cotta, Stoneware, Fire-Brick, etc., by Arthur Beckwith, p. 86.

† Reports on the Paris Universal Exhibition, 1867, II., 415.

by Torrigiano or his pupils. They still show the marks of the modelling tool. Terra-cotta, like bricks and tiles, is practically indestructible by ordinary agencies, and this quality alone should commend it particularly for fine ornaments, capitals, bas-reliefs, cornices, window-caps, etc. It is admirably adapted for, and is chiefly used in, combination with brick. Examples abound in the chief cities of Europe, notably in the modern public buildings of London, Berlin and Vienna. The Royal Albert Hall and the South Kensington Museum in London are familiar. It is now largely used in Vienna for decoration, especially for figures, balustrades, consoles, and bas-reliefs for insertion in walls.

The industry was largely represented in the Paris Exposition of 1867, in the London International Exhibition of 1871, and at the Exhibition in Vienna. It is gratifying that the industry is already firmly established in the United States, and that it bids fair to assume large proportions, particularly in the Western States, where suitable building stone cannot be readily and cheaply obtained.

Terra-Cotta at Vienna.

Vienna Brick and Building Company.—The great brick and tile company of Vienna—the "Wienerberger Ziegelfabriks und Baugesellschaft"—made an exhibition worthy of its reputation as the most extensive brick and terra-cotta manufacturing concern in the world. It erected an artistic triumphal arch at the eastern end of the space, partly enclosed by the art buildings,—a sort of gate-way or entrance to the Art Department from the east,—which not only added to the fine architectural effects of that group of buildings, but gave the company the opportunity to display their varied architectural productions to the best advantage. This arch, high and broad enough for a carriage-way and transverse arched portals, was constructed wholly of the red and drab bricks made by the company, with ornaments of terra-cotta, such as cornices, mouldings, statues, bas-reliefs, and medallions,—some plain, others enamelled in colors. The various forms of bricks were well displayed in this arch, in the cornices, in the door-jambs and vaulted roof, the bricks being so perfect in form and finish that, when well laid, no surface-plastering or decoration is required. The joints of this work were made with great care, the mortar being freely used, but uniform in thickness in each course, and rounded over between the bricks.* The joints are striped in black, contrasting well with the buff color of the bricks. A variety of designs was introduced in the entablatures and pilasters, chiefly in the Rennaissance; those on one side being plain red, and on the other enamelled in colors. Medallions were inserted in the façade, and terra-cotta groups of figures adorned the top.

Within the area of this construction, below, there was room enough for the exhibition, on tables and counters, of the various articles made by the company. Bricks, of all the varieties and forms, were to be found there: some plain, some enamelled white, blue, or green; some wedge-shaped, for arches, and many with rounded, curved, and moulded angles, designed for the ornamentation of window-openings, for string-courses, and other parts of buildings. Here, too, were to be found a variety of decorative objects in bold relief, such as bas-reliefs, slabs, fillets, parts of cornices and medallions, designed for insertion in the façades of buildings, —the same, in fact, as were shown in their proper settings in the front of the archway. All these were noteworthy for their boldness and elegance of design, sharpness of relief and brilliant coloring, fitting them for decorative purposes high up in the fronts of buildings. The company also exhibited a variety of tiles for paving and for roofing purposes, the latter being either plain or glazed in a variety of colors, thus facilitating the chromatic decoration of roofs. There were also small hollow bricks with glazed faces. A majolica wall-fountain is worthy of mention, and was purchased by the Austrian Art Museum for its collection.

A large part of this collection—the smaller objects, bricks, tiles, fillets, etc.—was presented by the company to the

* The quantity of mortar used in laying bricks varies in different countries. Much, of course, depends upon the form of the brick. If they are warped or curved; if, as is generally the case even with pressed brick, the corners "droop," the thickness of the bedding must be sufficient to permit an average adjustment in the course to a level surface. In coarse work in France the ratio in volume of the joints or mortar to the whole mass of masonry is, as 17 or 18 to 100. But in finer work, where a better quality of mortar or plaster is used, the ratio is reduced to 10 or 12 to 100.

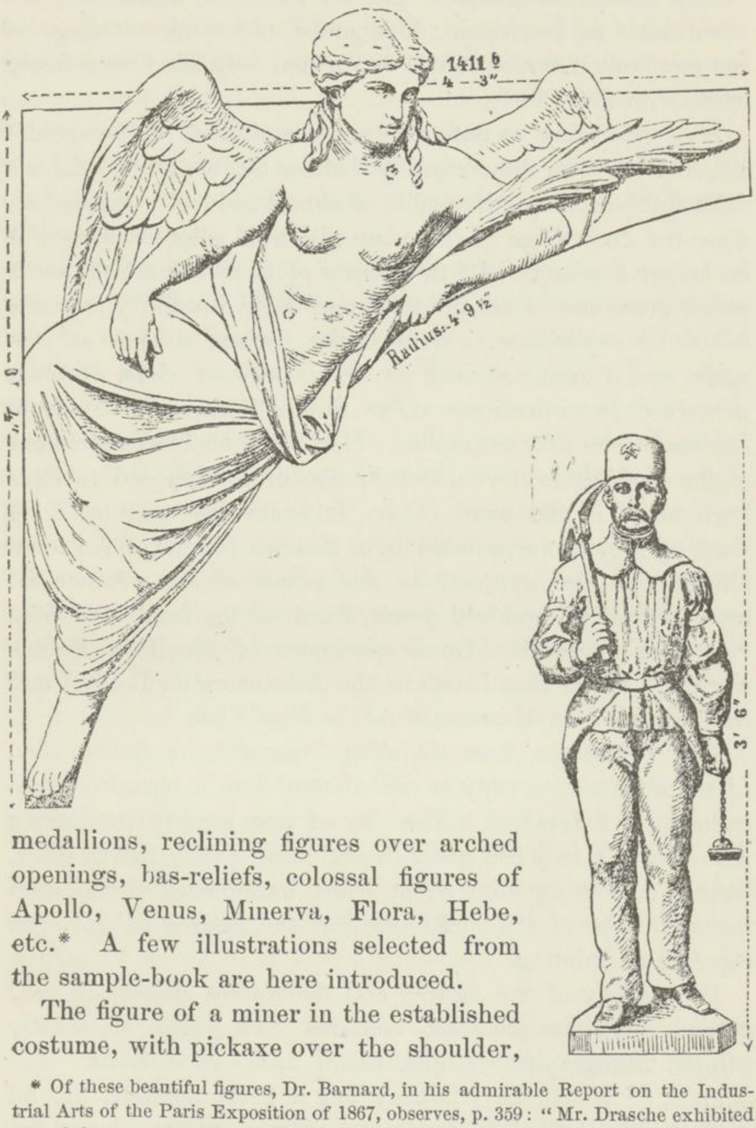
United States Centennial Commission for exhibition in 1876, and to be afterwards deposited in the Permanent Museum.

The enamelled plaques, panels, pilasters, and fillets are beautiful. In the façade, door-jambs and window-casings of the new university buildings in Vienna, they have been freely used, with fine effect.

It is gratifying to note this modern revival of the ancient art, kept alive in the sixteenth century by the genius of Luca della Robbia, and now capable of almost indefinite expansion, since the knowledge of the composition of colored enamels is no longer a secret. Of the beauty of such enamelled terra-cottas there can be no question, and their durability is established by experience. Witness the ancient enamels of Assyria and Egypt, as well as the works of della Robbia, preserved in collections. The South Kensington Museum has more than fifty examples. One of the choicest specimens is the medallion, eleven feet in diameter, supposed to have been made in the year 1453. It bears the arms of King René of Anjou, surrounded by a massive border of fruit and foliage. It was exposed to the action of the weather for more than four hundred years, fixed in the front wall of a villa near Florence. Good specimens of the della Robbia ware are to be found also in the Athenæum in Boston, and the Metropolitan Museum of Art in New York.

The terra-cotta ware, building ornaments, majolica, etc., of the Vienna Company is manufactured in a separate establishment at Inzersdorf. The clay of that locality produces a ware that not only has great strength and resists the weather, but has a pleasing stone color, which harmonizes so well with the usual tone of the buildings that the figures do not need coloring or painting.

The variety of the figures and decorative objects is very great. The sample-book contains 242 pages of closely printed lithographic designs, about 2,000 in number. The models, of which the company has a great number, are all made from drawings by the most eminent architects, and are exquisite in design. The possession of such a stock of patterns insures, practically, a monopoly of the business. A large proportion of the decorative figures seen in the façades of the splendid buildings adorning the Ring Strasse and over the arched portals is from this establishment. The list comprises a great variety of brackets, consoles, capitals, balusters,

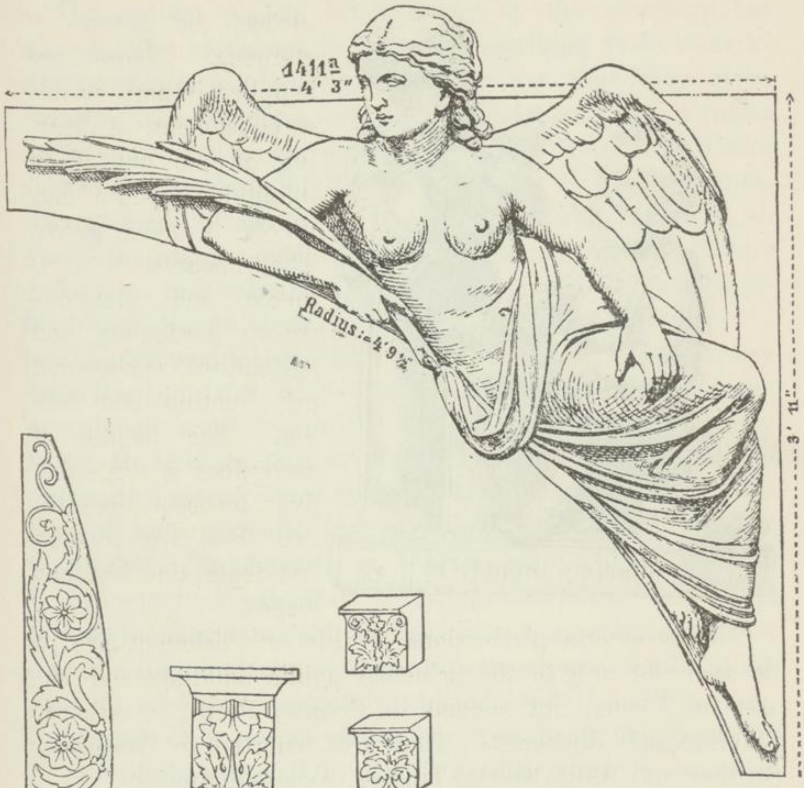


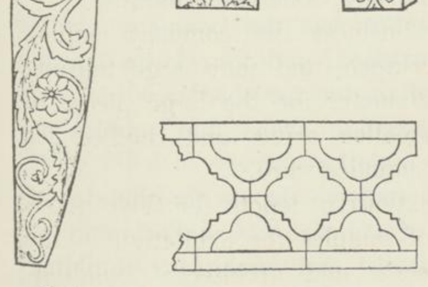
medallions, reclining figures over arched openings, bas-reliefs, colossal figures of Apollo, Venus, Minerva, Flora, Hebe, etc.* A few illustrations selected from the sample-book are here introduced.

The figure of a miner in the established costume, with pickaxe over the shoulder,

* Of these beautiful figures, Dr. Barnard, in his admirable Report on the Industrial Arts of the Paris Exposition of 1867, observes, p. 359: "Mr. Drasche exhibited one of the most attractive collections of bas-reliefs statues, vases, architectural and other ornaments in the Exposition, all of them formed in terra-cotta. His display was as remarkable for the great number of beautiful objects which it contained as for the taste with which they had been designed. They were bought up by visitors with eagerness, and only a few weeks had elapsed after the opening of the Exposition before nearly every object in the whole collection bore the mark, which in all quarters grew more and more familiar every day, 'sold.' All these beautiful productions were baked in the Hoffmann furnaces of Mr. Drasche's establishment."

lamp in hand, and the leather apron behind. This is made of two sizes: the smaller being one foot two inches high,





the other three feet six inches, and both suitable as ornaments in mining-schools, museums and residences. There are also figures in similar style typical of agriculture and forestry.

Suits of armor, in a dozen or more different styles, are produced for the exterior decoration of the gateways of castles or vestibules and halls in the interior. Being practically indestructible by the weather, they can be freely exposed. It would be easy, if desired, to cover such groups for interior decoration with metallic paints or bronze-powders, in imitation of steel or iron.

The arched entrances to the Vienna buildings, leading into the interior courts, afford suitable places on either side, in niches, for groups of statuary. These are supplied in part by this establishment. A drawing of one out of an inimitable group of four pieces is here given. They represent commerce and manufactures, gardening and agriculture, science and art, hunting and fishing. The height of each piece is three feet five inches; breadth, two feet five inches; and depth, one foot four inches.

The terra-cotta productions of this establishment are to be seen not only in the principal public buildings and palaces of Vienna, but abound in Prague, Pesth, in Athens, Smyrna and Bucharest. They are exported to Germany, Switzerland, Italy, Russia, Turkey, Asia and America.

In this branch of their business the company employ three hundred and fifty workmen, and four large burning ovens twenty-two feet in diameter for the large pieces of terra-cotta ware, besides smaller ovens and muffles for burning-in the colors of the majolica ware.

The company have two extensive depots for their goods in Vienna, besides a stock of samples for exhibition in the lower story of the engineer's and architect's building. The transportation from the works is by railways, canals, and common roads. There are also local tramways, upon which horses are used. There are about nine hundred horses belonging to the company.

Vienna Brick Manufacture.

The nature of the brick made by the company has already been explained in part, in describing their remarkable exhibition. It is sufficient to say that they make almost every standard form of brick, for corners, cornices and arches, similar to those made by the Rennberg Works in Berlin, of which a full suite of figures is given beyond. The glazed and enamelled bricks appear well, and will, no doubt, be largely used in exterior and interior decoration; and, also, for walls of dairies, kitchens, stables, and similar places, the walls of which require washing.

The manufacture of bricks and tiles in the Vienna valley undoubtedly dates from the occupation by the Romans, seventy years after Christ. Excavations in the old city bring to light quantities of bricks, of various sizes and forms, and among them those of Roman make, bearing the date of xiii. (*gemini*) and x. *(pro fidelis)* Legions. The collections of antiquities at Vienna contain many of these bricks remarkable for their perfect preservation, every angle and line being as sharp as when they were taken from the kiln.* They are generally thin compared with their breadth, and are of large size and red color.

The excellent quality of the bricks made by this company is sufficiently attested by the large constructions in which they have been used, and without change after long exposure. In 1851, 20,000,000 bricks were furnished under contract to the Semmering tunnels for the railway, and another contract for 40,000,000 for the public works at Vienna was being filled at the same time. The following named well-known edifices are constructed of these bricks: The Imperial and Royal Arsenals (very large structures, wholly of red brick), the Greek Church, Synagogue, Protestant School, the Chemical Laboratory of the new University, and the Austrian Museum of Art and Industry.

* The most interesting of these collections is perhaps that in the fourth cabinet of the Q. & R. Medals and Antiquities, Petit-Belvédère. The greater portion of these bricks were found at Vienna and at Petronell. Some of them bear the mark VINDOB (onæ) and KAR (nuntum). In this collection there are two tile-like bricks from Bagdad, impressed with cuneform characters of the time of Nebuchadnezzar, seventh century B. C. Size, 12 by 13 by 3 inches.

The clay is found in inexhaustible quantities stratified in beds of the tertiary epoch, ranging from five to sixty feet in thickness. Some of these beds contain fine silicious sand, and others a small portion of lime. Some give light yellow, or cream-stone-colored bricks, and others red colored.

The usual size of the Vienna brick is 11 inches long, $5\frac{1}{2}$ broad, $2\frac{1}{2}$ thick, $= 290 \times 140 \times 65$ millimetres, being considerably larger than ours.

The strength of these bricks has been carefully ascertained by a series of experiments conducted by Professor Rebhau of the Polytechnic Institute, Vienna, and by Prof. J. Bauschinger of the Mechanical-technical Laboratory in Munich.

Resistance of Vienna Brick to breaking strain.

[Experiments by Professor F. Rebhau.]

Description of the bricks.	Breaking with a load of zoll (inch) pounds.	Coefficient of Resistance.	
		Kilos per one square c. m.	Zoll (inch) pounds per one square inch.
Common, ...	1,419	42	603
Common arch brick, ...	2,417	52	737
Ordinary wall brick, ...	2,255	65	925
Red brick, ...	1,711	50	708
Yellow, ...	2,875	84	1,187
Machine made, ...	1,662	49	692
Machine made, hollow, with two holes, ...	1,785	54	766
Machine made, hollow, with three holes, ...	1,812	84	1,194
Hollow machine made arch brick with sixteen holes, ...	1,307	39	554

Tabular statement of the resistance to crushing of the bricks made by the Vienna Company.

[Experiments made by Professor J. BAUSCHINGER.]

NAME OF THE LOCALITY AND DESCRIPTION OF THE BRICKS.	Crushing load per brick in tons of 1,000 Kilos.	STRENGTH IN—	
		Kilos per square c. m.	Zoll (inch) pounds per one square inch.
Wienerberg.			
a. Ordinary hand-struck, . . .	77.5	188	2,613
b. Ordinary machine, ...	100.0	230	3,197
c. Ordinary wall brick, . . .	77.0	183	2,544
d. Yellow wall brick, ...	80.0	205	2,850
e. Yellow machine wall brick, . .	100.0	230	3,197
f. Red wall brick, ...	81.0	200	2,780
g. Red, ...	85.0	195	2,711
h. Ordinary arch brick, . . .	48.0	125	1,738
i. Porous arch brick, ...	10 0	27	375
k. Machine brick with three holes, .	19.5	50	695
l. Machine arch brick with three holes,	5.5	19	264
m. Clinker, ...	53.0	240	3,336
Vösendorf.			
Ordinary hand-struck, ...	74.5	180	2,502
Leopoldsdorf.			
Ordinary hand-struck, ...	71.0	175	2,433
Laaerberg I.			
Ordinary hand-struck, ...	96.0	236	4,281
Laaerberg II.			
Ordinary hand-struck, ...	76.5	196	2,725
Laaerwald.			
Ordinary hand-struck, ...	64.0	158	2,196
Guntramsdorf.			
Ordinary hand-struck, ...	65.0	162	2,252
Biedermannsdorf.			
Ordinary hand-struck, ...	78.0	200	2,780
Hernals.			
Ordinary hand-struck, ...	62.0	158	2,196
Ordinary machine, ...	90.0	205	2,850

The company published, in connection with their costly exhibition, a descriptive pamphlet, giving a short historical résumé of the brick and tile manufacture in Vienna, the origin of the company, and the extent of its operations.* It is illustrated by maps and sections, and is altogether a most commendable contribution to the history of the industry in Vienna, and worthy of imitation by all wealthy corporations when, as in duty bound, they participate in great international exhibitions.

The great Vienna brick and tile company, as now organized, is based upon the union of several extensive establishments, dating back to the time of Maria Theresa, and before it, and conducted in succession by Miesbach and by Drasche. In 1851 the works of the Wiener-berg occupied an area of $264\frac{3}{4}$ English acres, while an area of 680 English acres supplied the clay. There were 24,930 feet in length of drying sheds for the manufacture of ordinary bricks, and 8,304 feet of moulding sheds for tiles, facing and ornamental bricks, with 43 kilns, calculated to burn 45,000 to 110,000 bricks per kiln, or 3,500,000 at one time. Six establishments at that time had a united production of 91,900,000 bricks annually; the Wiener-berg alone producing 65,500,000. There were 649 moulding benches, and 4,140 persons employed.

The present organization was effected in March, 1869, under a nominal capital of 7,000,000 florins (equal to 3,500,000 dollars), in 35,000 shares, at 200 florins each. Between 6,000 and 7,000 workmen are employed, besides 58 officers, 36 machinists and foremen. There are eight large establishments, where the bricks and tiles are made, viz.:—

1. Inzersdorf Wienerberger, the largest of all, in six sections; 2. Hernals; 3. Laaerberge; 4. Laaerwald; 5. Leopoldsdorf; 6. Biedermansdorf; 7. Guntramsdorf; 8. Vösendorf,—all in the vicinity of Vienna. The total area devoted to the manufacture is 882 joch, 65 square klafters, equivalent to about 1,254 acres. The annual production of the works is enormous. In the four years from the organization of the company to the end of 1872 the production and sale were as follows:—

* Die Wienerberger, Ziegelfabriks und Bau-Gesellschaft zur zeit der Wiener Weltausstellung, 1873. Wien, 1873. Selbstverlag der gesellschaft, Centralbureau: Wien 1; Elisabethstrasse 6. 8vo., p. 92, with maps and graphic chart.

Annual Production, Vienna Brick and Tile Works.

YEAR.	Production—pieces.	Sold—pieces.
1869, ...	134,674,930	122,117,000
1870, ...	149,457,000	118,512,000
1871, ...	147,549,375	167,418,328
1872, ...	166,849,000	164,313,466

The production can easily be carried to 200,000,000 of bricks annually. These great results are accomplished by the use of labor-saving machinery and furnaces continuously working, on Hoffmann's system, 33 of which are in use. Over one and one-third million hundred-weight of different kinds of brown coal and of coke are consumed yearly.

The receipts, expenditures, and profits are no less remarkable than the production, and are as follows :—

Profits for four years, in Austrian florins.

YEAR.	Receipts.	Expenditures.	Balance—profits.
1869, ...	2,946,548.15	1,917,914.22	1,028,633.93
1870, ...	3,608,467.87	2,558,795.61	1,049,672.26
1871, ...	4,199,500.32	2,769,657.84	1,429,842.48
1872, ...	5,256,335.85	3,119,327.90	2,137,007.95

The company divided per share in—

1869, florins 15, corresponding to annual interest of 15 per ct.
1870, " 15, " " " 12½ per ct.
1871, " 20, " " " 16⅔ per ct.
1872, " 30, " " " 25 per ct.

In addition, there were placed to the credit of the reserve funds, in—

1869, ... 76,870.98 florins.
1870, ... 90,572.34 "
1871, ... 141,153.67 "
1872, ... 259,358.34 "

The projectors and managers of this great enterprise have given special attention to the well-being of their employés. They have organized a pension system, hospitals, schools, and a kindergarten, concerning each of which, full details, with sanitary statistics, are given in the publication before mentioned as accompanying their exhibition, and presented to the international jury.

The establishment, before and since the organization of the company, has been honored by the following prizes or awards: At the Industrial Exhibition, Vienna, 1845, and at Pesth, Hungary, in 1846, the great gold medal; at the London Exhibition, 1851, the large gold medal; at Amsterdam, 1853, the great silver medal; at Munich, 1854, and at Paris, 1855, the large medal; so, also, the large medal at the Exhibition of the *Gartenbau-Gesellschaft*, in Vienna, 1858–1859; the great gold medal at the International Exhibition at London in 1862, and at Paris in 1867; the great prize medal at the International Agricultural Exhibition, Vienna, 1866; the large medal of the Agricultural Exhibition, Mödling, 1871.

Dithmer's Brick and Clay Ware Company.

The Actien Gesellschaft der Dithmerschen Ziegel und Thonwaaren Fabrik, *in Rennberg, Schleswig-Holstein, German Kingdom*, made one of the best exhibitions of plain and ornamental bricks and terra-cotta ornaments, particularly of cornice, coping, moulding and arch brick, for corners of buildings and door and window openings. There were also terra-cotta columns, capitals, pedestals and urns.

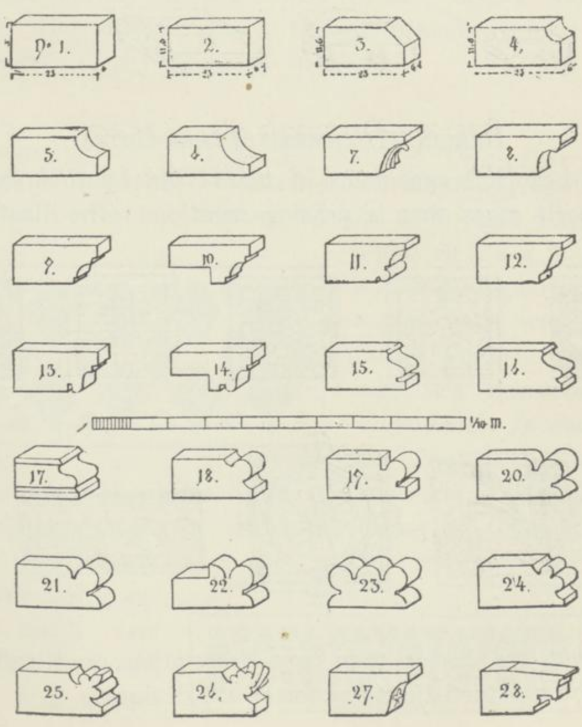
This establishment dates from 1782, and in 1871 produced 65,000 thalers' worth of bricks and ornaments, using 21,550 thalers in value of raw materials. There are four establishments, with 228 workmen and three steam-engines.

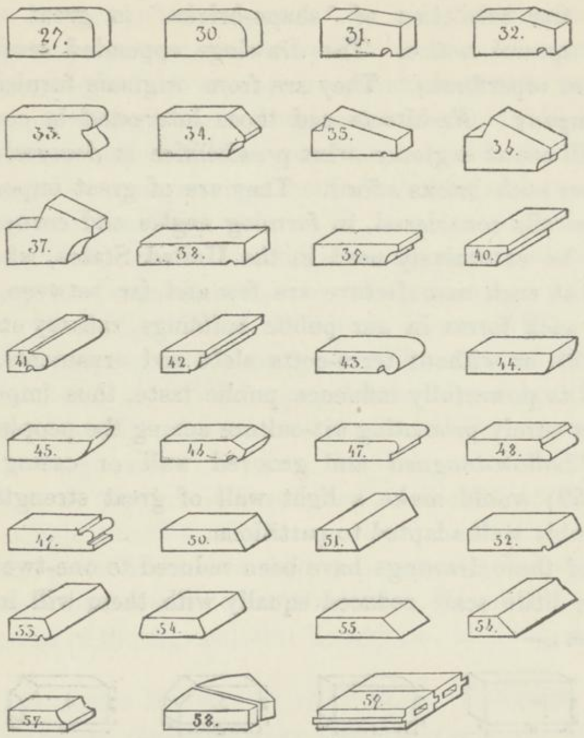
There are three standard colors—yellow, red and gray—in which the various articles are made, but they are also enamelled or glazed, in almost any desired color; but browns, greens, yellow and lilac are the most common. All the glazed bricks shown were perfect in form, with an even coating of color, and seemed particularly well adapted for decorative purposes and for walls where a clean, smooth surface, capable of being washed indefinitely, is desired.

The fine exhibition of "shape-bricks," in great variety, merits special notice. The drawings appended render description superfluous. They are from originals furnished by the company. Architects and those interested in construction will see at a glance what possibilities in decorative construction such bricks afford. They are of great importance, economically considered, in forming angles and corners, and should be extensively used in the United States, where attempts at such manufacture are few and far between. The use of such forms in our public buildings, railway stations, etc., with or without terra-cotta slabs and ornaments, could not fail to powerfully influence public taste, thus imperceptibly but surely promoting art-culture among the people.

The hollow-tongued and grooved wall or casing brick (Fig. 59) would make a light wall of great strength, and is probably well adapted to partitions.

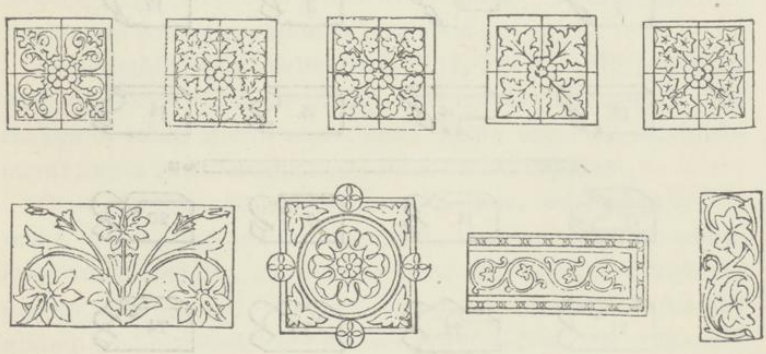
All of these drawings have been reduced to one-twentieth, but the little scale reduced equally with them will indicate the sizes :—





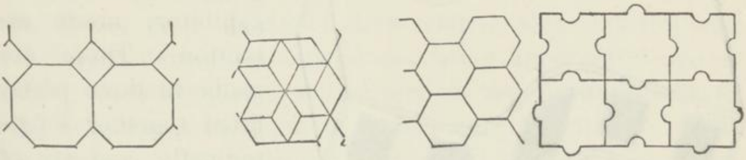
BERLIN—DITHMER'S TERRA-COTTA.

The beautiful specimens of terra-cotta by this exhibitor also merit more than a passing mention. The illustrations



presented are better than any description, and suffice to show the high artistic character of the designs.

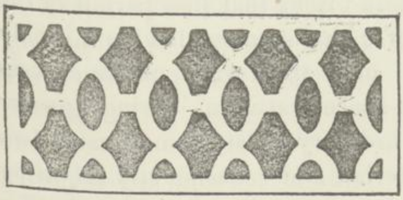
The following drawings show the forms in which the company manufacture paving tiles of excellent quality, far better than the ordinary paving brick in common use in the United States, for want of forms better adapted to the purpose.

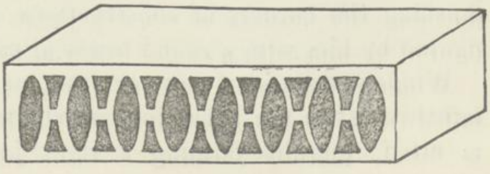


Ringofen-Ziegelei der Stadtgemeinde, *Troppau.* This establishment exhibited in the Austrian court a series of remarkably smooth and well-formed pressed red brick, and square slabs, and paving tiles. The latter were both yellow and red, in hexagons, about eight inches across; and in rhombs, same size, and two and a half inches thick. A fine effect is produced by laying the two colors alternately. The large slabs were twelve inches square and three inches thick. A variety of angle and cornice bricks were also shown. The ordinary brick shown measured about $11\frac{3}{4}\times 6\times 3$ inches, or say $12\times 6\times 3$ inches.

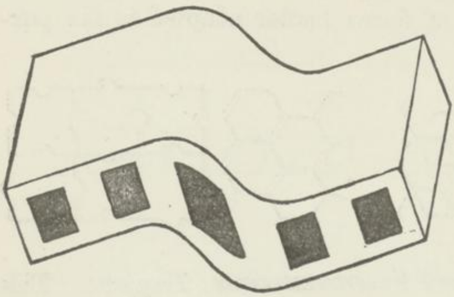
Perforated Brick—*England.*

George Jennings Poole, *Dorset*, *England*, exhibited a variety of perforated bricks, red and of a light gray color, about $9\times 3\times 2$ inches, and some square slabs 9 inches each way and 2 inches thick. The openings are numerous and ornamental, as shown in the annexed cuts, and extend through the brick from side to side. These bricks are evidently made in machines similar to those used for drain tiles. They are very light, require much less material than solid brick, and appear





to be strong. Some perforated curved bricks like the figure, $16 \times 4 \times 2$ inches, were also in the collection.



Curved channel tiles for open drains or gutters, by the same exhibitor, merit attention. These are made in three parts, fitted together longitudinally, and are of several sizes, all of them with large openings in the body, effecting a great saving of material and giving lightness and strength.

Dovetailed Bricks.—*France.*

Mr. E. Pavy, of *Chateau du Claveau*, near *Mézières-en-Brenne (Indre)*, France, exhibited a novel invention, for which he has taken out a patent in France, consisting of bricks formed with dovetailed recesses in each end, so that two bricks may be locked together by a third piece which fits into the two opposite openings.

The dimensions of the ordinary bricks are stated as $0^{m}.25 \times 0^{m}.12 \times 0^{m}.06$, which is about $9\frac{3}{4} \times 4\frac{3}{4} \times 2\frac{3}{8}$ inches. The locking-piece or dovetail is about five inches long.

The inventor claims for these bricks that they permit of the rapid construction of walls of a single course having not only lightness but great strength; or of thick walls, of two courses of the brick, with an air-space between, giving greater strength than is obtained in ordinary constructions using two or three times as much material, and consequently requiring more carting, more time, labor and expense. The circular brick are designed for round towers and chimneys, and appear to be favored by the exhibitor as an attractive mode of finishing the corners of constructions, an ideal house being figured by him with a round tower at each corner.

Window frames of oak, or iron, are made with a dovetailed recess in the sides, into which the small locking-piece is fitted, thereby forming a tight joint and holding the frame firmly in its place. For rectangular buildings, without towers at the corners, angle bricks are specially made.

The inventor claims that the circular brick are especially valuable for towers, tall chimnneys, light-houses, reservoirs for grain and for water conduits, cisterns, tubs for distillers, dyers, etc. Some of these claims seem fanciful and not duly sustained by experience, being apparently suggestions. For example, a tall cistern is represented, built to hold five metres in depth of water, and warranted to resist the pressure. The walls are double and connected at intervals with tie-bricks, leaving an air-space between. The bottom is to be of sheet iron "three to five millimetres" in thickness, with the edges turned up so as to hold the lower course of bricks and to prevent the iron from drawing in by sagging.

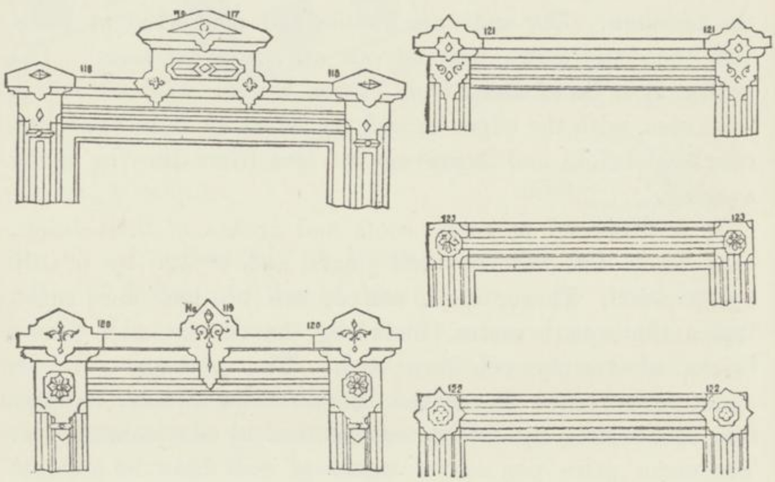
It is proposed to make roofs and arches of these brick, each brick with six dovetail joints, and $0^{m}\cdot320$ by $0^{m}\cdot190$ by $0^{m}.060$. These, it is stated, can be laid for seven francs the square metre, including the cement and fifteen bricks at twenty centimes each. The average price is about seventy-five francs the thousand for bricks, twenty-five centimetres by twelve centimetres by six centimetres. The mean price per square metre of wall built of a single thickness of brick $0^{m}.14$ thick, is stated to be nine francs seventy-five centimes; and of a square metre of double wall with bricks $0^{m}.075$ broad, fourteen francs.

There was no opportunity of verifying any of these statements, and no references were made to any constructions made in this manner.

Terra-Cotta from India.

The Madras School of Art sent forty-two terra-cotta casts of Hindoo temple ornamentation, consisting of ornamental pillars, scrolls, running and border ornaments, perforated panels, circular and star patterns, all of great interest to art, and, at the same time, good examples of the ease of reproducing architectural designs and details in terra-cotta.

Chicago Terra-Cotta Company, *Chicago*. This establishment has, for the past eight years, been engaged in the manufacture of terra-cotta building ornaments, vases, pedestals, statuary, etc. The market for the architectural pieces is very large, they being used in the erection of public and private buildings all over the West. They are sent as far south as Texas, west to Salt Lake, and as far north as the railways extend. The demand is constantly increasing and with every prospect of its continuing to increase, for in many parts of the West stone is very scarce,



and it is too costly to transport it great distances. The terra-cotta ware being hollow and light, bears the cost of transportation to almost any required distance. Again, where stone is found it costs more to work it than to pay the cost and transportation of the terra-cotta. It has become, to a great extent, a building necessity. In Chicago there are miles in length of fronts ornamented with the terra-cotta work of this establishment. During the summer of 1873, about $40,000 worth of trimmings were furnished to the new Illinois State House, in Springfield, consisting chiefly of dormer windows, balustrades, and open tracery work. The above illustrations show some of the styles of window-frames. Much of the work in Chicago and the larger cities is produced from designs furnished by architects, and specially adapted to some particular building, but the company has a large stock of moulds from which it is not difficult to select objects suitable for most of the smaller constructions, thereby saving a considerable item of cost for new patterns. The superintendent of the works (Mr. Taylor) was formerly employed in the works of Mr. Blashfield, Stamford, England. This establishment exhibited largely, and with great credit, at the Paris Exposition in 1867, and is making the ornaments for the Art Museum now building in Boston.

Refractory Bricks, Retorts, Crucibles, etc.

In refractory materials of all kinds, for construction of furnaces and various metallurgical purposes, the Exhibition was particularly rich. The amount and variety of such goods were far greater than at Paris in 1867, and there was a notable advance in the art, especially in the production of special forms of large dimensions, and the increasing use of them in the construction of furnaces. Attention may be directed to the exhibits of fire-brick for the hearths and crucibles of blast-furnaces and for the stack complete, which are now being made at several establishments at very moderate prices. The formation of tubes and retorts of superior density and strength, by hydraulic pressure, is also worthy of attention.

H. J. Vygen & Co., *Duisburg*, *Rhein-prov. Deutsches, Reiches*, exhibited fire-brick and blocks for blast-furnaces, cast-steel melting furnaces, reheating furnaces, gas-retorts, and for smelting purposes generally. The plumbago-pots for cast-steel from this establishment are formed as in the annexed outline, and stand about two feet high.

These works were founded in 1856. The value of their products in 1871 was 200,000 thalers for 360,000 cwt. of goods, being the heaviest production of large pieces in Germany. There are 266 workmen employed, and 3 steam-engines of 130 horse-power.

C. Kulmiz, *Marienhütte*.—Fire-bricks and fire-clay, gas-retorts and drain-tiles were exhibited by this firm. The value of their products in 1871 was 150,000 thalers, and, in addition, they raised 370,000 cwt. of fire-clay. Employ 345 workmen and 4 steam-engines.

STEINBERGER GEWERKSCHAFT, *Grossalmerode bei Cassel, Deutsches, Reiches*, exhibited fire-brick and slabs for blast-furnaces. The production of this company in 1871 was 35,000 cwt. of clay and 54,000 cwt. of fire-brick, worth 30,500 thalers. One hundred and thirty-one workmen, and two steam-engines. The samples of tuyeres for Bessemer converters appeared to be excellent in quality. The largest, with nine holes, were 20 inches long and 5 inches in diameter at the small end.

SMAL-SMAL & CO., *à Andennes (province de Namur), Belgium*, exhibited fire-brick and flags for the hearths and crucibles of blast-furnaces and for a furnace complete; also, bricks specially adapted to the needs of steel-works, glass-works, and zinc-works. The blast-furnace brick were specially interesting, and they are supplied at the following rates per ton (1,000 kilogrammes), loaded upon cars at Andennes :—

Bricks	for the	hearth and crucible,	75 francs.
"	"	boshes, . .	65 "
"	"	interior lining, .	55 "
"	"	outer casing, .	50 "
"	"	a furnace complete,	65 "

Slabs or tiles, for the bottoms of soda-furnaces, are supplied at 80 francs, and other fire-brick, for steel-works, glass-works, puddling furnaces, etc., at 40 francs the ton (about $8 gold). Crude and calcined clay, for the use of glass and zinc works, is sold at from 14 to 28 francs the ton.

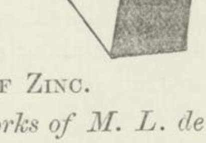
SOCIÉTÉ ANONYME DES TERRES PLASTIQUES ET PRODUITS REFRACTAIRES, *d'Andennes, lez-Namur. Directeur gérant:* M. FRANCOIS BERTRAND.—This establishment made an extensive display of retorts, cylinders, and of bricks for condensation chimneys for acid works; bricks for Siemen's furnaces, Bessemer converters and high furnaces. The following is a short description of some of the principal objects, with the prices per piece, or per ton :—

Retort, $3^{m.}12$ long × 0.66 × 0.40, weighing 810 kilog. = 1,620 lbs.; price, 100 francs = $20. Retort, $2^{m.}75$ × 0.545 ×0.315, weighing 560 kilog. = 1,120 lbs.; price, 70 francs. Refractory bricks, for the crucible and boshes of blast-furnaces; price, 65 francs per 1,000 kilos = per ton. Bricks for rolling mills, Siemen's furnaces, Bessemer steel-works, coke-ovens, etc., at 35 francs per 1,000 kilos. = about $7 per ton. Bricks—"artificial sandstone"—for chimneys and towers for the condensation of acids, at 50 francs per 1,000 kilos. *Cascade denitrante*, in artificial sandstone, at 130 francs per piece. Cylinder, in artificial sandstone, with bottom, $1^{m.}05$ high × $1^{m.}00$ in diameter, for condensing acids, at 85 francs per piece. Cylinder, in artificial sandstone, without bottom, $1^{m.}00$ × $1^{m.}00$ in diameter, for condensing acids, at 65 francs each.

This company also make a specialty of supplying furnaces and metallurgical establishments with refractory materials of the best quality, at the following rates: For glass-works' pots, crucibles, etc., 15 and 18 francs per 1,000 kilogs. Calcined earths for crucibles, at 28 to 35 francs. Calcined quartz, at 20 francs per 1,000 kilogs.

The establishment was founded in 1856, and it has received awards at several of the great exhibitions.

Tongued and Grooved Fire-Brick.



A novelty, in the form of tongued and grooved fire-brick, was seen, but the exhibitor's name was not obtained. The annexed outline will give an idea of the form.

Retorts for the Distillation of Zinc.

N. J. Dor, *Director of the mines and works of M. L. de Lamine, à Ampsin près Huy (province de Liége)*, exhibited improved crucibles for the distillation of zinc, made under hydraulic pressure, in a machine specially designed for the purpose, invented by the exhibitor. This machine has been in operation for five years at the works of M. de Lamine, and similar machines are used at Vielle-Montagne and other establishments. The crucibles made in this manner are remarkable for their superior density, compactness, freedom from flaws, and their cheapness,—the machine effecting a great saving over hand-labor. The appearance of the crucibles justifies these claims for excellence. The details of the machinery, as shown by working-drawings, were highly interesting, and are suggestive of much that may be accomplished in the art of forming clay ware by the use of hydraulic power.

Fire-Bricks and Clay—England.

An interesting report on the fire-clay goods of the London International Exhibition of 1871, was made by Lieut. Grover, R. E. He states that the trade in English products of this class has marvellously increased in the past thirty years. Over 30,000,000 of fire-bricks are annually made at Stourbridge, instead of 14,000,000 as formerly. Newcastle produces 80,000,000 instead of 7,000,000. The export trade increased sixfold since 1862.

The celebrated Stourbridge clay, obtained about twenty miles south-west of Birmingham, is dug from shafts in the coal measures, generally below three workable seams of coal, and between marl, or rock, and an inferior clay. The seam averages three feet in thickness. The middle portion is selected. After hoisting to the surface, the clay is sorted by women, the best lumps, or kernels, being laid aside for glass-house pots. This selected clay costs fifty-five shillings a ton. Ordinary fire-clay costs, at the same place, only ten shillings a ton. About four tons are required to make a thousand nine-inch fire-bricks. The clay is mined over an area of about nine square miles, and there are about a dozen establishments.

The percentages of the important ingredients of the Stourbridge clays are shown in the following analyses made by Mr. F. A. Abel, F. R. S., chemist to the War Department, England :—

Analyses of Stourbridge Clay.

	Silica.	Alumina.	Peroxide Iron.	Alkalies, loss, etc.
1, ...	66.47	26.26	6.63	.64
2, ...	65.65	26.59	5.71	2.05
3, ...	65.50	27.35	5.40	1.75
4, ...	67.00	25.80	4.90	2.30
5, ...	63.42	31.20	4.70	.68
6, ...	65.08	27.39	3.98	3.55
7, ...	65.21	27.82	3.41	3.56
8, ...	58.48	35.78	3.02	2.72
9, ...	63.40	31.70	3.00	1.90

Lieut. Grover very justly points out "that the infusibility of any substance depends not merely upon the chemical nature of its constituents, but also upon the manner in which those constituents are combined with one another. For example, granite *per se* is infusible at ordinary high temperatures, whilst pounded granite can be readily melted by the same degree of heat. Thus it would seem that a porosity in structure, brought about by a coarseness of elementary particles, would enhance the chemical infusibility of a material; and that in fire-clay goods a close uniform structure, though pleasing to the eye, is not favorable to their refractory powers, since the component particles should have a facility for contraction or expansion under high temperature, and the air cavities act as valuable nonconductors of heat. Hence it will be evident that to determine accurate conclusions respecting these wares, a fire test is as essential as chemical analysis."

Hollow Brick.

Much attention has of late been given to the manufacture of hollow brick, to enclose air-spaces between the interior and exterior surfaces of walls, so as to exclude dampness and secure greater warmth. This is of great importance, and especially where "furring off" the wall is avoided, as it should be for many good reasons. But the great cause of dampness, and consequent great conducting power of walls, is not likely to be avoided by even hollow brick of the best construction, unless access of water to the outside and the foundations is prevented by impervious materials. The capillary power of raising water in walls is well known, particularly in Paris, where dampness has been observed to rise thirty-two feet above the foundations. Long, driving rains fully saturate brick walls and chimneys, and exudations of water are found inside of dwellings about chimneys where no leak can be discovered. The capacity of absorption of water by bricks is probably not less than a pint to each one. Mr. Chadwick, in his "Report on Dwellings for the Poor," says that in England common bricks absorb as much as a pint or pound of water; and supposes a case of a cottage wall consisting of twelve thousand bricks, which would be capable of holding fifteen hundred gallons, or six and a half tons of water when saturated. To evaporate this would require a ton of coal. Sandstone and granite also hold quantities of water in their pores. Prof. Ansted states that granite, in a dry state, is rarely without a pint and a half of water in each cubic foot. Sandstone may contain half a gallon, and loose sand two gallons.

The absorptive capacity of bricks varies with their density, depending upon the process of manufacture. This has been shown by Cyrus Chambers, in experiments upon bricks made by the machine of his invention and on hand-made bricks, the results of which are given in the annexed table :—

Table showing the Percentage of Water absorbed by various Bricks after Thirteen Days' submersion.

Number.	Degree of Burning.	Locality of Clay.	The Process of Manufacture.	Weight in pounds and ozs. before submersion.	Weight in pounds and ozs. after submersion.	Gain in weight in ounces.	Percentage of whole weight gained.
1	Hard, . .	Pea Shore, N. J., .	Chambers' machine,	5 0	5 2	2	2.5
2	Dark, . .	" " " .	" "	4 15	5 7	8	10.12
3	Light, . .	" " " .	" "	4 14	5 10	12	15.4
4	Salmon, .	" " " .	" "	4 14	5 12	14	17.95
5	Very hard,	" " " .	Hyd. Press, 600 tons pressure, . .	2 4	2 6	2	*5.55
6	Dark, . .	" " " .	Dry Press, . .	4 13	5 7	10	13.
7	Salmon, .	" " " .	Dry Press,† . .	2 8	3 1	9	22.5
8	Dark, . .	Hestonville, Phila.,	Chambers' machine,	5 3	5 15	12	14.46
9	Dark, . .	" "	" "	5 5	6 3	14	16.47
10	Light, . .	" "	" "	5 3	6 0	13	15.66
11	Salmon, .	" "	" "	5 8	6 8	16	18.18
12	Salmon, .	" "	Hand, . . .	4 8	5 8	16	22.22
13	Light, . .	" "	" . . .	4 10	5 8	14	18.91
14	Hard, . .	" "	" . . .	4 12	5 8	12	15.78
15	Salmon, .	Neck, Phila., . .	" . . .	4 8	5 7	15	20.83
16	Light, . .	" " . .	" . . .	4 13	5 9	12	15.58
17	Hard, . .	" " . .	" . . .	4 11	5 2	7	9.33
18	Hard, . .	" " . .	" . . .	4 10	5 3	9	12.16
19	Dark, . .	Hudson R., N. Y.,	Hall's machine, .	4 3	4 6	3	4.47
20	Light, . .	" " "	" " .	4 2	4 12	10	15.15

* This brick, in the process of manufacture, was submitted to a pressure under a hydraulic press of 121,695 pounds to the square inch.

† This brick was made by the *dry-clay* process, of the same clay as No. 1, and was exposed one winter to the action of the frost, and had partially fallen, none of the angles being left.

This shows a gain in weight of from two to sixteen ounces, or from $2\frac{1}{2}$ per cent. to $22\frac{1}{2}$ per cent.

The capillary power of bricks is such that even if made hollow in the best manner, the inner surface must become as fully saturated with water as the outer; and there is no remedy except to protect the outer surface by an impervious glaze, or enamel, or to thoroughly isolate the inside wall, or layer, from contact with the outer. Even headers, or tie-bricks, at intervals, serve to convey the moisture and destroy the efficacy of a hollow wall.

Sizes of Bricks.

There was a variety of sizes of bricks shown at Vienna. In general, they are broad and not thick. In the United States there is no standard size. In the Eastern States bricks are short, narrow, and very thick. The latter make a wall thick enough to pass inspection, while the thickness promotes rapid laying. As a general rule the dimensions increase in breadth and length southward, and decrease in thickness. For example, a Boston brick is about $2\frac{1}{2}$ by $3\frac{1}{2}$ by $7\frac{1}{2}$ inches. In Valparaiso, Chili, they are made $1\frac{1}{2}$ by 10 by 18 inches. Cuban brick are about $3\frac{1}{2}$ by 6 by 13 inches. New Orleans, $2\frac{3}{4}$ by $4\frac{3}{8}$ by 9 inches. Philadelphia (common) are usually about $2\frac{1}{8}$ by 4 by $8\frac{1}{2}$ inches.

A Philadelphia brick contains about 85.6 cubic inches of clay. A Boston, or a Hudson River brick, contains about 69.12 cubic inches; therefore, twenty-five thousand (25,000) Philadelphia bricks have the volume of thirty thousand nine hundred and thirty-two (30,932) of the Eastern bricks.

M. Paul Bonneville, in his Report upon the Bricks and Tiles of the Paris Exposition, 1867, gives the following table showing the—

Dimensions of Bricks of several Countries.

LOCALITY.	Length.	Breadth.	Thickness.	Volume.
	m.	m.	m.	c. c.
Burgundy,	0.220	0.110	0.060	1,452
Montereau,	0.220	0.110	0.055	1,331
Larcelles, red, largest,	0.220	0.110	0.050	1,210
Larcelles, red, seconds,	0.190	0.100	0.045	940
"Country brick," Paris,	0.220	0.110	0.050	1,210
"Country brick," Paris,	0.220	0.100	0.060	1,320
Flemish,	0.210	0.110	0.047	1,085
English,	0.250	0.110	0.060	1,650
English,	0.238	0.115	0.077	2,107
English,	0.254	0.124	0.076	2,400
Holland,	0.260	0.120	0.054	1,684

Experiments made upon French brick show that the resistance to breaking strain ranges from eight kilogrammes the square centimetre for ordinary soft brick, to twenty kilogrammes for brown Burgundy bricks, which will also bear one hundred and ten to one hundred and fifty kilogrammes before crushing.

Brick-Making Machinery.

Space and time both prevent the consideration of this subject in detail, permitting only brief notices of some of the machines.

The two principal types are the piston machines, and those for continuous delivery through dies of the size and form of the section of the brick. Of the former there was an example in the United States section, and of the latter in the Austrian.

Gregg's Excelsior Brick Press.—The celebrated brick press, invented by William L. Gregg, of Chicago, and which was honored with a prize medal at Paris in 1867, was exhibited in model. This invention, which has been improved since 1867, is competent to produce fifty-six bricks per minute, or twenty-six thousand to thirty thousand bricks in a day of ten hours. And it is claimed by the inventor that bricks of the lower grades can be made by this machine for less than one-half, and face or front bricks for about one-third the cost of making by hand.

The machine has two sets of moulds, seven in each set, fixed upon a movable table which passes back and forth under a feeder through which clay is forced into the moulds. When filled, the contents receive, in the movement, two distinct downward pressures from a wheel above. The bottoms of the moulds are movable, and are attached to a piston which slides up on an inclined plane as the carriage or table moves out from under the wheel. This forces the bottom of each mould upward, carrying with it the brick, and when all are out of the moulds they are swept off to one side, the empty moulds return under the hopper and the process is repeated. The clay is taken directly from the bank, and is prepared for the moulds by two grinding rollers. From the discharge of these rollers it is elevated to the hopper of the machine.

The rapidity of the production of the moulded clay bricks is not the only great advantage of this system. The clay need not be so wet as is necessary for hand-moulding, and thus a great saving of time in drying results. Hand-made bricks as they come from the moulds must lose twenty-five per cent. of water by artificial drying or spontaneous evaporation before it is safe to burn them, but the machine-made bricks, it is claimed, do not contain more than one-eight this amount of water. This permits expensive sheds and drying floors to be discarded, and renders it possible to manufacture continuously throughout the year.

In Chicago, in 1872, there were some 400,000,000 of bricks made and used, and about half that number in 1873. The clay for the common brick is obtained from the excavations made for docks and slips along the river in the city. Fine front or facing bricks are made from clay procured at Gregg Station, eighteen miles from the city, on the Chicago, Burlington and Quincy Railroad. Brick made from this clay in the Excelsior Press are surpassed in color only by the finer grades of Philadelphia and St. Louis brick, but are as strong as any.

CHAMBERS' CONTINUOUS DELIVERY MACHINE.—There were brick-making machines exhibited, belonging to the class of tempered clay continuous delivery machines, in which the clay, being properly mixed, is forced through a rectangular die in a continuous stream or column of clay, of the breadth and thickness required for brick. From this column of clay, bricks are cut off at proper intervals by wires, stretched in a frame, or by knives. The principle is the same as that of the machine invented and patented in the United States, by Cyrus Chambers, Jr., of Philadelphia. These machines have been in operation for several years, and have produced many millions of brick.

The machine is constructed almost wholly of iron, and is made very strong. It receives the clay direct from the bank, tempers it with water, and forms it into bricks, with well-defined corners, and smooth, straight surfaces, at the rate of from fifty to eighty per minute, or from twenty-five to thirty-five thousand per day for ten hours.

The tempering portion of the machine consists of a strong iron case, in which revolves a horizontal shaft, into which are set spirally, strong tempering knives, or blades of steel, so that, as they pass through the clay, they move it forward their thickness, or whatever distance they may be *set* to do. The clay being stiff, and not having much water on it, is not liable to *slip* before the knives, but is cut through and through, and *thoroughly* mixed; so that by the time it reaches the small end of the tempering case it is ready to be formed into bricks.

On the end of the tempering shaft is secured a conical screw, which revolves in a cast-iron conical case, the inside of which is pitted, checked, or ribbed, so as to prevent the clay from revolving in it, and is chilled, to prevent wearing.

The screw being *smooth* and very hard, the clay slides on it, thus becoming, as it were, a *nut;* the screw revolving, and the clay thus not being allowed to move backward, it *must* go forward.

This operation further tempers the clay, and delivers it, in a solid, round column, to the *forming die*, which is of peculiar construction and form, and so designed as to reduce the round column to a rectangular one, whose breadth and thickness is the *proper breadth* and *thickness* for a brick, while at the same time *the clay is forced into the corners* of the finishing part of the die, so that the angles of the bar of clay are made full, solid and sharp. This column of moulded clay, as it issues from the die, is conducted by an endless belt, supported on rollers, to the cutting device, which consists of a thin blade of steel, secured to the periphery of a wheel, passing through the bar of clay, and being guided by steel plates, so arranged as to move with the clay while the knife is passing through it, and so as to support the under-side and edge of the bar while being cut.

The bricks are then dusted with fine sand, and are conveyed on cars or barrows to the packing-floors or drying-chambers.

One of these machines will make from twenty-five thousand to thirty-five thousand bricks regularly, in ordinary clays, per day of ten hours; or from fifty to eighty bricks per minute.

Messrs. Chambers & Brother made some experiments to determine the crushing pressure of bricks made by this machine out of New Jersey and Philadelphia clays, with the following results:—

Table showing the Pressure different Bricks are capable of sustaining in various positions.

No.	Degree of Burning.	Locality of Clay.	Process of Manufacture.	Position—pressure.	The material between which the bricks were placed.	Number of pounds pressure at which the bricks crushed.
1	Salmon,	Pea Shore, N. J.	C. B. & Co. Machine.	End.	Ash wood.	8,960= 4 tons.
2	Salmon, .	"	"	Edge.	" "	15,680= 7 tons.
3	Salmon, .	"	"	Side.	" "	40,320=18 tons.
4	Light Stretcher,	"	"	Edge.	" "	13,440= 6 tons.
5	Hard, .	"	"	Side.	Cast iron.	134,400=60 tons, without crushing.
6	Salmon,	Philada. Neck.	By hand, .	Edge.	" "	11,200= 5 tons.
7	Light Stretcher,	"	" .	Side.	" "	33,600=15 tons.
8	Hard, .	"	" .	Side.	" "	67,200=30 tons.

The first four experiments were made with the bricks laid between hard ash planks, but the wood crushed and spread out, carrying the edges of the bricks with it, so that the pressure at which they crushed may be considered far under the actual pressure the bricks are capable of sustaining. The last four experiments were made with the bricks between plates of cast-iron, without any cement, or anything between them, the rough, uneven surfaces coming in contact; consequently, they were much more severe than though the bricks had been laid in cement, so as to allow the pressure to be evenly distributed over the whole surface.

Display of Brick Machines at Former Exhibitions.

At the Exhibition in Paris, 1867, several brick machines were shown, and were reported upon specially by M. Paul Bonneaville, Engineer of Arts and Manufactures, with drawings.*

The London International Exhibition in 1871 was particularly rich in all forms of the potter's art and appliances, and the brick and tile machinery of Europe was well shown. It is described in some detail by Peter Bawden, Esq.,† and also by Arthur Beckwith of New York. Salvetat and Ebelmen,

* Etudes sur L'Exposition, Lacroix, VII., 350.

† Official Reports (British) on the London International Exhibition, I., 345.

in their report upon pottery at the Exhibition of 1851, give a very full list of works, publications, and patents connected with brick-making machinery. Those specially interested in this branch of the subject may find in the above-cited authorities the most accurate available information, at least from the European point of view.*

Hoffmann's Furnace.

The great establishment for the manufacture of bricks in Vienna now has thirty-three of Hoffmann's patent "ring-ovens" or annular brick-kilns in use. They are said to mark a new era in the history of the works, effecting a great saving of fuel, and consequently increasing the profits. They are equally applicable to burning brick, lime, earthenware, cement, and gypsum. The inventor states that over one thousand are now in use, and claims to effect a saving of two-thirds of the fuel required by the old methods of burning. Inasmuch as a very good description of the apparatus has been given by Dr. Barnard in his report on the Paris Exposition,† it is sufficient to direct attention to this furnace, which does not appear to have found favor in the United States. One objection given against its use is the greater scale upon which our brick manufacture is conducted. When a kiln of the ordinary form is opened there is room enough for carts and horses to drive in and load with brick of any desired kind,—either hard-burned, pressed, or soft, or "salmon brick." This objection might, however, be readily overcome by making the chambers of greater size.

Clay Pipes.

The manufacture of clay pipes is a branch of ceramic art of no small importance, industrially. The establishment of Messrs. McElroy & Co., in Philadelphia, turns out about a thousand gross of pipes weekly. About twenty different styles are made, ranging in price from 85 cents to $1.35 the gross. A clay of peculiar excellence is required.

* Pottery—Terra-Cotta Stoneware, Fire-Brick, etc. Van Nostrand, 1872.
† Industrial Arts, by Frederick A. P. Barnard, LL. D.

V. Materials for Pottery.

The materials used in the manufacture of pottery were exhibited in several of the sections, notably from Japan. Much more attention has been given abroad to explorations for clays and to their examination chemically, and experimentally in the furnace, than in the United States. Collections are made under government auspices to illustrate and promote the potter's art. The Museum of Practical Geology in London contains very full collections, illustrating the qualities of the clays and plastic strata of Great Britain, selected with a view to their applicability to ceramic manufactures. There are over one hundred and twenty-three localities represented in the series, and each set of specimens contains six examples. They are all arranged in geological sequence, commencing with the newer deposits and ranging downwards.

As already stated in the general survey, there is no lack in the United States of suitable clays for pottery. They are widely distributed, not only in recent deposits along the granite ranges of the country, but in the tertiary and older formations. They result from the gradual disintegration and decay of feldspathic rocks. This decay and softening is seen on a grand scale in the Southern States, but at the North the decayed portions appear to have been removed by the mechanical force of ice. The antiquity of the decomposition and its great extent in past geological ages, has been pointed out by Prof. T. Sterry Hunt, who believes it to have been accomplished in great part by an atmosphere of carbonic acid, aided by warmth and moisture. He connects it with the slow purification of the atmosphere which has been in progress from very early times. The alkalies, lime and magnesia, set free by the decomposition, absorbed the carbonic acid, and carried in solution to the ocean, gave rise to limestones, dolomites and common salt.

In New England the principal known deposits of clay suitable for potters' use, are along the western base of the Green Mountains in tertiary deposits. They have been worked at Brandon, and Monkton, in Vermont. From the former place quantities have been taken for fire-brick and for putting into paper. In Massachusetts, clay is cited as occurring at Northampton, and at Martha's Vineyard. Granular quartz, another important ingredient of the body, is mined in Berkshire County.

The early exportation of samples of clay from the Southern States to England, has been noticed. No doubt extensive deposits of valuable clays exist there. Good clays are found in California.

Extensive deposits of the finest clays for pottery purposes are found at many points in the State of New Jersey, and including the varieties known as fire-clay, paper-clay, and alum-clay, they form a continuous belt extending obliquely across the State from Raritan Bay and Staten Island Sound on the east, to the Delaware River on the west.* The pits dug for these clays are chiefly within areas of no great extent near Woodbridge, Amboy, Bonhamtown, Washington and Trenton, but explorations have shown the existence of other places where they can be dug with profit. They are, in general, overlaid with superficial beds of drift of sand and gravel. The beds are extensively mined, not only for pottery and fire-brick, but for shipment. Large quantities are used in New York, Philadelphia and Boston, for the manufacture of alum. Much of the whitest and purest is sold to the manufacturers of paper-hanging for facing wall-papers. By far the greatest consumption is in the manufacture of fire-brick, especially at Perth Amboy, South Amboy, and at Trenton. In one township, Woodbridge, over fifty thousand tons of clay were raised in 1865.

Fire-sand, moulding-sand, kaolin and feldspar, often occur with these beds of clay and in workable quantities. The materials used for fire-brick consist of about five-eighths raw

* The limits of this belt are defined by the state geologists of New Jersey, as follows: "The northern limit is marked by the outcropping red shale and sandstone of the triassic formation, following an almost straight line from Woodbridge, south-west by Bonhamtown, to the mouth of Lawrence's Brook on the Raritan River; along this stream, nearly to the Monmouth Junction, and thence north of the railroad near Penn's Neck and Baker's Basin, to the Delaware River at Trenton. The southern boundary of this sub-division of the cretaceous formation is not well defined in consequence of the superficial beds of drift which cover it. Near Raritan Bay they are not so thick, and the division line between the plastic clays and the clay marls is accurately located near the mouth of Cheesquake Creek. But towards the south-west the overlying drift is so deep that it is impossible to draw the southern boundary with much certainty."—*Cook, Geol. Rept.*, 1873, *p.* 103.

clay, one-eighth cement, one-eighth kaolin, and one-eighth fire-sand. The "cement" is a burned fire-clay.

In the best New Jersey clays no grit can be perceived when tested between the teeth. Analyses of good specimens show the following ingredients[1] :—

	1.*	2.†	3.‡	4.‡
Silica,	43.20	45.30	46.32	46.29
Alumina,	39.71	37.10	39.74	40.09
Zirconia,	1.40	1.40	–	–
Potash,	.37	1.30	–	–
Lime,	–	.17	.36	.50
Magnesia,	–	.22	.44	–
Peroxide of iron,	.74	1.30	–	–
Protoxide,	–	–	.27	.27
Water,	14.25	13.40	12.67	12.67

* White clay from Burt's Creek near South Amboy.
† White clay from Trenton. ‡ Cornwall, England.

Prof. Cook, state geologist of New Jersey, says of the potter's clay, that it is tenacious, of a light-blue color; a little gritty when tried between the teeth. When highly heated it becomes partially vitrified without losing its shape, and is thus well adapted for earthenware. And it can be heated sufficiently for salt-glazing without injury. The following analyses show composition at several localities :—

	1.*	2.†	3.‡	4.§
Silica,	71.80	68.00	65.62	75.55
Alumina,	19.05	23.66	20.88	19.04
Potash,	.61	1.19	1.95	.10
Lime,	.31	–	–	–
Magnesia,	.79	–	.30	–
Oxide of iron,	1.31	1.17	1.23	.71
Water,	6.08	6.40	8.10	4.85
	99.95	100.42	98.08	100.25

* Morgan clay, pits near South Amboy.
† Bank of Rancocas Creek, near Bridgebora.
‡ Billingsport, on the bank of the Delaware, below the mouth of Mantua Creek.
§ Raccoon Creek, a mile above Bridgeport.

[1] These and the following analyses for comparison are taken from the Geology of New Jersey, 1868, p. 683. Analyses 3 and 4 from Percy's Metallurgy.

He observes that the clay pits about South Amboy furnish a large amount of this useful substance every year, and that the market is continually widening. It sold for from \$1.50 to \$5.00 per ton. Any needed amount of clay can be had from the pits along the Delaware and its branches. Clay suitable for making water-pipes is dug near the Woodmansie Station on the Raritan and Delaware Bay Railway. Light colored clays of the tertiary formation are found at many points in the southern part of the State, suitable for making a common quality of fire-brick and for other purposes.

Coarse clays, superior to brick clays, occur in inexhaustible quantities over and under the fire-clays. They are well adapted to the manufacture of coarse pottery, sewer-pipes, drain-tiles, etc., for which they are already, to some extent, utilized.

For the manufacture of glass-pots, which require a peculiar and excellent quality of clay, it was formerly thought that none of a suitable composition existed in the United States, and that only English and German clays could be relied upon. Experiments were made at Wheeling, Virginia, on clays obtained at the Mt. Savage Iron Works, and the measure of success attained encouraged the belief that the glass-works might become independent of foreign sources for this material. Soon after, a clay was obtained from Missouri which proved to be equal to, if not superior, to any other known clays for such purposes.

The fire-clays of St. Louis, according to Dr. Litton, have the following composition:—

	1.*	2.†
Silica,	61.02	59.60
Alumina,	25.64	26.41
Oxide of iron,	1.70	1.61
Lime,	.70	1.00
Magnesia,	.08	.07
Potash,	.48	.29
Soda,	.25	.16
Sulphur,	.45	.38
Water,	10.00	10.36

* Raw clay. † Prepared, probably washed.

CHINA CLAY—*England.*

The following tabular statement shows the extent of the production of China stone and China clay in Cornwall, for a series of years* :—

Shipments of China Clay and China Stone from Cornwall, England.

YEAR.	Kaolin (China Clay).	China Stone.	St. Agnes Clay.
1865, ...	97,750	25,500	1,566
1866, ...	105,000	35,000	1,524
1867, ...	127,000	33,500	1,316
1868, ...	100,000	29,000	979
1869, ...	105,700	28,500	875
1870, ...	110,520	32,500	946
1871, ...	125,000	33,000	774

At St. Agnes there were also, in 1871, about four hundred tons produced for candle-clay, used in the mines for supporting the candles.

In Devonshire, 19,000 tons were produced, in 1871, at the Lee Moor, and other china-works, and 47,639 tons of pipe and potter's clay were shipped at Teignmouth, the production of Newton and neighborhood. Of a total of 57,670 tons exported from Poole, Devonshire, in 1871, the greater portion was sent to London and Runcorn, and to Quebec 200 tons.

Of potter's material (clay, flint, chert, etc.) there were imported into the potteries by Trent and Mersey navigation, 144,588 tons, and by the North Staffordshire Railway, clay, flint, chert, etc., 11,345 tons.

The demand for porcelain clays sustains a very considerable mining industry in Cornwall and Devonshire. The official mineral statistics of the United Kingdom contain a list of no less than one hundred and five separate clay-works in Cornwall, seven in Devonshire for porcelain clay, five of "Teignmouth clay," and six of "Poole clay." In Staffordshire there are nineteen works producing Stour-

* Compiled from Hunt's Mineral Statistics of Great Britain.

bridge clay. The following analyses show the composition of the celebrated Stourbridge and other foreign clays :—

	1.*	2.†	3.‡	4.‡
Silica,	65.10	73.	50.20	51.90
Alumina,	22.22	19.93	34.13	30.03
Potash,	.18	.89	.39	.89
Lime,	.14	.39	.30	1.60
Magnesia,	.18	–	–	.18
Protoxide of iron,	1.92	.87	.87	–
	–	–	–	1.50
Phosphoric acid,	.06	–	–	–
Water and organic matter,	9.86	6.40	13.70	13.90

* English Stourbridge, Percy.

† German clay for glass-pots, from Bremen, Germany.

‡ Coblentz, for glass-pots.

NOTE.—Numbers 2, 3 and 4, made in the New Jersey State Laboratory.

CERAMIC ENAMELS.

CHEMISCH-TECHNISCHE FABRIK BEI ELBOGEN IN BÖHMEN. *Director*, *Max Rösler*. *C. F. Merker*, *Agent*, *1 Getreidemarkt*, Vienna. There was from this source a very interesting exhibition of coloring materials for the use of potters and decorators, which was honored with the Progress Medal. The highest skill of the chemist is called for by this art, and the demand is such that the manufacture of standard colors, or enamels, ready for use, has become an important industry. A large glass case was filled with a collection of the manufactures of their establishment, consisting of fluxes, glazes, colored glazes and enamels, and metallic oxides for glass, porcelain, stoneware and majolica. These are accompanied by proof-tiles, upon which the colors have been tested by burning, showing all the colors and shades of color—the greens, blues, red, rose, yellow, etc., etc. All the preparations of chromium, copper, mercury, gold and cobalt were beautifully displayed. By the courtesy of the director I have been favored with a price-list, from which I make the following extracts for the benefit of amateur decorators and others, who have found difficulty in getting such materials in the United States.

Lustres for Porcelain, Stoneware and Glass (Glass Ornaments and Pearl ditto).

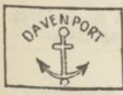
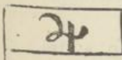
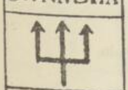
No.		Per half oz. in silver krs.	Cheaper price—per lb. in silver florins.*
1	Flux, ...	25	6
2	Pearl white, ...	30	7½
3	White, ...	35	9
4	White, ...	30	7½
7	White, ...	30	7½
8	White, ...	30	7½
10	White, ...	30	7½
11	Gray, ...	35	9
12	Gray, ...	40	10½
13	Gray, ...	75	20
5	Dove color, ...	40	10
14	Rose, ...	85	22½
17	Light green, ...	60	15
18	Green, ...	70	18
19	Yellow green, ...	55	13½
36	Dark blue green, ...	170	45
32	Gold lustre, ...	170	45
35	Purple lustre, ...	280	75
33	Blue, ...	85	22½
21	Yellow, ...	35	9
	Bright gold, ...	430	120
22	Gold yellow, ...	35	9
24	Orange, ...	45	12
27	Russet, ...	30	7½
25	Yellow brown, ...	30	7½
26	Iron red, ...	25	6
29	Tawny brown, ...	60	15
28	Dark brown, ...	90	22½
31	Platinum, ...	170	45
30	Bright silver, ...	280	75
34	Bright silver, ...	400	112½†

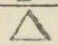
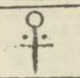
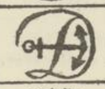
* The prices given are in Austrian silver florins, 1=100 kreutzers=50 cents U. S.

† The above list will give an idea of the colors furnished and the prices. As any parties interested can obtain a catalogue by addressing the works, we do not think it necessary to complete the list in these pages. The catalogue includes some two hundred colors for enamelling, transparent bases, glazing, &c.

MARKS AND MONOGRAMS, PORCELAIN AND FAIENCE.*

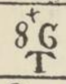
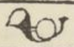
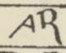
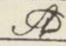
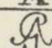
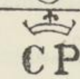
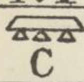
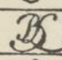
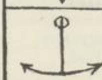
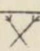
ENGLAND.

WEDGWOOD	STAFFORDSHIRE, i. 1759.
TURNER	STAFFORDSHIRE, i. 1762.
ADAMS	STAFFORDSHIRE.
ROGERS	STAFFORDSHIRE.
WOOD and CALDWELL	STAFFORDSHIRE.
	STAFFORDSHIRE, i. 1793.
LONGPORT	STAFFORDSHIRE.
SPODE	STAFFORDSHIRE.
C and Q	STAFFORDSHIRE, Copeland & Qarrett.
Richard Chaffers 1769	LIVERPOOL, i. 1752.
SADLER 1756	LIVERPOOL, i. 1756.
HERCULANEUM	LIVERPOOL, i. 1756.
	PLYMOUTH, i. 1760, by Cookworthy.
Absolon Yarm	YARMOUTH, Absolon.
SWANSEA	SWANSEA, i. 1750.
	SWANSEA, red stamp.
Nantgarw	WALES, red.
C G	LEEDS, Chas. Green, 1770.
	LEEDS, same Manuf.
	BRISTOL, i. 1772.
+	BRISTOL, 1772.

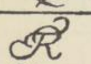
1776	BRISTOL, removed to Staffordshire, 1777.
	BOW, i. 1740.
	BOW. This also is considered a Bow Mark.
	BOW or BRISTOL.
	CHELSEA, i. 1740, s. p. the oldest Mark.
	CHELSEA, red mark.
	CHELSEA, the best quality marked in gold.
	CHELSEA, DERBY, s. p. 1765, blue used.
	CROWN DERBY, a later blue mark.
	DERBY or WORCESTER.
	WORCESTER, i. 1751, the oldest mark.
	WORCESTER, usually Chinese pattern.
W	WORCESTER, 1751.
C *Flight*	WORCESTER, Flight, 1783.
Flight Barr & Barr	WORCESTER, Flight, Barr & Barr, 1807-1813.
	WORCESTER, 1857-1862.
	SHROPSHIRE, E. Caughley, 1772.
S	SHROPSHIRE, Broseley, 1780, Willow Pattern.
CBD	SHROPSHIRE, Cole Brook Dale.
	STAFFORDSHIRE, Stoke on Trent.

* From Carl Barth's Pocket Chart, Stuttgart, 1873.

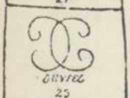
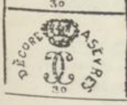
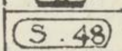
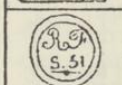
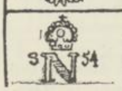
FRANCE.

	St. CLOUD, 1st Period, s. p.	H	PARIS, Faubourg St. Lazare. Hannong, 1773, h. p.
	St. CLOUD, Trou. 1715-1730.	MAP	PARIS, Faubourg St. Antoine Morelle, 1773, h. p.
	CHANTILLY, c. 1735, s. p. Blue, red or green.	S	PARIS, Faubourg St. Antoine Souroux, 1773, h. p.
	ARRAS, c. 1782, s. p. Blue pattern.		PARIS, "Gros Caillou," h. p. advent of Lamarre, 1773.
D V	MENECY, i. 1735, s. p. Prince of Villeroy.		PARIS, Rue de Clichy.
MP	ETIOLLES, i. 1768, s. p. Monnier Manufr.		PARIS, stamped with Caduceus.
BR	BOUR-LA-REINE, i. 1773, s. p.		PARIS, Rue Thirous, 1778. "Porcelain de la reine" (Antoinette.)
SX	SCEAUX-PENTHIÈVRE, i. 1751, s. p.		PARIS, Rue de Bondy, 1780. Duke of Angoulême.
	CLIGNANCOURT. A mark used by Deruelle before 1775.		PARIS, 1780, Angoulême.
	CLIGNANCOURT, f. 1780. In leather color.		PARIS, Christ'r Potter, called "Prince of Wales," 1789.
	CLIGNANCOURT, h. p. Called porcelain of Monseur, 1775.	JP.	BELLEVILLE, Jacob Petit, i. 1796, h. p.
	ORLEANS, h. & s. p. Under the protection of the Duke of Orleans, 1750-1770.	Dihl	PARIS, Rue de Bondy. Dihl, maker.
	ORLEANS, h. p. Blue Mark.		ROUEN, under Louis XIV.
	PARIS, Pont-aux-Choux, i. 1756, h. p.		SCEAUX-PENTHIÈVRE. The word Sceaux often appears underneath.
	PARIS, Pont-aux-Choux, Another style.		LILLE, h. p., c. 1783. Red mark.
	PARIS, Rue Fontaine au Roi. i. 1773, M. Locré, h. p.		

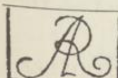
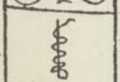
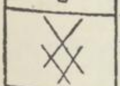
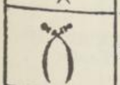
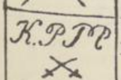
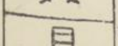
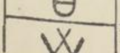
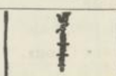
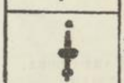
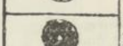
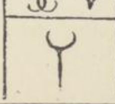
FRANCE (SÈVRES).

	SÈVRES. I. at Vincennes, 1753. The oldest mark.	RF Sèvres	SÈVRES. Another style. 1792-1799.
	Alphabetical, from 1753-1776.	RF Sèvres	Another style. 1792-1799.
	Double letter, from 1777-1793.	Sèvres	The monogram out of use, 1798-1802.
 Sèvres	French Republic, 1792-1799.	MNle Sèvres	The Consular Period, used 1801-1804.
		M. Imple de Sèvres	v. 1804-1809, generally red with color.

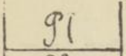
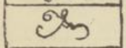
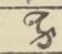
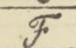
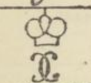
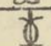
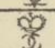
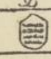
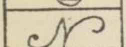
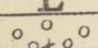
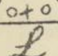
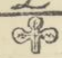
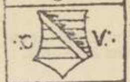
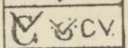
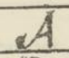
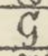
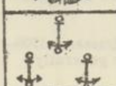
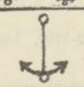
FRANCE (SÈVRES)—Continued

	SÈVRES. The Imperial Eagle, generally from 1810-1814.
	The royal cipher before 1814-1823 used again.
	Charles the X., the marks show the year.
	Same reign, another style.
	Same reign, another style.
	Charles X., 1830. On common ware.
	On decorated pieces, 1829-1830.
	SÈVRES. Used 1830, from August.
	Louis Phillippe, f. 1830-1834.
	Initials of Louis Philippe from 1834-1848, common.
	Chateau D'Eu service, sometimes in gold, dated from 1837.
	Cipher of Louis Phillippe, printed marks, 1845-47.
	1848 & 1851, in decorated pieces.
	French Republic, 1848-1851.
	Imperial Eagle, 1852.
	Monogram of Louis Napoleon III., 1854.

GERMANY AND AUSTRIA.

	DRESDEN, Meissen, 1709-1726, in blue generally.
	DRESDEN, 1712-1720, blue mark.
	DRESDEN, to 1720, blue mark.
	DRESDEN, 1730, blue mark.
	DRESDEN, 1770, blue, Royal period.
	DRESDEN, 1796, Marcolini period.
	DRESDEN, Royal Porcelain Manufacture.
	WIEN, i. 1718, generally to 1744.
	BERLIN, 1751-1761, Wegely's mark.
	BERLIN, sometimes an eagle added.
	BERLIN, another form of sceptre.
	BERLIN, special mark, particularly of 1830.
	HÖCHST, Nassau, i. 1740, gold or color.
	HÖCHST.
	HÖCHST.
	FRANKENTHAL, h. p. first Period, 1755-1761.
	FRANKENTHAL, h. p. second Period Carl Theodor. (+1799.)
	FRANKENTHAL, this mark is allotted to Franz Bartold.

GERMANY AND AUSTRIA—Continued.

	FRANKENTHAL, Philipp Hanong.
	FRANKENTHAL, Joseph Adam Hanong.
H ✻872	FRANKENTHAL, Joh. Hanong.
∞ B	FRANKENTHAL, Franz Bartold.
	NIMPHENBURG, near Munich, i. 1747, h. p.
	NIMPHENBURG, printed in colors.
	NIMPHENBURG, h. p. earlier mark.
	FÜRSTENBERG, i. 1750.
	FÜRSTENBERG.
	LUDWIGSBURG, or KRONENBURG, i. 1758-1806.
	LUDWIGSBURG, 1st Period.
	LUDWIGSBURG, 2d Period.
	LUDWIGSBURG.
	LUDWIGSBURG.
	FULDA, i. 1763-1780, h. p.
+	FULDA.
R	RUDOLSTADT. i. 1758.
R— n	RAUENSTEIN, h. p.
L	LIMBACH, h. p.
	LIMBACH.
	LIMBACH.
	GROSSBREITENBACH, h. p.
	GROSSBREITENBACH.
	KLOSTER VEILSDORF, coat of arms, often with C. V. added.
	VEILSDORF.
	VEILSDORF, another mark.
	ANSBACH.
	ANSBACH, often with the letter A joined.
	ANSBACH.
	ANSBACH.
	GOTHA.
	GERA.
G ou G	GERA.
	ALT-HALDENSLEBEN, h. p. M. Nathusius.
	CHARLOTTENBURG, i. 1790. M. Pressel.
	BADEN, E. 1793. Cut of an axe in gold.
	COELN, M. Cremer.
	POPPELSDORF, M. Wessel.
	STRASSBURG, lately so marked.
	NIEDERVILLERS, i. 1768, h p. F. Lanfray.
Sarguemines	SAARGEMÜND Dep't of the Moselle. M. Utz-Schneider

SWITZERLAND.

Z	NYON, h. p., i. 1790.		ZÜRICH, h. p., i. 1763, blue mark.

RUSSIA.

Korzec	POLEN, h. p. manufacturer. Korzec, 1803.
	ELBOGEN, h. p. In Bohemia marked Haidinger.
	COPENHAGEN, i. 1772. h. p.
S	SCHLACKENWALD, h. p. 1812, in gold.
F&R	LE HAMMER, h. p. stamped.
A	MOSKAU. Apaporé.
C	ST. PETERSBURG, blue mark.
E	ST. PETERSBURG, i. 1762. Katharina.
H	ST. PETERSBURG, Monogram Nikolus d. 1st 1828.
III	ST. PETERSBURG.

HOLLAND AND BELGIUM.

Amstel	AMSTERDAM, h. p., i. 1782. in blue.
A.	AMSTERDAM, h. p. in blue.
M.oL	AMSTERDAM, blue mark.
	TOURNAY, s. p., i. 1750. This mark is a kiln.
	TOURNAY, s. p. gold mark.
	TOURNAY, s. p. another mark.
	LA HAYE, h. p. gray mark.

SPAIN AND ITALY.

	MADRID. Buen Xetiro s. p., i. 1759.
)(C	MADRID, cheap kind.
O.F.L	MADRID, s. p. blue mark, best quality.
	MADRID, s. p. best quality.
	MADRID, Monogramm Karls III. of Gründers.
VA	VISTA ALEGRE, h. p. in gold or colors.
*	LE NOVE, s. p. blue or red mark.
	VENICE, red mark.
Vº	VENICE.
Venº	VENICE, h. p.
	VENICE, s. p. red mark.
D V G	TURIN, h. p. conducted by Dr. Gioanetti.
A	VINEUF near TURIN, i. 1750.
	DOCCIA, h. & s. p. 1727.
	DOCCIA, i. 1727.
GINORI	DOCCIA, pressed mark, 1770.
	NAPLES, s. p., i. 1759, A. 1821.
N	NAPLES, s. p. decorated or painted.
L)(C	NAPLES.
Milano	MILAN, red mark.

NOTE.—The abbreviations are: h. p. hard paste; s. p. soft paste; i. introduced.

CHRONOLOGICAL TABLE OF THE SÈVRES PRODUCTIONS.

MARKS.	YEAR.	MARKS.	YEAR.
A Vincennes, . .	1753	HH	1785
B " . .	1754	II	1786
C " . .	1755	JJ	1787
D	1756	KK	1788
E	1757	LL	1789
F	1758	MM	1790
G	1759	NN	1791
H	1760	OO	1792
I	1761	PP	1793
J	1762	QQ	1794
K	1763	RR	1795
L	1764	T 9	1801
M	1765	X	1802
N	1766	H	1803
O	1767	//	1804
P	1768	1	1805
Q	1769	=	1806
R	1769–70	7	1807
S	1771	8	1808
T	1772	9	1809
U	1773	10	1810
V	1774	o. z.	1811
X	1775	d. z.	1812
Y	1776	t. z.	1813
Z	1777	q. z.	1814
AA	1778	q. n.	1815
BB	1779	s. z.	1816
CC	1780	d. s.	1817
DD	1781	18	1818
EE	1782	19	1819
FF	1783	20	1820
GG	1784	21 etc., . . .	1821

CHRONICLE OF THE PRINCIPAL EVENTS DIRECTLY CONNECTED WITH THE MANUFACTURE OF POTTERY.

B. C. 600 to 900 years. Manufacture of enamelled bricks in Nineveh and Babylon. The Museum of Practical Geology, London, contains several specimens of enamelled bricks from Babylon, dating some 600 to 900 years before Christ.

B. C. 185. Manufacture of porcelain supposed to have commenced in China between this date and A. D. 87, during the Han dynasty.

A. D. 600. Porcelain in common use in China, and supposed to have reached its greatest perfection about the year 1000.

1115. Moorish tiles probably introduced in Italy at the conquest of Majorca by the Pisans.

1200–1300. Colored tiles believed to have been in common use in Persia.

1273–1302. Earliest tiles of the Alhambra.

1310. Delft ware successfully manufactured in Holland.
Incised or Sgriffiato ware largely produced by the Italian artists.

1400. Luca della Robbia born; the sculptor, painter on faience, modeller in bronze, and supposed to have been the first to employ stanniferous glazes in Italy.

Encaustic tiles manufactured in Great Britain, at Malvern Hills and other localities.

1475. Earliest date noticed on any piece of lustred Majolica of the manufacture of Maestro Georgio. Fortnum considers a piece in the Sèrves Museum, dated 1489, to be the earliest piece of lustred ware on record.

1500. About this time oriental porcelain was imported to Europe by the Venetians and Portuguese, and in the following century the Dutch imported great quantities.

1510. Bernard Palissy born about this date, at La Chapelle Biron, Perigord.

1540–1560. Manufacture of majolica in a flourishing state.

1540–1620. Flemish ware, commonly known as Grès de Flandres, in great esteem in Great Britain.

1580. About this date, the earliest known production in Europe of pieces of porcelain in the laboratory of Duke Francesco de' Medici at Florence.

1581. Soft porcelain discovered in Italy by Francis, Grand Duke of Tuscany.

1585. Gold purple or precipitate of cassius discovered.

1589. Palissy died in confinement in the Bastile.

1671. Earliest efforts to manufacture Porcelain in England, by Mr. John Dwight, at Fulham.

1674. Manufacture of pottery established in Liverpool before this date.

1680. Salt glazing said to have been discovered in Staffordshire by accident.

1690. Crouch ware first made by Burslem potters.
Dresden (Meissen) porcelain manufactory established by Augustus II., Elector of Saxony.

1706. Commencement of the experiments of Tschirnhaus and Böttcher, two alchemists in the service of the Elector of Saxony, leading to the production by Böttcher of the first hard or true porcelain in Europe, but of a dark color.

1709. White porcelain made by Böttcher.

1710. Böttcher appointed director of the manufactory at Meissen.

1715. White porcelain of good quality commonly made.

1720. Paintings on porcelain, and gilding, produced at Meissen.

1730. Josiah Wedgwood born at Burslem, England; died 1795.

Bow works, England, commenced manufacture of porcelain.

1731. Kandler, the sculptor, superintended the modelling of groups and figures at Meissen.

1744. St. Petersburg porcelain works founded by the Baron Ivan Antinovitsh.

1745. Cookworthy in a letter mentions that a person had discovered both kaolin and petuntse in the State of Virginia, and had made from them specimens of porcelain. The same party professed to have purchased the whole region from the Indians.

1747. Porcelain works of Blanquier, Vienna, Austria, purchased by the Empress Maria Theresa, and made an imperial establishment.
Porcelain works established at Neudeck, Bavaria.

1750. Decoration of earthenware and porcelain by transfer from copperplate prints, believed to have originated with John Sadler, of Liverpool.

Swansea earthenware works established.

From about this date the true Sèvres *pâte tendre* was manufactured with habitual success.

Manufacture of porcelain commenced at Berlin by Wegely.

1751. Worcester porcelain works established at Worcester, England.
Foundation of the Derby porcelain works, England, by Mr. William Duesbury.

1755. Discovery of kaolin in Cornwall, by William Cookworthy, whose attention appears to have been directed to the subject by a citizen of Virginia, in 1745.

Works established at Coxside, Plymouth, England, by Cookworthy and Lord Camelford, about 1755, soon after the discovery of the materials at Cornwall. Transferred to Bristol, 1774.

1756. Porcelain works removed from St. Cloud to Sèvres.

Manufacture of porcelain attempted at Lowestoft. 1770–1800 period of greatest prosperity. Works abandoned in 1802.

1757. Rockingham porcelain and brownware made at Swinton, on estate of Charles, Marquis of Rockingham.

1758. Neudeck manufactory, Bavaria, transferred to Nymphenburg, near Munich.

1760. Louis XV. became proprietor of the Sèvres establishment.
Isleworth pottery established by Joseph Shore, of Worcester.

1763. Frederic II. bought the Berlin porcelain works and converted them into a royal manufactory.

1765. Discovery of kaolin in France, by Guettard, who gave an account of it in this year to the *Académie des Sciences.*

1766. Kaolin was found near Limoges at St. Yrieix, in abundance and of good quality.

1769. Hard body porcelain introduced at Sèvres manufactory.

1772. Porcelain of superior quality manufactured at the Shropshire potteries, under Thomas Turner, from the Worcester works.

1795. Pinxton porcelain works established near Alfreton, England. Closed about 1812.
Wedgwood died.

1796. The "Marcolini period" at Meissen commenced.

1800. Calcined bones introduced by Spode into the paste of his porcelain at Stoke-upon-Trent, England.

1812. Inspection of the porcelain works at Meissen by M. Brongiart, on the requisition of Napoleon I. The greatest secrecy maintained until that time.

1813. Nantgarw (near Cardiff) porcelain manufactory established.

1840. Foundation of the tile manufacture of the Mintons, Stoke-upon-Trent, England.

1864. The Austrian imperial porcelain works discontinued.

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BY W. J. STILLMAN.

GROUP XII.

Amongst the industrial products collected at Vienna, and which, owing to a bad arrangement of the contributions, were deprived of an adequate presentation, perhaps the least cared for, considering the prominence which it has attained of late in many scientific and industrial undertakings, was photography. Its position, half-way between art and manufacture, is one which explains, perhaps, this want of attention; for art had its separate quarters, and photography, too much dependent on the capacities of individuals and unadapted to the arrangements of the great industries, had no collective interest to be looked after or national advantage to be subserved by bringing it prominently before the public. Yet it is safe to say, that if due regard had been given to the immense range of subjects of absorbing attraction and scientific value, over which it has extended itself since the last great international industrial gathering, and the proper steps had been taken to bring together a complete collection of its products, the world would have been astonished at the results which have grown out of what, within the memory of the present generation, was only a curious phenomenon of the action of light upon certain chemical products, of scarcely more promise of commercial value than the spectrum analysis has to-day. It not only has become the constant and indispensable solace of domestic affections,—almost as wide-spread and cheap as light itself,—and brought reminders and lessons of art to the homes of the millions, but it has become the infallible record of almost all physical phenomena, the touchstone of astronomical observation, and the main reliance of physico-chemical research. It promises to replace all the more tedious processes connected with pictorial reproduction by mechanical ones, at once immeasurably more rapid and more exact; and to spread the cultivation of the plastic arts to an extent certainly never dreamed of by the most devoted enthusiast fifty years ago.

In reviewing the province assigned to me, it seems fitting to divide the Report into two parts,—one on the negative or primary reproduction in which the image is first secured; and the other on the positive or multiplying methods, in which will be included all the new printing processes. The quest of that philosopher's stone of photography,—the representation of nature in her actual colors,—so ardently pursued at one time, seems to have been in a great measure lost sight of; and, without assuming such a knowledge of chemistry as should pretend to recognize a limitation of its resources, it may be permitted at least to say, that until new conditions, as yet undreamed of, are developed, this quest must remain a fruitless one. The simple fact that the photographic effect is produced, not by the optical, but by the chemical action of light, would seem to debar us from entertaining any hope that color, which belongs to the former, should ever become an attribute to the latter, in the sense demanded by photography, and the equally unquestionable fact that the sub-chloride of silver, in course of reduction under the action of light transmitted through colored media, takes, under certain circumstances, somewhat of the color of those media (which is the only phenomenon so far recorded tending to chromo-photography), does not necessarily imply the possibility of a sequential reproduction of colors, as this solitary phenomenon may be (and probably is) merely a case of coincident iridescence, the sub-chloride passing through the different primary tints in the course of its further reduction; which conclusion is practically established by the final reduction of the chloride to the usual monochrome by the continual action of light, and the impossibility of rendering permanent the tints so obtained. So far, chemistry has given no hint of a process for practically reproducing color; and the phenomena of this class which have been produced are, by their fugitive character, not subjects for an exhibition, much less of commercial value.

The original daguerreotype was a positive photograph, incapable of multiplication; but the law of the reduction of silver, under the joint action of light and a developing agent, having once been made known, practical investigators soon worked out the bases of the negative processes now in use,—the first being the paper process, introduced by Talbot, and now abandoned except by amateurs, who find its pictorial advantages and practical convenience more than a compensation for the greater delicacy and perfection of the detail which are obtained by the processes which employ a film of the sensitive salts spread on glass. There was no contribution of works by the original paper process in the Exhibition; and there seems never to have been any serious attempt made to produce a satisfactory substitute for the fragile glass,—the precarious foundation of all our present effective processes. With the introduction of the collodion process and the modifications which the experience of photographers have found advisable, progress seems to have stopped, so that most of the work shown at Vienna is produced by the wet collodion negative process, substantially as introduced by Archer in England about a quarter of a century ago. In the many and useful modifications of it, the English photographers, amateur and professional, have distinguished themselves beyond all rivalry; and especially in the perfection of dry collodion processes, which, for all out-of-door work, where portability is an advantage, for tourists' uses and for architects and amateurs' work generally, have become a notable feature in the status of the art. All who have attempted the manipulations of photography under the difficulties which portable or improvised dark rooms present, with all the chances and disasters of broken apparatus,—chemicals poured over delicate mechanism and mixed in waste,—or who, under urgent need of working at inaccessible stations, have found how cumbersome is the most portable apparatus for the working of the ordinary process, will appreciate the desirability of a modification of it, by which sensitive films of equal rapidity, capable of indefinite preservation and always ready for use without the necessity of apparatus either for preparation or development, will be glad to know that these conditions are very nearly attained, and that the most difficult part, technically, of the photographic art bids fair to become superseded by trustworthy manufacture for commercial purposes.

Several manufacturers in England now send sensitive plates all over the world, and one of them especially, the "Liverpool Dry Plate Company," produces them of so great certainty and rapidity of action, that for ordinary uses, and especially for landscape work, they are likely to supersede the common methods of working; while another, a photographer of wide repute, Colonel Stuart Wortley, has perfected a modification of the same dry process, by which plates of great rapidity are produced, and, like the Liverpool plates, may be kept indefinitely.

A scientific expedition starting on a three years' voyage might carry with it plates enough to suffice for all its purposes, and carry on its operations without any of the inconveniences which travelling photographic laboratories cause.

The advance of commercial activity in this direction is so great, that since the Exhibition has been closed a new facility for scientific photography has been added to its former products by the Liverpool Dry Plate Company, in a preparation containing in a single solution all the elements necessary for photographic results, which retains for an indefinite time all its qualities, and needs only to be applied to the glass and dried to be ready for use.

With the introduction of a successful substitute for glass the commercial preparation of sensitive films, for photographic uses, will become so satisfactory that for all but portrait or other localized practitioners, they will supersede the preparations of the photographers themselves. The importance of these developments of photographic industry to all kinds of scientific research, as well as all branches of pictorial reproduction, cannot fail to strike every one, and there is good reason to hope that the whole of the desiderata above mentioned will soon be attained.

In the English department of the Exhibition there were some frames of landscapes of a very high excellence, and some large heads by Colonel Wortley, all on dry plates; and since the opening of the Exhibition a still farther improvement, in the substitution of gelatine for collodion in the preparation of dry plates, has been announced, and presented with such success as to leave no doubt of its finally superseding collodion for this purpose.

In the important department of the apparatus requisite for photography, there was little to represent the actual state of either optical construction or the portable appliances which have been carried to so high a perfection, especially in England. A single case of the work of George Hare, of London, is beyond any question the finest display of common workmanship and general good construction that was sent, and fully sustained the maker's reputation as the manufacturer of the best apparatus of this kind in the world; but from the English opticians now at the head of the trade, even considering the great continental celebrities, Steinheil and Voightländer, there is no contribution. No representation of photographic optics could to-day be given which would not put in the first place the admirable rectilinear lenses of Ross and Dallmeyer, of London, which, especially for scientific purposes, where correction to perfect rectilinearity of the photographic image is necessary, are incomparable; and have long been recognized as such even by the continental photographers, who are by their aid enabled to give architectural views free from the curvilinear distortions formerly always present in this class of work, and which were consequent on the use of the old view lenses.

A complete apparatus for microscopic photography, by Haack of Vienna, was a most admirable piece of construction, and showed proofs of enlargements to four hundred diameters, with admirable definition and flatness of field.

But in that which is after all the immediate object of the most arduous study on the part of investigators in photographic reproduction, the printing processes, properly so called, that is, those in which the image is transferred to a surface capable of producing impressions as from a block, stone or plate, the Exhibition contained but little, though that little is full of magnificent promise.

While all the negative processes by which the first impression from nature is received depend on the action of light on the haloid salts of silver,—an action so subtle and imperceptible as to require the supplementary force of a reducing agent, or developer, and the ordinary silver prints being the result of the same agency without this supplementary action, making the reproduction of the impression dependent on the uncertain condition of weather,—the printing processes depend on a preliminary action of light on a film of gelatine, which, when impregnated with a chromate, has the fortunate faculty of being rendered insoluble by the influence of light, and the copies are then produced by a merely mechanical action. The gelatine film, charged with the bichromate, is exposed to light under a negative; and as the ray penetrates more readily through the shadows or transparent portions of the negative, these become indurated and repel the action of water. On this fact, employed in several ways, the different processes are based; one employing the film in its unequally softened condition, in which the portions imbued with water repel the printing ink, and those parts which were protected by the denser portions of the negative become the lights of the print, the indurated portions receiving the ink in proportion to their induration. This, with various provisions for the adhesion of the gelatine film to the basis, is the Albert-type, of which some examples are contributed to the Exhibition by Herr Albert, of a size hitherto unknown in such perfection of workmanship, some of them being a metre in length, portraits in life-size, copies of pictures and drawings in graduated tints, in which the reproduction is simply incapable of being bettered for large prints.

This gelatine film, exposed to light, as indicated, and then subjected to the action of moderately warm water, has the unindurated portions washed away, and, on drying, becomes a horny pellicle, with the subject in relief, and may be separated from the support used in printing and kept between the leaves of a book and used again as often as required, being in effect insoluble and indestructible, except by application of a force not required in printing. In this state it is utilized by Mr. Woodbury in his photo-relief process (better known by the name of its inventor, as the Woodbury-type), by producing, under hydraulic pressure, a relief in soft metal, which, filled with a transparent gelatinous ink and put under gentle pressure on paper, produces a print equal in every respect to the best produced by any photographic process, with a texture and gradation absolutely more delicate than the most carefully printed silver prints under any conditions whatever. This process is the solution of one of the most interesting practical problems ever developed in photographic industry, and the results, within the limits of size dependent on the hydraulic pressure available, are, for certainty, equality of result, and beauty, quite unrivalled in pictorial art. The limitations of hydraulic power have, so far, kept these prints down to the size of twelve by ten inches,—not, of course, to be judged with the immense prints of Herr Albert,—but they have the advantage over those of all other processes, that they give gradation without any grain; and perfect uniformity of result,—a point not yet attained by any of the rival processes, in most of which the perfect result is exceptional. The action of the Woodbury press is so equal and certain that, once the metal intaglio is obtained, the merest tyro can print more rapidly than the most experienced printers can produce ordinary lithographs. This structureless film of tinted gelatine, when put on glass, forms transparencies, which, for the magic-lantern, for reproduction of the negative, for scientific purposes, for the production of enlarged diagrams, etc., is almost without limit in the power of enlargement; and its advantages over the granular film of the common collodion transparency, or even the albumen film prepared with silver, is evident at once on seeing the enlarged image.

The delicate relief of gelatine, when dried, is subjected to the pressure of several tons per square inch, and is completely imbedded in the soft metal, without the slightest injury from the pressure, and may be used again and again to produce duplicate moulds. This film, though, as will be understood, relieved only on one side, may be reversed, and the relief forced, through itself, to appear on the previously plane side, without destroying its value or injuring its detail,—a quality which, it will be seen, adapts the process to negatives, taken either direct or reversed.

The Woodbury-type is, of all forms of the mechanical production of photographic prints, the most fitting for book illustrations, with the exception of such illustrations as require a considerable extent of white ungraduated surface, on which the gelatinous ink will leave marks,—the result of its imperfect expulsion from the two plane surfaces in contact. In reproduction of drawings, therefore, and wherever broad, white masses are included, the Albert-type and its analogous process, the Heliotype, have a decided advantage, as well as in the almost unlimited size of which they may be produced. The Heliotype differs in several important particulars from the Albert-type, or its close relative, Lichtdruck. The latter have a gelatine, or gelatine and albumen, film supported on a plate of glass; the former employs a film entirely detached, and only temporarily laid on a metallic or other basis while being printed from. The sheet of gelatine which is employed for the printing material in the Albert-type receives the image on its *outer* surface, which is necessarily more liable to accidental imperfections than the under surface or that which is formed by the glass on which the gelatine is spread, which is employed in the Heliotype; and the flexibility of the detached film is of the highest value in receiving the impressions from the negative, insuring perfect contact between the negative and sensitive film, scarcely to be obtained when the latter is on a rigid material.

This, and the analogous processes, are in comparative infancy yet; but we have already results produced by them, which, in certain directions, are hardly capable of very material improvement; and, when the conditions of certainty and excellence are absolutely determined, we may expect to see the splendid results of photography made more accessible than those of any other form of pictorial reproduction.

The accidental employment of a granular pigment in the gelatine used for making the relief in the Woodbury process led to the discovery that in this way a grain may be produced similar to that of a mezzotint engraving; and this was ingeniously developed by Mr. Woodbury into an admirable substitute for that kind of engraving. The film of gelatine, which was exposed under the negative, was prepared with a granular substance of various degrees of fineness, so arranged that the coarser particles are on the side to be placed opposite the negative, and the finest next to it; which is readily effected by allowing the granular substance to depose gradually in the fluid gelatine, so that, when the film has been exposed, the induration caused by light penetrates to the coarser deposit, which elsewhere is washed away, leaving the coarseness of grain in the result proportional to the depth of induration, *i. e.*, to the transparency of the negative; and, as this is in the shadows, of course the photo-engraving plate produced by electro-deposit, will have the desired granulation more strongly marked as the shadows are deeper.

The results of this process, in the hands of a French firm who are working it commercially, rival in effect and far surpass in fidelity the best mezzotint engraving.

The chromatized gelatine, charged with such color as may be desired, becomes also the basis of a light-printing process, long known as the Autotype, in which a tissue prepared for the purpose is exposed to the action of light under the negative; and then, being immersed in tepid water, the unindurated gelatine is washed away, carrying the color with it and leaving the protected parts of the tissue thin and colorless in proportion to their degree of protection.

Any tint or pigment may be employed. This process, however, from the fact of its continual dependence on light, each impression being produced from the negative as in the chloride of silver process of printing, can hardly be expected to maintain a permanent footing beside the mechanical processes. The Autotype Company, however, have developed another admirable use for this gelatine tissue, by preparing it with a strong color and then supporting it by glass instead of paper, so that, on development, it makes a transparency with all the exquisite delicacy of detail and gradation which have been alluded to as belonging to the gelatine film. From this, by an enlarging camera, a new negative is made of any required dimensions, preferably not to exceed eight diameters of the original negative, the enlarged prints thus produced having a charm quite unique; and if the original negative was well calculated for the purpose, with no loss of any of the qualities most desirable in a photograph. By this application of the various facilities drawn from the optical, chemical and mechanical resources of photography, the smallest apparatus which it is desirable to use may be made to produce results scarcely inferior to those formerly obtained by the ponderous and expensive apparatus in use for the large photographs, which are so much in vogue and so admirable when judiciously executed.

It will not escape attention that, on the one hand, the results of photographic science and art are so cheapened and perfected as to come almost within the cost of the most imperfect manual methods of pictorial reproduction; and on the other, that the processes which are the means of the art have been so far simplified and reduced to the condition of commercial productions, that neither lack of time nor technical training need prevent any person having even a low average of manual dexterity from becoming, for all practical purposes, a successful photographer. There remains one important desideratum, already alluded to (a substitute for glass), with the attainment of which photography can place in the hands of every person of average intelligence and taste, most portable means of making, at an expense of time and trouble quite trivial, representations more accurate than art can produce, of all visible objects which come within the chromatic conditions imposed.

The weight of glass and the liability to fracture of the negatives when finished, have been the great drawbacks to the use of photography in remote and not easily accessible regions; but even with this drawback, a tourist may carry literally in his pockets, photographic apparatus, with dry plates, sufficient to do all the work required in many days, and without exceeding the weight one man could carry on his back, enough of all material required to cross a continent on foot and secure negatives of a small but available size of every object most worthy reproducing, up to several hundreds, and these may be reproduced in a most perfect and superb manner at a cost of less than one cent each to the producers.

Regarded from this point of view it would seem that photography need not go much farther; but we may confidently expect that even this will be inefficience compared with what will be done when what is now being sought for is attained.

It is to be hoped that the Exhibition about to be held in Philadelphia will not let the opportunity be lost of doing what Vienna so signally failed in, bringing together and so systematically arranging the results of photography that they can be seen and understood at a view; and we shall see how large a place in the world of industry the last of the arts has made, and how fully it supplements the others; and, highest of all its uses, serves as the link between art and science, the interpreter and aid of both alike, the automatic record of all things, least and greatest, that the sun has looked on and science made known.

W. J. STILLMAN.

ON BUILDING AND ARCHITECTURE.

BY NELSON L. DERBY.*

Group XVIII.

In no capital of Europe is such an amount of building going on at the present moment as at Vienna. Dwelling-houses of enormous size—some built around two, three, and even four court-yards, and accomodating twenty, thirty, or more, families—are arising; new churches are approaching completion; and, above all, many monumental buildings, whose erection will cost years of labor, are in various stages of construction.

Twenty years ago, beyond the Cathedral of St. Stephen, there was little or nothing imposing or beautiful in the architecture of this city. The streets were narrow, and lined by plain, stuccoed buildings of great height, whose lower stories received so little light that remarkable contrivances were often resorted to, to introduce the same. In the interior city one sees still many windows provided with mirrors, set at an angle of forty-five degrees with the front, to reflect the light from above into the rooms. Within the period mentioned, great changes have been wrought,—the old fortification walls encircling the city have been removed; the great ditch, exterior to these, and having a depth of some sixty feet, has been filled; and the space thus gained, to-

* The Vienna Exposition contained a magnificent collection of architectural material in the shape of models, drawings, engravings, plans, etc.; and, in this display, the Vienna architects were easily first. And this happened both from their propinquity and from the fact, that the enormously rapid growth of the city of late years, has developed the science of building to a remarkable extent. In this Report, it has been deemed better to refer to the actual buildings as examples, rather than to the drawings and illustrations of the same exhibited in the Exposition.—Editor.

gether with a large area beyond, previously used for military purposes, devoted to wide boulevards and squares. These were soon lined with fine structures; and the city acquired a large sum of money from the sale of sites, which it is now devoting to building purposes. The first structure completed with these funds was the beautiful Opera House,—until the completion of the Paris opera building, the finest in the world, —surpassing those of Milan and Naples, if not in size, yet in magnificence and taste. Its cost was not far from five to six million dollars. Within a few steps of this building, a new Academy of the Fine Arts is erecting; while, following the line of boulevards surrounding the interior city, we come to the old parade-ground, on which the foundations of three enormous structures are being placed: first, a new Parliament House, to be built in Grecian style, by Hausen; next, in the centre, the new city hall, or Rathhaus, with a front of four hundred and fifty feet, in modernized Gothic, with a central tower, from the plans of Schmidt, which were accepted from among a large number coming from all parts of the world; and third, the University, by Ferstel, in Roman style. All these buildings are of great size, and will each cost millions, —the Rathhaus perhaps six or seven. The place upon which they stand will be, at their completion, the finest in the world; and will be still further beautified by a new imperial and royal theatre, to be erected in the immediate vicinity.

Passing by these buildings and the Votive Cathedral,—now building for fifteen years, at a great cost,—we turn down the Schotten ring,—a section of the encircling boulevards,—leaving, right and left, palatial dwellings and hotels, and reach the site of the new Exchange, whose massive foundations astonish the gazer, and have alone cost several hundred thousand dollars. At other points on the ring are to be seen the imposing palaces of the arch-dukes and the new Art Museum; while, on the newer neighboring streets, are numberless dwelling-houses, of graceful and ornamental architecture, whose forms are borrowed in general from the Italian Renaissance, abounding in widely projecting cornices and figural decoration. These are mostly of a color very cheering and grateful to the eye,—a creamy ochre,—similar to that of our light sandstones, and apparently of that material.

Closer inspection and observation of the many buildings erecting shows, however, that they are, in reality, built of mastic, which, in some instances, too, is painted. It looks, however, very differently from the mastic on the older buildings; is harder, and presents little tendency to crack or scale away. This arises from various causes, which will be explained further on. Besides the great size of these buildings, —whose fronts are rarely less than one hundred feet long, and whose height is uniform,—an American is struck by the great thickness of the walls; the massive nature of the floors, in which the arch and iron play a prominent part; and the existence of large interior court-yards, which, in many cases, are covered by a glass roof. The great roughness and apparent instability of the masonry produces an unpleasant effect upon one accustomed to the neat brick walls of England and America; but what is apparently carelessness soon proves to be intentional aim on the part of the builder. The bricks are set upon one another with joints an inch thick, and open on the exterior to the depth of an inch, for the purpose of giving a hold to the mastic.

Other points soon noticed are the absence of wooden stairways; instead of which, those of stone alone, or stone in connection with iron, are invariable, and the practice of making all partition-walls of masonry. The generality of these features proves sufficiently that they are the results of building-laws, since their cost is great, and the tendency in building, left to itself, is to secure cheapness rather than durability, or protection from the danger of fire. There is little doubt that such laws—requiring thick walls, stone stairways, etc.—have had an effect upon the material employed for the exterior in Vienna. The great predominance of mastic fronts, and the development of the manufacture of the constituents of this material, reached in Austria, is, without doubt, thus to be in part explained. In order that the final expense of the building may not be too great, the builder economizes where the law permits him, and uses mastic instead of face-brick or stone, seeking, however, to secure as good a mastic as possible,—one that will present a good appearance and prove durable.

The great amount of building undertaken has called for numerous architects, and these were soon at hand; some came from Northern Germany, and brought with them the taste for Gothic art; others were favorers of the French school; but by far the most seem to have drawn their inspiration from study of the Italian works of the fifteenth century.

The close promixity of Venice—to be reached by rail in less than twenty-four hours—attracts crowds of young enthusiasts each winter, who, after study of the famous monuments, are rarely content to return home without a visit to the neighboring cities of Northern Italy,—Padua; Vicenza, the home of Palladio; Brescia, Bergamo, and, finally, Milan, where the famous passage or gallery of Victor Emanuel, by the architect Mengoni, has now nearly reached completion.

Leaving this point, and returning as far as Verona, the favorite home trip is by way of the Brenner pass and Munich, —the latter, fifteen or twenty years ago, the most famous architectural city of Germany, and still possessing numerous structures in ancient Grecian style, fresh and unimpaired by the ravages of time. Vienna has also one master of the Grecian art, whose name is well known upon the continent (Hausen),—the same who has prepared the plans for the Parliament Building referred to above, and has erected many of the public structures of the new Vienna. He, and the other two architects employed in beautifying the old parade-grounds, have the first names in architecture in Vienna. Within a few years, the renowned Semper, formerly connected with the polytechnical school at Zurich, has also taken up his abode here, and is now engaged with the erection of two large museums,—destined also to beautify the ring,—while, in Dresden, the new Royal Theatre, also by him, now well above the ground, has, without doubt, been seen and admired by many Americans who have been abroad within the last year.

The erection of so many public buildings in Vienna, in ornamental style, has affected the architecture of the better dwellings. No one ventures to build a dwelling-house to-day upon one of the newer streets of Vienna without attention to the requirements of beauty and taste; and the building laws have become so rigid that permission could, under other conditions, not be obtained for their erection. The use of mastic has rendered this possible without undue expense. Within four to six weeks from the time of completion of the rough brick walls, this coating is applied; the cornices and window-cappings are planed out, and the ornamentation put in place,—to last, perhaps, longer than stone itself.

The Viennese are doing their utmost to make their city the most beautiful in the world; and, though much remains to be accomplished, certainly a wonderful amount has been done within a very short period, and it is already disputing the palm with Paris. The use in the latter city of stone for building purposes, to the almost entire exclusion of brick and terra-cotta,—whose durability is surpassed by no material,—causes indirectly a certain uniformity and plainness in the greater mass of buildings.

Many of the newer streets of Paris, as well as of the other larger cities of France,—as Marseilles and Lyons,—are excessively monotonous and tiresome to the eye. No further attempt seems to have been made in the planning of the fronts than to secure the necessary light for the interior, and the exclusion of the weather. Every window in every house is the same,—and, in general, the interior arrangements are similar; so that the owner of any particular house would find himself equally comfortable in any other in the street. Still more pitiful is the appearance of a larger part of the more respectable portion of London, where proprietors content themselves with plain brick walls, in which rectangular holes are left for windows, and from whose upper portion the roof arises without intervening cornice. The meanness and plainness of these dwellings, miles of which are to be found to-day at the west end of London,—almost invariably the property of men of means,—are, to one who has passed several years upon the continent, most displeasing. In the business portions of the same city a decorative art is widely spread, which, though well represented in America, has, luckily for the Viennese, not made its appearance to an undue extent as yet in their city. I refer to shop and store signs, which cover every available point with their glaring characters, and destroy the little harmony that the architect has given to the comparatively few handsome buildings there to be found. A writer in one of the Boston papers, after the great fire, advised that decoration should be very scantily applied to the new buildings to be erected, since it would be immediately concealed by signs of stores, banks, etc. Where ornamentation is, as with us, produced by the use of elaborately chiselled granite, this is, without doubt, true. In Vienna, where only the lower stories of buildings are used for business purposes and the upper invariably for dwellings, the matter is different. Here signs are fewer in number, and the growing taste of the people leads them to place them symmetrically upon the fronts, and blend them with the architecture of the building. I have seen many cases where a sign has been made of the same width as a frieze, which, having been left smooth and without decoration, serves admirably as a position for it, and where its protruding nature is rendered less prominent by the shadow thrown by the overhanging cornice.

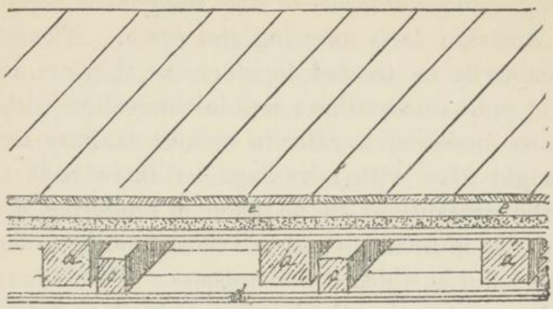
While in Paris the use of stone has had a direct effect upon the appearance of the streets, through the ensuing absence of ornamentation, which, for ordinary buildings, would, in this material, require too great an outlay of money; in Vienna, on the other hand, the use of mastic in connection with terracotta, has played the greatest part in beautifying that city. There are, however, certain indirect effects which arise from the same causes. Where stone is used for the main walls of a building, these need not be as thick as when constructed of brick. For instance: in Paris, at the basement, the front wall of an ordinary dwelling-house may be two feet in thickness, and, at the roof, one foot and a half. In Vienna, such a wall of brick is often two feet and a half to three feet at the roof. Now much, in the way of architectural ornamentation, in order to produce its due effect, must project to a certain extent from this wall, thus giving to the front the light and shade sought for. This is especially true of the upper or main cornice of a building,—that portion which crowns the whole. This is constructed in general by the assistance of stones resting upon the upper surface of the wall, and projecting to the required extent. It is evident that, if these stones project too far, they will topple over into the street, unless they are counterpoised by a certain weight, or are tied down by irons, built firmly into the interior of the wall. In Paris, to avoid all danger from such causes, these stones are required by law to rest upon the whole width of the wall, and in no case project more than the thickness of this wall at its upper portion. Now, where the wall is but eighteen inches or a foot thick, the cornice can also have no greater projection; and this is insufficient to produce much effect. In Vienna, with thicker walls, wider cornices can be made; and those of three and even four feet projection are frequent. The laws of harmony and taste require that this projection of the main cornice should govern all other projections upon the fronts,—such as of window-cappings, subordinate cornices, etc., all of which are made less than the first. Thus in Paris there is a lack of relief in the general street architecture, which is not found in the newer Vienna. In this connection,—now that the matter of cornices is under consideration,—I wish to call attention to a certain matter connected with the late fire in Boston. Although not present there at that time, I have understood that the large stones forming the cornices of buildings toppled over into the streets at an early period in the conflagration. Before the existence of the present building laws of Vienna, which are recognized as among the best on the continent, such accidents also occurred here, and were occasioned by holding these stones in place on the wall simply by the weight of the roof resting upon them. Upon the burning of the latter, there remained nothing to counterpoise the weight of the projecting portion of these stones, and they necessarily fell. At present, they must be tied in place with irons, which are built into the wall and anchored six to twelve feet below the cornice. Whether these stones fell in Boston from a similar cause to that referred to, or whether the walls, from insufficient thickness, crumbled beneath them, is to me unknown. When a fire occurs in the roof of a Viennese house, the wood simply burns away, without disquieting or affecting the dwellers in the lower stories, and the fire then ceases from want of fuel. I remember, last year, trying to discover a house upon the Ring where the roof had thus been burnt, and found nothing in the exterior appearance of the building to indicate that a fire had taken place, and should have passed by had it not been for the crowd assembled in the vicinity.

Having called attention to the activity in building, reigning at present in Vienna, and referred to the especial efforts made to beautify the city ; and also given some hints as to the substantial character of the work done, I wish now to discuss these matters more at length. The field here is an especially good one for study, from the fact that so many of the buildings erecting are to be of a monumental character, where no expense or pains are spared to secure durability and preservation from the dangers of fire. The German race is not an inventive one, but is certainly acquisitive. There is little new and good that other nationalities contrive that they do not sooner or later apply to their own purposes ;—thus, all the methods of construction through the use of iron as devised by the French, are, perhaps, to-day more widely used in Vienna than in Paris. A work has been published by a North German, Brandt, upon this subject, and is filled with the most useful drawings made by himself in Paris, London and Berlin, of all varieties of construction in this material. Many of these are, without doubt, known in America, but not as widely as they should be, and this work is well worthy of translation into English and publication at home. The first matter to be looked into would appear to be that of mastic, from its predominant use and excellent character in this city. Unfortunately, no books have been written upon the subject, and what information I have been able to collect upon it has been gained by questioning builders and masons, and in some cases architects, though these latter seem in general to know less of the matter. Whatever the nature of the material may be, it is always desirable to give it a firm hold upon the fronts to which it is applied, and this is here gained by the use of soft, porous bricks, laid with joints open to a depth of an inch from their external surface, and from half an inch to an inch in width. This has been stated above already, but I repeat it here as of particular importance. The mastic keys itself into these crevices exactly as the plaster of a wall or ceiling is held in place by the openings between the laths. The material used in Vienna is of several varieties, but the chief heads under which it can be classified are two : that prepared by the use of ordinary lime, and that prepared by the use of cement. The latter is considerably dearer, but possesses great advantages. Formerly the first alone was used, and lasted very well when not applied in exposed positions, but where rain and frost could attack it, it showed, after several years, a tendency to crack and blister, though rarely to fall from the wall. Its application here is different from our own. Three mixtures are prepared : the first consists of coarse sand and lime which is thrown upon the walls forcibly from the trowel and allowed to become tolerably dry, the precaution being taken that the bricks be not too dry on its application, since otherwise they absorb the moisture too rapidly from the mortar and cause it to crack; then follows a second mixture of finer sand and lime, which is planed into the required shape, whether of cornice or window capping, by a profile cut in sheet iron and stiffened by a board backing,—this is guided as in stucco-work by strips nailed to the wall. On the second coating becoming nearly dry, an almost liquid mixture of the finest sifted sand and lime is thrown as before upon the wall and again planed out; and finally, corners of moulding, etc., are finished by hand, which presupposes some skill on the part of the workman. It is important that this mastic should nowhere have a greater thickness than one half an inch, and thus, where great projections occur, the rough form of the moulding should be built out with bricks which are broken with the trowel to the required form. For this latter purpose, bricks two feet in length, are burnt in the vicinity of Vienna. The upper surface of such a projection then receives a covering of zinc as a protection against the effects of rain. All the conditions necessary to the production of good mortar are equally applicable to this mastic. The lime and sand must be pure and good; the latter must be sharp, and best from the pit; during its application and setting the mastic must be protected from the influences of the weather, especially of rain. At present, in Vienna, this variety of mastic is going out of use, and the hydraulic variety produced by intermixture of sand and cement is coming into favor; partly on account of its greater durability, partly from the resulting dryness of the walls thus coated, and finally from the greater ease in working. The first variety is now used principally in sheltered positions, as for court-yards covered with glass, for the portions of walls directly sheltered by cornices, etc. Hydraulic cement is best known to us at home under the names of Portland and Roman cement, and the best varieties have been supposed to come from England. At the International Exposition at Vienna, varieties have been exhibited by the Germans and Austrians, which, however, are quite equal to the best English, and are considerably cheaper. The Portland cement is prepared from a limestone with which clay and silica are mixed previous to burning. The Roman cement is obtained directly from a limestone containing the same materials naturally. The proportions are important, and upon them depend the excellence of the cement and its power of hardening under water. The variety employed, principally in Vienna, is manufactured in Kufstein, in Tyrol. United with broken stone in small pieces, *béton* is prepared from it, which is here applied to many uses, among others the construction of foundation walls in moist places, as an underlayer for asphalt pavement, manufacture of artificial stone, etc. The basin for a large fountain has just been completed in Vienna entirely of this substance. The foundations, commenced at a depth of some sixteen feet below the surface of the soil, were prepared of a mixture of three parts of gravel and one part of Kufsteiner cement, and upon these the bed of the basin was laid with a thickness of one foot. The parapet, after being brought roughly into form with the same material, received a coating of a mixture of one part of cement and two parts of clean sand. The mouldings were then planed out and a final coating of one part of cement and one part of fine sand was applied, planed into form and finally polished with a variety of Bohemian stone, which appears to be a soft sandstone containing mica. In conducting this work the whole was kept constantly moist to prevent the appearance of cracks. The workmen employed were all Italians; and these have the reputation in Vienna of thoroughly understanding all applications of cement, and beyond this, of great faithfulness and industry. As masons in general they are unsurpassed, and doubtless, those who are now engaged in street-sweeping in New York, could be much more profitably employed in this labor. The use of cement, as mastic for buildings, is conducted under similar conditions to those described. The exact proportion of sand to be added to the cement cannot be fixed for all varieties, but is always dependent on the quality of the latter. In some cases in Vienna I have understood that the cement is applied without intermixture of sand at all. It must be worked into form immediately upon application, which must ensue directly upon mixing with water. The latter must be used unsparingly, and the whole kept thoroughly wet for several days to prevent the appearance of cracks. It is not, as the ordinary lime mastic, applied in three layers, but all at once, the other conditions being, however, the same as those described in connection with that substance.

The best varieties of cement for mastic are those which set slowly, but the proportions vary for different climates, and can be best determined by experiment. In Vienna the Kufsteiner cement costs about 75 cents per hundred-weight and the labor of application as mastic varies from 30 cents to 75 cents per square yard, according to the nature of the work. Many of the more elaborately ornamental features of fronts, which cannot be directly prepared by the workmen with his ordinary tools, or which require a certain amount of artistic skill, such as consoles or brackets, key-stones, fretwork, etc., are cast in cement and afterwards attached in position with irons, and, if hollow, filled with cement. These, of course, have no weight to support, but are purely decorative. Better and more durable than cement for such purposes is terra-cotta, which is now widely used in Vienna, and is only prevented from supplanting the cement castings by its greater cost. The color of these mastic fronts is that of light sandstone, and is very pleasing to the eye; only when a deposit of saltpetre appears from the brick wall beneath is it customary to paint them. Very pleasing decoration of smooth surfaces of mastic is also produced by the Italian art of Sgrafitto painting. The finest modern specimens of this are to be seen in the passage Victor Emanuel, in Milan. The process is the following: With the mastic is mixed hard coal and charcoal dust, also Frankfort black, previous to its application. After setting it receives a thin coating of slack lime and water, which while still moist is scraped away by a pointed steel instrument, in such a manner as to produce the drawing in white, with black shading and background, or in black upon a white background. This method of treatment is more satisfactory to those minds which find a sham and pretence in the imitation of stone-work by mastic.

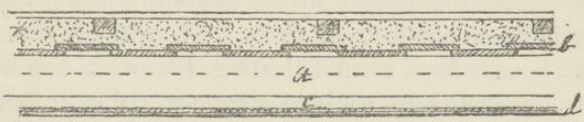
Terra-cotta, as before said, is very extensively employed in Vienna, and many large works are now in operation in the vicinity of the city, where statues, mouldings, columns, capitals, fountains, and in fact all varieties of decoration for exterior and interior purposes, are prepared. This material has been known from the earliest times in history, but has occasionally gone out of use for long periods. The ancient Greeks manufactured vases for ornamental and practical purposes from it. Before them it was employed by the Egyptians, and after them by the Etruscans and Romans. In Pompeii large earthen vessels, capable of containing several hogsheads each, have been excavated, while in Rome, one of still more colossal size has recently been discovered; pieces of frieze and cornice in good preservation have also came down to us from these times. In the fourteenth and fifteenth centuries its use was again revived in Northern Italy, and the hospital at Milan, and above all, the court-yards of the Certosa, near Pavia, are resplendent with the material in most gorgeous hues, to be still seen in unimpaired condition. In England, terra-cotta is manufactured to-day of great hardness and durability, and it is well known that that employed in the Parliament Houses in London is lasting much better than the stone by its side. At the Exposition in Vienna, the finest exhibition of terra-cotta has been made by Austria; the design of all ornamental objects of the substance is marked by taste, and their color,—a light, creamy hue, almost identical with that of the cement mastic described above,—is very pleasing to the eye. It is not so hardly burned as the English varieties, but stands frost well, and is sold at a very low price. Life-size statues, of careful workmanship, as durable and well finished as marble, can be had for ten to fifteen dollars each. The most celebrated factory here is the Wienerberger, within a half an hour's ride of Vienna. Here some four thousand workman are employed in the manufacture of bricks, form-bricks, tiles, terra-cotta objects, etc.; and for the purpose of burning, the ring furnace is alone used. This, I believe, is already known in America. Its essential features consist in the feeding of the fires from above, and in a strong draught produced by a tall chimney. It is said to occasion a great saving of fuel, estimated at as high a rate as three-quarters of that required for the old methods of burning; but the bricks do not seem as hardly burned as our own. Among the conspicuous Austrian structures at the International Exhibition was a triumphal archway, erected of the products of this factory. Under its shelter were exposed various models of furnaces,—terra-cotta objects, such as vases, brackets, etc., of very exquisite design,—and many varieties of brick. The bricks used generally for building purposes in Vienna are slightly less than $12 \times 6 \times 3$ inches, the full size being made up by the joints; others are to be seen here eighteen inches and two feet in length, used, as previously described, for cornices, window-cappings, etc., in connection with mastic; others used for similar purposes have one edge bevelled to avoid the necessity on the part of the workmen of chipping them with the trowel. In addition are hollow bricks used in the construction of fire-proof floors, fire-bricks, perhaps six inches square and two inches thick, used in paving cattle stalls; wedge-shaped bricks for arches and vaults; and hollow conical bricks, in shape much like a small flower-pot closed at both ends. Some of the latter have been employed in the construction of the dome which surmounts the centre of this triumphal arch. Nearly all of these varieties are, I believe, if not novel in America, still limited in their use there. While here upon the continent generally, and especialy in Austria, the arch and vault play a prominent part in every house, in America only our most important public buildings are constructed with them. In Vienna the law requires that the cellars shall be, with few exceptions, vaulted throughout, while in the basement story, the ceiling is in general supported upon iron girders or beams upon which are sprung vaults of hollow brick. These measures are taken in part to secure the solidity of the building and in part as a precaution against fire. A valuable and costly work upon the subject of terra-cotta and form-bricks, containing numerous colored illustrations, by Gruner, appeared some years ago in London, and is recommended to all especially interested in the subject.

I now pass to a matter of especial interest to Bostonians, and, in fact, to Americans in general, and one which can nowhere be better studied than in Vienna. I refer to the methods of building which have for their object the insurance of stability and avoidance of the danger of fire, with the various Austrian laws affecting the same. These subjects must necessarily be treated together, as they are intimately dependent upon one another; and in connection with them it will also be necessary to refer to various sanitary regulations which might also with advantage be introduced at home. Among the precautions to be taken in rendering a building fire-proof, the most important are those tending to confine the fire to the point at which it first appears. This is here accomplished by constructing the interior as well as exterior walls of masonry, making the floors and ceilings as far as possible fire-proof; completely isolating the woodwork of the roof from the remainder of the building, and avoiding the use of wood or other combustible matter generally in staircases and the skylights opening upon them. To prevent the roofs of adjacent houses from communicating fire with one another, they are separated by walls of masonry rising a foot above their upper surface and are in all cases covered with slate, tiles, metal or other uninflammable substance. To prevent the burning roof from falling through into the lower stories, the floor of the attic is made both incombustible and of great strength. The fire-proof floors here employed are of several varieties and materials. A wooden floor is rendered incombustible by a filling of dry mortar, gravel or sand, supported by a rough boarding placed either upon or between the rafters. The depth of this layer is generally six to eight inches, and upon its upper surface comes the flooring, nailed to joists, which are buried in the filling. I have never heard of a case where a fire in Vienna has penetrated through this filling to the beams or rafters below. If fire breaks out in the room below, the plaster of the ceiling is sufficient to protect the beams, since there are no partition-walls of wood to strengthen the flames, and the burning of doors and windows, with their casing, together with the furniture, is insufficient to destroy it. In case of rooms used for the storage of large quantities of combustible matter, there are especial laws requiring brick ceilings. The construction common in the better class of houses in Vienna, where the depth of the room is twenty-four feet generally, is shown in the accompanying drawing.



Section across beams.

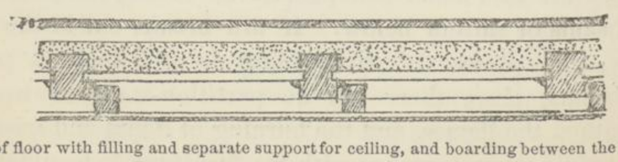
Beams of nine-inch by six-inch timber, separated by intervals of not more than three feet, rest parallel to each other, with at



. Section parallel to beams.

a main beams. *b* boarding. *c* smaller beams supporting ceiling. *d* stucco, etc. *e* joists.

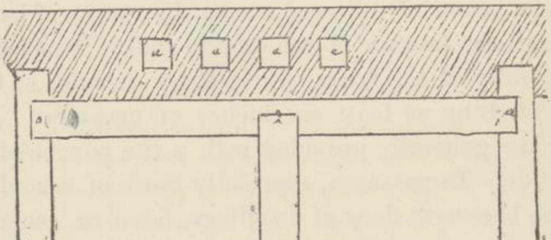
least six inches of their ends upon the walls. Upon these a boarding is laid to receive the filling referred to. In this filling are buried joists at right angles to the main beams, and upon these the flooring is finally nailed. The laths or reeds to receive the plaster of the ceiling may be nailed directly to the lower surfaces of the beams, or, as is more customary, to smaller beams placed between the first and slightly lower. In this way the ceiling is secured from vibration, which is especially desirable when much stucco-work is employed.



Fire-proof floor with filling and separate support for ceiling, and boarding between the beams.

The whole thickness of this construction is eighteen inches, which includes a parquet flooring. At the risk of making these details still more minute, and taking it for granted that great interest is felt at home in these matters, I will state further that as regard the walls upon which the beams rest, the exterior one is of such thickness that it can generally be diminished six inches at each story at the point where these rest, thus giving them a free support, and diminishing the danger of injury to the wall by the vibration of the floors; where it is impossible to make the middle wall of such thickness as to admit of a diminution of six inches on each side in every story, the ends of the beams, before being built in, are covered with zinc to prevent the corrosive effect of the wet mortar upon the wood. These matters are not connected with fire, but I mention them here incidentally as of value and perhaps not generally known at home.

A building-law of Vienna requires that all woodwork should be separated from the interior surface of flues by a thickness of at least six inches of brick. It further insists, that in the interior of the flue, an earthen pipe shall be inserted in every story, extending at least from the ceiling to the surface of the flooring above. Flues occur frequently here in the middle



Manner of guarding floors from flues. *a* Flues.

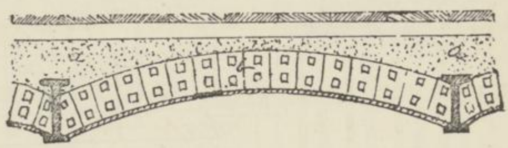
wall, which supports the ends of the beams for floors, and often several flues occur side by side, so that the end of one of the beams might lie directly upon their opening, if all are supported directly by the wall. To avoid this, a simple contrivance is employed, known, without doubt, in America, and easily understood from inspection of the accompanying drawing. Upon the two adjacent beams a cross-timber is supported, which receives, at its middle point, the end of the beam in question. The flues are in general six inches in diameter, and the wall necessarily at least eighteen inches thick, in order to allow six inches of masonry upon each side of the opening. The object of carrying the flues up through the middle wall is to cause as much heat as possible to be retained in the building, and to avoid the protrusion of the chimney into the interior, which would result if it were placed in the side-walls, which are generally of lesser thickness. Whether the neglect of these precautions has anything to do with the constant fires which we hear of at home, as resulting from defective flues, I am unable to say.

Another form of construction in wood, common in the attic, and often occurring also in the basement floors, consists in laying half or whole trees side by side, and pinning them firmly together. Upon these comes a filling and flooring, as above described, for the basement; and, for the attic, a filling and tile pavement. In all these floors, greater solidity is gained, if the ends of the beams rest upon a timber running the entire length of the wall, thus diffusing their weight more uniformly upon the masonry. This is, of course, especially applicable to the case where the wall is diminished six inches in thickness at the point where it takes up the beams.

Another practice, here worthy of note, is the union of the ends of the beams of adjacent rooms, by means of irons passing through the interior of the middle wall. This adds much to the stability of the floors, while these remain, at the same time, isolated by at least six inches of masonry. Further, kitchens are generally provided with a tile pavement as well as the attics. In passages, especially those of school-houses, and in the basement floor of dwellings, *béton* or cement floors are not uncommon. These are rendered ornamental by the insertion of small bits of stone into the mass before setting, forming regular patterns, and the whole is eventually polished.

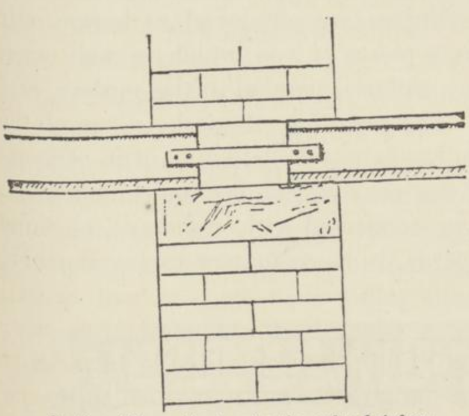
These two forms of fire-proof floors are the most common in Vienna, where wood is used. It remains now to speak of iron and masonry, alone or in connection with one another. Where transverse strains occur, wrought-iron is made use of, and only in a few of the cases where there is a pressure in the direction of the length to withstand, is cast-iron considered admissible. Where beams of moderate length are used, railroad iron is often applied here; but for greater lengths, double T or I girders are necessary. In cases where greater strength is required, beams are rivetted together from bar and angle iron. These forms are all well known in America, but are not in general use there for the construction of floors.

The first variety of floor I shall describe, is that most common on the continent, and, without doubt, known in special cases at home. Girders are laid parallel, from wall to wall, at intervals of about six feet, and upon them flat segmental vaults of hollow brick are sprung. Where additional security



Section across vaults and girders. *a* Filling. *b* Hollow bricks.

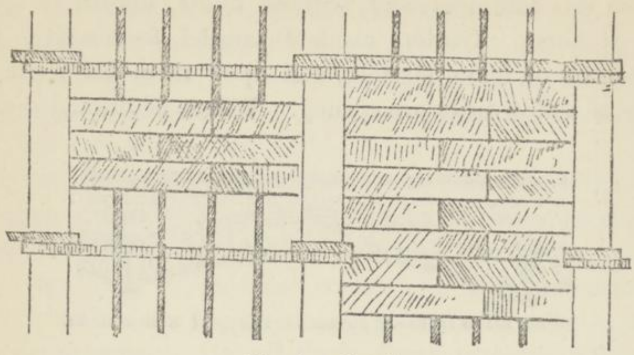
is desired, the ends of these girders are anchored fast in the walls, or where adjacent rooms occur, having this form of floor, the girders may be tied together through the middle wall. In some cases, the thrust of the vaults is taken up by rods of iron tying the girders to one another transversely. To prevent the protrusion of these rods, it is becoming usual, in England, to pass them through the interior of the bricks, which requires them to be slightly curved, but not sufficiently so to produce any undue pressure. The lower surface of the vaults receives a coating of plaster, and is, in Vienna, generally decorated with frescoes, as may be seen in many of the new coffee-houses. Above, the vaults are covered with a filling, upon which come the joists and flooring, as before described. This form of floor is more thoroughly fire-proof than either of the others, and is required by law in Vienna, in most cases, in the basement story of buildings. To secure the greatest solidity, a stone is built



Section of the wall, showing the ends of girders.

into the walls to receive the end of each girder, and distributes its weight over several bricks.

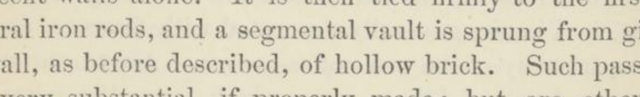
A second form of floor, employed where it is desirable to



View from above.'

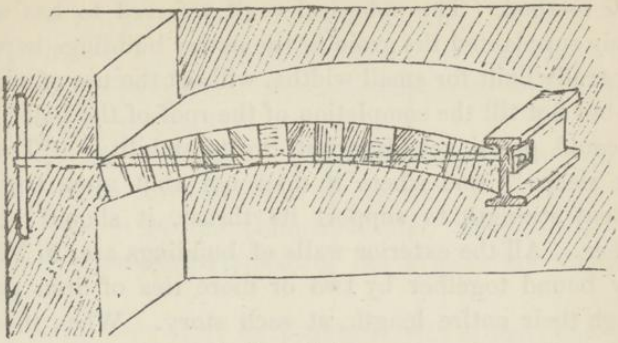
save room, occurs in several buildings in Vienna, but not so generally as the last. Girders are employed as before, but support, in this case, cross-pieces of iron, which, in their turn, receive rods of the same material parallel to the girders, and placed between them. The resulting network is bound together with wire, and hollow bricks are laid upon it in cement. The whole thickness of this construction is about nine inches.

For fire-proof passages connected with stairways, or built on the sides of court-yards, it is customary to lay a girder



Cross-section through girders.

parallel to the wall, with its ends supported by the two adjacent walls alone. It is then tied firmly to the first by several iron rods, and a segmental vault is sprung from girder to wall, as before described, of hollow brick. Such passages are very substantial, if properly made; but are otherwise excessively dangerous. From insufficient strength in the tie-rods, an accident of the most distressing nature occurred a year ago here. Some heavy weights thrown violently upon such a passage connected with a stairway, tore the ties asunder, and the whole mass of brick-work fell, carrying stairs and passages with it, from the fourth story to the cellar,



Austrian arched passage.

while fourteen workmen were killed. However, there are but few houses in the newer part of the city where these passages do not occur, and ordinary care proves sufficient to prevent such disasters.

Vaulting of masonry alone was formerly common in Austria in all stories of buildings, but is now confined, in most cases, to the cellars, having been supplanted elsewhere by the extended use of iron. The ordinary cylindrical vault is employed occasionally, but the tendency seems to be to transfer the weight of the superstructure to special points or pillars, rather than to continuous walls, after the principles of the Gothic architecture. In this way the same stability is secured, with a less expenditure of material; and German writers contend that the necessities of building are thus met in the most rational manner. A passage, for instance, is to be built and covered by masonry alone. Instead of erecting two walls of uniform thickness, and joining them above by a cylindrical vault, a row of pillars is built, having, in special cases, the width of the passage for their distance apart in the row. Each pillar is then connected by a strong arch of several superposed layers of brick with the one opposite it, and the one on each side of it. In this way the length of the passage is divided into squares, and each of these is covered by a light vault of spherical form, supported by four of the arches described. The spaces left between the pillars in row, are then built up with a light brick wall, which has nothing but its own weight to support. The amount of material thus employed is much less than that required by the first mentioned method. The spherical vault referred to has almost entirely supplanted the groin in the newer buildings here, and is generally built for small widths, without the use of scaffolding; but not till the completion of the roof of the building, as rain could prove very injurious to its stability. "The arch never sleeps"; and where it does not abut upon a wall of sufficient strength to support its thrust, it should be tied together. All the exterior walls of buildings are, in Vienna, firmly bound together by two or more ties of iron passing through their entire length, at each story. When these are built into the masonry, and protected from contact with the air, they are not affected by rust. At the demolition of a house at least fifty years old, I have seen such ties taken out in perfect condition.

Before proceeding to the description of fire-proof stairways, one of which, at least, is required in every building in Vienna, I will give a translation of the more important building-laws here in force, as they contain much information on this subject, and will assist in making the preceding portion of this article more intelligible.

1. When the position of a building is such as to make it desirable, as a precaution against fire, the ground floor must be vaulted. In the attic, and in the first story, when the ground floor is not vaulted, the floors must be massive (as described), and a layer of dry mortar, sand or other incombustible matter, must separate the beams from the planking.

2. Stables and hay-lofts must have a fire-proof ceiling.

3. Rooms for storing fuel must be, in general, located in the cellar, and built of masonry. When they are in sheds of but one story, they must, in addition, have a fire-proof roof.

4. In every building fire-proof stairways must communicate from the attic to the cellar, and with every dwelling, by means of fire-proof passages. (This implies, that the vestibule should be also fire-proof; and it is, in fact, invariably vaulted, and has a flooring of stone or *béton*.) In buildings of great extent, there must be several such stairways, sufficient to

enable all persons dwelling in them to pass readily out of doors.

5. When a stairway is lighted by means of a skylight, the frame of the latter must be constructed entirely of iron, and rest, on all sides, on masonry rising above the roof.

6. All stairways and passages connected with them must have a fire-proof railing.

7. Woodwork must be removed from the interior surface of all flues by a thickness of at least six inches of masonry. The masonry of the chimneys must be plastered on the exterior, from the pavement of the attic to the highest point of the roof.

8. Each story shall be provided with at least one separate flue, passing, without communication with any other, to its exit at the roof. Where the beams of the floors rest upon the walls containing flues, an earthen pipe shall be inserted into the latter, having, for its length at least, the thickness of the whole floor; and for its thickness, at least one inch. Every flue must have, at its commencement in the lower story, and also in the attic, a side opening, closed by two iron doors, closely shutting, and provided with a lock. Where several flues lie side by side, they shall be closed still further by an iron bar and padlock, extending over the openings of all. All woodwork in the vicinity of these doors must be covered with sheet-iron.

9. All roofs must be covered with tiles, slate, metal or some other fire-proof material. The woodwork of the roof must at no point be nearer than six inches to the pavement of the attic. Iron roof-frames must rest upon masonry alone; wooden cornices are forbidden.

10. The attic roof must be covered with tiles, cement or other fire-proof material. An iron door, hung in an iron frame, must communicate alone from the main stairway with the attic. At least once, in every ninety feet of its length, the attic must be subdivided by a brick wall running across its width and rising nine inches above the roof. (This is generally covered above with zinc.) The compartments ensuing shall communicate with each other only by means of iron doors hung in iron frames. No dwelling-rooms are permitted in the attics of buildings.

11. Every house shall be provided with a wall at least six inches thick, separating it from its neighbor,—for the two houses thus ensues a wall of twelve inches.

The thickness of walls must be regulated by the weight they have to support and the material of which they are composed; also by the height of the stories and the construction of the floors and ceilings.

The following rules are to be observed:—

(a.) The principal outer walls, as well as all interior walls, at the point where they contain flues, must be at least eighteen inches thick. The principal walls of the upper story must be at least two feet thick, if the depth of the rooms is more than twenty feet. The main walls may have the same thickness in two successive stories. In buildings of three stories, the main walls must, at the ground, be at least two feet thick; in buildings of four stories, at least two and one-half feet thick. Those portions of the main walls which do not support floors can be made eighteen inches thick for all stories.

(b.) Where the ceilings are vaulted and rest on iron girders, in case the latter are not more than twenty feet long, the walls supporting them need only be eighteen inches thick for all stories; where they are of greater length, the walls must be two feet thick.

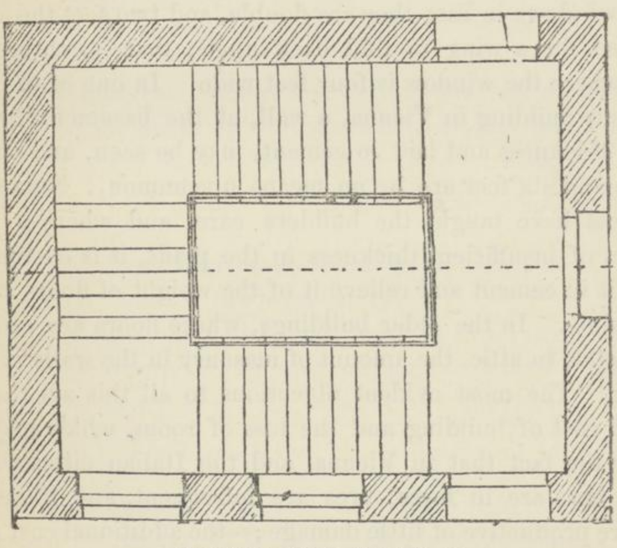
(c.) The foundation walls must, in all cases, be six inches thicker than those of the lower story.

(d.) In light walls, the walls must be in all cases eighteen inches thick where they support ceilings or bound rooms used for dwelling purposes. In other cases they need be only twelve inches thick.

(e.) Walls supporting massive floorings of half or whole trees (as described) must be two feet thick, and the trees must rest for six inches at their ends upon the same.

The thickness of walls, as seen by the above extracts from the laws, is fixed in no case at more than three feet, which would occur in foundations where the basement wall had two and a half feet. The Austrian foot is about one-half inch longer than the English, and the thicknesses fixed are in all cases multiples of the length, breadth and thickness of the bricks. The tendency is, however, in the better buildings, to build walls of still greater strength, and for a variety of reasons. These admit, as before mentioned, of greater projection of cornices; they are good non-conductors of temperature, and remain in good condition even after extensive fires. The large size of rooms in the newer houses, having in general a depth of twenty-four feet, and a height of twelve to eighteen feet, and the great size of the windows, call also for an additional strength of masonry. The latter do not, as with us, slide up and down, but fold back in two wings on hinges, and generally towards the interior, thus enabling the whole window opening to be uncovered, while by our method one-half of it must always remain closed. To prevent the projection of these wings into the interior of the rooms on opening, the walls must be at least three feet thick, of which six inches represent the distance the window is set back from the front, six inches the interval between the exterior and interior windows in case they are double, and two feet the space required for a wing to fold back upon; that is, three feet in all where the window is four feet wide. In one of the new museums building in Vienna, a wall, at the basement twelve feet in thickness and laid in cement, may be seen, and others of five and six feet are by no means uncommon. Numerous accidents have taught the builders care, and where a wall appears of insufficient thickness in the plans, it is customary to lay it in cement and relieve it of the weight of floors as far as possible. In the older buildings, where floors are vaulted from cellar to attic, the amount of masonry in the walls is still greater. The most evident objections to all this are the increased cost of building and the loss of room, which may be met by the fact that in Vienna, and the Italian cities where similar laws are in force, fires are infrequent, and if occurring, are productive of little damage;—the additional cost may thus be looked upon as a good investment of capital. If such regulations cannot be introduced in general in America, something might be done to insure the safety of human life, in theatres and hotels especially, by requiring the construction of substantial and fire-proof stairways and passages.

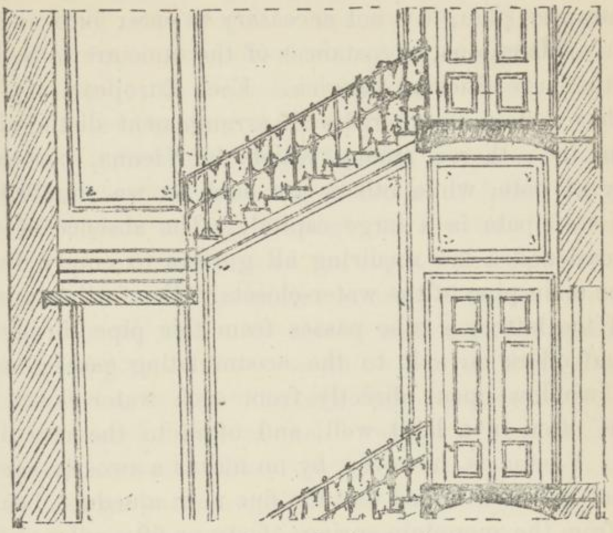
In most of the dwelling-houses and other buildings of Vienna, the stairway forms one of the most important architectural features of the interior. It is of stone usually, although of late the French constructions, with the use of wrought-iron, are coming somewhat into vogue. Where the flights are direct, without curve, the breadth of the steps must be at least four feet clear for buildings more than two stories high. The favorite form of stairway is that in which each step is built at one end alone, some ten inches into the wall, and is not otherwise supported. Good limestone is chiefly employed for this purpose, and stands very well when not subjected to violent shocks from heavy weights. In one of the new large hotels, where the steps are some twelve feet long, these are supported by double T girders, passing under each end and resting upon stone columns. Where the necessary space is at hand, a three-armed stairway is generally built in dwelling-houses, in each corner of which a square resting-place occurs, formed by a single stone built on two of its



Plan of staircase in a Vienna house.

sides into the adjacent walls. There is a case in Vienna of artificial stone being applied to this purpose and standing very well for several years;—its width and breadth are about six feet, its thickness six inches, and its composition Kufsteiner cement and sand.

I lived on one occasion for several months in a new house in Vienna, where a stairway of the form referred to exists.



Section of same, showing one story.

It is remarkably easy of ascent, and has plenty of light and air, provided by windows opening onto a large court. It is inclosed, with passage, by four walls, bounding a rectangle of eighteen feet in width by twenty-two feet in depth; on three sides of this, three flights of steps, each six feet in width, are supported at one end only; on the fourth side is a vaulted passage of the same width, running across from wall to wall, and communicating with three dwellings. In each of the two opposite corners are resting-places, six feet square, and in the centre of the whole is an open space measuring six feet by ten feet. The breadth of each step is thirteen inches, and its height six inches. By law, these dimensions cannot be less in the first case than eleven inches, nor more in the second than six inches. In the case of spiral stairways, or those ascending in any curve, the breadth of the steps at the distance of eighteen inches from the walls must be at least eleven inches, and at the smaller end at least five inches. All these stairways are provided with a metallic or stone railing. If such stairways already exist in a house, others of wood are also permitted, but their width cannot be made less than three and one-half feet, and in their other dimensions they must conform with the laws already quoted.

As regards the general arrangement of dwelling-houses on the European plan, it is not necessary to enter into any very minute explanations, as instances of the same are to be found in all the large cities of America. Each European city, however, has certain peculiarities of arrangement distinguishing it from the others; among which, in Vienna, certain are worthy of note, while others are such as we should by no means anticipate in a large capital. The absence of water has occasioned a law requiring all gutters to empty directly into the main-pipe of the water-closets. For further purification of the latter, a tube passes from this pipe through the roof and offers an exit to the accumulating gases; beyond this a window opens directly from each water-closet upon the air, often in a light well, and often to the rear of the house. Vienna is, however, by no means a sweetly-smelling city, but it is now hoped that the fine new aqueduct, bringing water from the mountain springs, forty or fifty miles distant, will do away with this evil. The direct communication of each water-closet with the exterior air, is a point which we unfortunately do not generally regard. In Berlin I have also noticed a great neglect of this precaution, the privy being there frequently placed in a corner of the kitchen, while with us, any point where room is at hand, is thought sufficient. How often do we place it in the interior of the house, and furnish it with light by means of a window opening into a bedroom! In buildings of great extent, interior court-yards are frequent here, and furnish light and air to subordinate rooms, passages frequently also to water-closets. Where these are of great size, at least sixty or seventy feet square, and the sun can shine into them several hours a day, the better apartments are also located upon them, and are thus secured from the noise and dust of the street; this being especially the case in large schools and university buildings where lecture-rooms are frequently so placed. Another advantage is the privacy thus gained. Smaller court-yards, measuring perhaps thirty by forty feet, are often covered by a glass roof, supported by an iron frame and provided with a monitor-top for ventilation. The newer hotels of Vienna and Paris, as for instance the Grand Hotel of the latter city, have such covered courts. Where two buildings have their courts adjacent, it is customary to carry the wall between them up to a height of only fifteen or twenty feet. The perspective view gained from the vestibule into the court is often made very pleasing by the presence of a statue or fountain in the latter. Frequently, too, the wall just referred to, is painted decoratively with architectural features which are sometimes so contrived as to give an appearance of increased depth. I remember once looking through the doorway of a modern Italian palace in the heart of the city of Brescia, and seeing to my astonishment beyond the court, an extensive range of meadow, beyond which lay a lake and villa with park. In the foreground was a fountain, and a row of arcades on each side terminating in a garden pavilion. On entering the vestibule I discovered that here was a remarkable combination of the real and unreal. The court was sown with grass, and several trees grew at irregular intervals at the sides. Upon a wall rising at the rear, the grass and trees were painted in diminishing perspective, while the arcades were only for a short extent real; their continuation and the garden pavilions being also painted as the remainder of the picture, with the exception of the fountain in the foreground. The main entrances of houses in Vienna, are, with few exceptions, eight to ten feet wide, and provided with a driveway, on each side of which is a narrow footway raised several inches above the former. The height of the buildings is fixed at four stories, in addition to which a half-story or mezzanine is allowed, separating the ground floor from the first story. Mansard roofs are almost unknown, from the fact that dwellings not being permitted in the attics, they could serve no purpose but that of ornamentation.

Thus far little has been said in this article in regard to the International Exhibition, since most of the buildings there are of a temporary nature, and, beyond their picturesque appearance, present little of interest. The central rotunda, however, is a remarkable structure, and, with the emperor's pavilion and a few other buildings, will be spared on the general demolition following the close of the Exhibition. It is composed entirely of iron, is circular in form, and covers, with its roof, the largest area as yet built over without the use of interior columns or pillars. Its essential features are thirty-two iron columns, placed at equal intervals in a circle, upon foundations of *béton*, and which support as many iron beams radiating towards the centre of the circle. A ring, also of iron, connects the tops of the columns and takes up the thrust of the roof, formed of iron plates riveted to these beams. The roof is of conical form, and supports a large and a small lantern. The diameter of the circle is one hundred and eight metres, and the height of the whole eighty-four metres. Exterior to the columns is a brick wall supporting an iron roof and inclosing the whole. The emperor's pavilion is chiefly remarkable from the magnificence of the interior decorations, but has been lost to most of the visitors at the Exhibition, from the difficulty of obtaining entrance. Beyond these, an Austrian building, composed entirely of concrete, is worthy of note. The roof is vaulted of this material, and is above flat and surrounded by a balustrade. It serves the purpose of a terrace, and is reached by a stairway of concrete alone, and supported entirely by a single arch. It is claimed in Vienna that such buildings can be erected at a less cost than those of brick; but the difference appears slight, since the walls must be made somewhat thicker of concrete, and, where it is used in such masses, great care must be taken to prevent its cracking, and, consequently, crumbling. The experiment is an old one; and, at the Exhibition in Paris in 1867, various laborers' cottages were built of the material without seeming to meet with general favor. The English exhibitors have erected, at the present Exhibition, several cottages of corrugated iron nailed to a wooden frame. These have the merit of cheapness, but are of little value in excluding heat or cold. During the hottest part of the summer it was excessively uncomfortable in their interior, and, moreover, in one or two cases where they have taken fire, elsewhere, they have burned like tinder. Wood in connection with iron, for building purposes, is, in fact, more dangerous than wood alone. When the latter has reached a glowing heat, everything in its vicinity that is at all combustible is instantly inflamed. This is well understood in Austria, as is shown by the building-laws quoted above, which require the separation of these two substances. Where danger of fire might arise from falling sparks,—as in many cases of railroad buildings,—of course a sheet-iron casing has its value; but in general, where fire is liable to occur within, its use, to any great extent, seems inadmissible.

Among the plans to be seen at the Exhibition, my attention was especially directed to those of the new national library at Paris, whose description was appended. I translate a few of the principal particulars. This building is capable of containing (2,000,000) two million books and manuscripts. Its walls are all of masonry, while the floors, roofs, doors and windows are all of iron. To avoid the necessity of steps and ladders, all books can be readily reached by numerous iron balconies, separated from one another by intervals of about six and a half feet, while the carpenters' work is, in general, replaced by iron throughout the building. The roof is covered by glazed tiles, supported upon iron trusswork, and, at various portions of the same, terraces, affording access to large reservoirs, constantly filled with water, offer additional protection in case of fire. In the large reading-room, containing seats for four hundred and fifty persons, several iron columns, of very small diameter, help to support the roof. These are here in place; but, where there is a large quantity of combustible matter in the vicinity, such supports are always dangerous. As the Boston fire showed, they bend immediately upon becoming red hot, and let everything borne by them fall in general destruction; granite proved little better,—cracking and falling rapidly to powder when attacked by the flames. For magazines and store-rooms,—especially those containing combustible matter, and where a small loss of room is comparatively unimportant,—brick, it would seem, might be used for pillars where these are necessary. Certainly, no other material has shown itself so valuable in case of fire.

Better than the Exhibition, as a field for study, is the city of Vienna itself; and I cannot do better than describe its finest building throughout, before closing this Report. For its beauty, the solidity of its construction, its security against fire, and its excellent arrangements for ventilation and heating, the Vienna Opera-house could well serve as a model for the world. Less imposing and costly than the similar building now completing in Paris, it is nevertheless admired by all visitors, and is acknowledged by the French as its rival in convenience and taste. It was completed in 1868 from the funds gained by the sale of land acquired by filling the ancient military ditch and levelling the walls, and cost not far from six million dollars. The area upon which it stands has an extent of eleven thousand square metres, of which eight thousand are occupied by the building itself. Its form is symmetrical, and the whole stands free, open on all sides to the view. The front upon the opera ring,—a section of the new boulevards surrounding the interior city,—presents two superposed arcades, containing five arches each, the lower being entrances to the main vestibule, which is reached from this point by crossing the *porte-cochère*, or at the ends directly from the sidewalk; the upper arches open upon a loggia, which is richly decorated with frescoes, and is, in the evening, brilliantly illuminated. From the centre of the vestibule ascends the main stairway, which, with its vaulted passages, covered with frescoes of light and graceful form and harmonious colors, forms perhaps the most beautiful portion of the interior. This communicates with the private boxes alone, which occupy such a large portion of the galleries of all European theatres. To the right and left are smaller stairways,—like the main one, of course, all of stone,—which lead to the seats in the upper galleries. Following the central line of the building, are next—the parquet and the front and rear stage. The latter, with their adjoining rooms, receive light from two court-yards measuring thirty-three by eleven metres, and covered with glass. These are situated symmetrically to the right and left of the central line, and descend below the level of the street to give light to the rooms below the stage. In the middle of each side of the building is a wing, advancing some twenty-five metres, bounding an end of the courts mentioned, and containing stairways for the emperor and arch-dukes. At the rear of the building are two similar wings, connected with the first by arcades, and behind them a row of shops,—these bounding the fourth side of the courts. In these wings are staircases for the actors and actresses, and in one of the courts are six steam-boilers, connected with the engines for heating and ventilation, and here placed to avoid the injurious results of an explosion. At the rear of the building is a central entrance to the rear stage, and to its right and left are situated magazines. At the height of the third gallery, which corresponds with the second story externally, a ceiling of iron and brick covers the main stairway, and above it is located a buffet or restaurant. In the upper stories of the four wings are wardrobes, rooms for scene painting, etc., to which purpose the room over the rear stage is also devoted. The ceilings of these rooms are all fire-proof, and, of course, all walls in the interior of the building are of masonry. Right and left from the stage are nine stories of vaulted passages, in whose floors are water-pipes, supplied by reservoirs in the attic, and furnished at short intervals with cocks, reached by small iron doors in the walls. These can throw powerful streams upon the stage in case of fire. A steam-engine, of eight horse-power, pumps water into the reservoir and moves the stage machinery. It is located in the cellar, under one of the wings. The auditorium accommodates in all three thousand persons, including six hundred standing places in the fourth gallery and the rear of the parquet. The breadth of the stage is 29 metres and its depth 24.6 metres. The opening covered by the curtain is 11.4 metres high, and 14.2 metres wide. The depth of the rear stage is 19.9 metres. The exterior of the building is covered by a layer of stone upon brick, and, though tastefully treated architecturally, is, in general, simple in design. The central portion of the building is covered by a semi-circular roof of iron, to which is hung the stage machinery and the fire-proof ceilings over the stage and the auditorium,—the latter of which is decorated with paintings by the first native artists. A wire curtain can separate the stage from the audience in case of fire. The ventilation of the opera-house is conducted by means of steam-pumps, which force in the fresh air through a multitude of small openings dispersed about the floor of the parquet, the boxes and the galleries, thus occasioning no perceptible draughts. The heated gases pass away by an opening, four metres in diameter, above the central chandelier of the auditorium. A steam-engine, of twelve horse-power, situated in the cellar below the main vestibule, sets a fan some three metres in diameter in revolution, which can force one hundred and twenty thousand cubic metres of air per hour into the rooms above. The cellar, which is more than seven metres in height, acts as a reservoir for the air, which is drawn in through various channels, and has here in summer the opportunity to cool. It then passes upwards by several openings into the upper rooms, or, in winter, can be first led through a chamber heated by steam-pipes. The system is on the largest scale ever as yet applied. Below the auditorium is situated the inspection-room, from which all the machinery is regulated. Here the temperature is observed, the position of the valves, the steam pressure, etc., while speaking-tubes and electrical wires communicate with all parts of the building.

Further information in regard to this building can be obtained from various works published in Vienna; among them the "Technical Guide,"—also translated into French,—which appeared at the commencement of the Exhibition; also the work of A. Folsch,—"Fires in Theatres and their Protection against the Same," and others.

The subject of ventilation, especially of that of schools, theatres, public buildings, etc., is still being investigated abroad, and every year finds some advance in the methods employed. In Glasgow a university building, recently completed, is provided with a tower of great height, in which a steam-fan sucks in the air from the summit and diffuses it through the building. In this way a pure atmosphere is secured which does not exist in the lower strata of the air of this great manufacturing town. This is introduced through numerous small openings, placed under the seats in the lecture-rooms and at the lower parts of the walls, while the exit of the bad air above is assisted by an additional engine. In the new Exchange building of Vienna, extensive provision is being made for thorough ventilation, and below the cellar, channels of great size, connecting with exterior openings, twelve to fifteen feet square, furnish the requisite fresh air. Some of the simpler contrivances in coffee-houses and dwellings, in this city, are also worthy of note. Openings are very often made in the upper portions of the walls connecting with the chimneys, and in these a gas-flame assists the draught. These are sufficient to carry off a large portion of the smoke and vitiated air, but unless some provision is made for introducing fresh air at various points, this is sure to make its entrance by the cracks of the doors and windows, thus causing disagreeable and often dangerous draughts.

One method of obviating these is, to pass pipes connecting with the external air through the stoves, or fireplaces, used for heating the rooms, in which way a draught is produced and the current is warmed. The practical result is immediately evident in the cessation of the cold currents from the cracks of the doors and windows. These particulars, and many others of interest, are contained in a little work by Ludwig Degen, architect of the city of Munich, on the subject of ventilation. As regards the applicability of the methods of building described in this Report, in a country like America, where labor and material are dear, it can only be said that they would effectually prevent the recurrence of the great fires which have proved so destructive there. It is very doubtful whether our government is sufficiently powerful to establish the regulations cited as prevalent in Vienna; but certainly a description of what other nations are doing (as the result of the experience of centuries) is of value, and will impart the information on the basis of which the necessity of such restrictive laws can alone be properly appreciated. A step can be taken in the right direction by the proper construction of government buildings, and by the application of the necessary restrictions to theatres, hotels, school-houses, and other buildings where fires could be productive of great loss of life. Beyond this, men of wealth and patriotism could set a good example by the erection of private edifices of the sort described, which would have the additional advantage of helping to check the spread of the flames, in the same manner that the Boston Post-office has already once done.

I have been repeatedly assured that it is impossible to induce the people at home to build fire-proof buildings, unless they be convinced that these are as cheap as those at present erected there. Now this is, of course, impossible to prove, for it is not true; but when it is generally understood that, in building houses with thin walls and pitch-pine floors a crime is committed against the public, it is natural to suppose that good citizens will cease from and discountenance such building, and that laws can finally be passed forbidding it. At the same time the expenses may, in many ways, be lessened. While a bricklayer in New York and Philadelphia (whose skill consists in making all the joints of a constant width, never varying by the thickness of paper) receives five dollars a day, the Italians, who are renowned in Europe as the first masons of the world; who, with inferior material, can construct a wall not only strong but handsome, and thoroughly understand all the jointing of vaults and arches, earn seventy-five cents a day. The ring-furnace, before referred to, produces bricks of inferior quality, but excellently adapted to the application of mastic, and at a greatly reduced price. With these, the thick walls necessary to sustain vaulting could be built at a low cost, which could be still further reduced by the importation of Italian workmen. The cheap terra-cotta could be imported from abroad at first, at reduced rates of duty, which is certainly as advantageous as importing our marble in wrought forms from Carrara, and other parts of Italy, as is now frequent.

I have heard it often said that we do not need to build fire-proof buildings, as those erected would form but a small percentage of all buildings standing and dating from other periods; but that we need care and an excellent fire department, and various other things, all of which are perfectly true, with the exception that we certainly also require as many fire-proof buildings as we can have. These points are all-important, and should all receive their proper consideration. The lesson is a hard one, but must be sooner or later learned, and those that profit by it earliest will profit the most. An objection to the Viennese methods of building has also been brought forward by those claiming that, in Paris, London, and other capitals, wood is used more generally than in Vienna, and that these cities are secure from fires. The matter is entirely a relative one. Fires are less frequent and extensive in all European cities, except, perhaps, Constantinople, than in America, for the reason that there is more masonry and less wood in their buildings than in ours. At the same time, fires are less frequent in Vienna than in other European cities, for the same reason. As I write, the news of the destruction of the French Opera-house has arrived, and I feel little doubt that the Communists would have found much more difficulty in destroying Vienna than they did in their work in Paris after the Franco-German war.

In closing here, let me say that the attempt has been made in this Report to convey as much information on the various subjects treated as possible, and, at the same time, to make it of interest to the general reader. The latter end has been, at times, sacrificed to the former, as must naturally be the case when technical matters are treated of. The writer, however, trusts that those who have had the patience to read it to the close will have found matter for reflection, and will be convinced of the importance of some changes, at least, in our manner of building at home.

NELSON L. DERBY.

VIENNA, 1873.

HARD VULCANIZED INDIA-RUBBER; CALLED, ALSO, EBONITE AND VULCANITE.

BY JOHN FRETWELL, JR.

CLASS VI. — SUBDIVISION 3.

No one who is intimate with American manufactures and inventions, could inspect the Vienna Exhibition without being convinced, that however inadequately our industries might be represented in the space allotted to the United States Commission, and however unwilling our manufacturers might be to exhibit their goods in a country where they did not seek a market for them, the inventive genius of Americans had contributed very largely to the goods and machinery exhibited by other nations.

One instance of this fact is to be found in the manufacture of the Hard Vulcanized India-rubber.

It appeared in the American Court only in one form; as a part of the penholders at the gold pen stands; and yet, invented by the American Goodyear, the subject of many American patents and patent lawsuits, and manufactured by the New York Rubber Comb Company, the Vulcanite Jewelry Company, the Novelty Rubber Company, and Austin G. Day, it might have claimed a prominent place among American industries at the Universal Exhibition.

On the other hand, the names accompanying the exhibits of the Russian American Company of St. Petersburg, in the Rotunda, and of the American Rubber Company of Mannheim, and the New York Hamburg Company of Hamburg, in the German Annexe, gave evidence of their American origin.

The Scottish Vulcanite Company of Edinburgh owes its establishment, in part at least, to American capital and enterprise, while the pamphlet distributed by the chief European manufacturer of vulcanite, H. C. Meyer, Jr., of Hamburg, whose lofty column of this material formed the most prominent of all the hard rubber exhibits, expressly states that *his* manufacture of this article originated in the purchase of Goodyear's American patent in 1851, and the establishment of a factory at New York, the forerunner of that now carried on by the New York India-rubber Comb Company, at College Point.

The process of manufacturing this hard compound in India-rubber is too well known to need a long description here. The raw material is first cleansed from the impurities with which it is mixed in the process of collection, is then incorporated with sulphur, or other vulcanizing material, and subjected, under careful exclusion from the atmosphere, to a heat of from 270° to 310° Fahrenheit, being, while in a soft condition, rolled into sheets or pressed into moulds, whose form it retains after being vulcanized. By the addition of various pigments it can be colored, and samples of red, brown, yellow and mottled vulcanite were exhibited by H. C. Meyer, Jr., of Hamburg.

So far as the various processes of manufacture are concerned, the means of hardening the material, of giving it a permanent polish, and protecting it against atmospheric and solar influence, of coloring and working it, etc., nothing new could be learned at Vienna. These processes are treated as secrets in Germany, and not, as here, published in the patent specifications.

The show-cases of H. C. Meyer, Jr., of Hamburg, gave a comprehensive view of all the purposes to which the hard rubber has hitherto been successfully applied.

The column itself, a homogenous cylinder of intensely black, highly polished vulcanite, was in itself an illustration of the extent to which the great technical difficulties connected with the manufacture of large masses of the material, hitherto employed almost exclusively for small articles, have been surmounted.

Other exhibits were patterns of vulcanite sheets of various colors used as veneers, and for the manufacture of combs, buttons, paper-knives, checks, eye-glass frames, counters, black piano-keys, knife-handles, whalebone substitute, etc. But it was in the manufacture of moulded articles of irregular form that the greatest progress had been made. While the deep blackness, ease of working and capability of receiving a high polish, long ago suggested the use of vulcanite as a substitute for the fashionable but more expensive and brittle English jet, its plastic qualities have not been employed here to so large extent as in Europe. The Hamburg house first availed itself of these qualities in 1864, and initiated thereby a revolution in the rubber jewelry manufacture, making, at a low price, copies of the boldest and finest carvings, and applying it to all purposes of plastic ornament, from the smallest articles of jewelry to statues, such as those exhibited in the gardens of the Vienna Exhibition, and having in their light brown color, their sharpness of outline, and capability of resisting the weather, some resemblance to the more expensive bronze.

The properties of rubber as a non-conductor of electricity have been largely utilized in the manufacture of electro-magnetic instruments for telegraphic purposes; but owing to some technical difficulties it has not been so largely employed for insulating open-air telegraph wire as might have been expected. In Europe it has been used for this purpose as a substitute for glass and porcelain on the telegraph lines of Russia, Denmark and North Germany, with so much success as to show that, if more expensive in first cost than the materials hitherto used, it was, in the long run, more economical and effectual. The Prussian government have used large quantities of the vulcanite insulators for their military telegraphs in their operations against Austria and France, and a certificate by the Prussian director of telegraphs, Major-General von Chauvin, bears evidence to the excellence of Meyer's vulcanite for this purpose.

By far the largest quantity of vulcanite manufactured, is used for the production of combs, of which one factory alone, the Harburg India-rubber Comb Company, have made and sold 10,800,000 combs of this material in one year. In the manufacture of this article, there are no new processes to be noted, but only the excessively low price of many of the goods produced. Rubber surgical instruments, syringes, etc., have hitherto been a specialty of New York, and those exhibited in the German Annexe, in the show-case of the Hamburg New

York Company, were on show-cards which bore the imprint of an American company. While the field of application for hard vulcanized India-rubber is being extended every year, the supply of the raw material is comparatively limited, and the English government have lately caused investigations to be made with a view to extend its culture.

JOHN FRETWELL, Junior.

THE MACHINERY OF THE VIENNA EXPOSITION.

BY HAMILTON A. HILL.

Group XIII.

For Group XIII. the Austrians provided an entirely separate building, which ran from its westerly entrance towards the east and parallel with the main Exposition building, for a distance of 2,625 feet. It was itself a very large structure, one hundred and sixty feet wide and covering an area of nearly ten acres. Even this space proved by far too small, and all that could by any reasonable construction be placed among agricultural or other special groups for which separate buildings were erected, was excluded from the general hall. The portion of the agricultural buildings devoted to machinery covered about three acres more. Many leading manufacturing establishments also preferred to erect their own structures and to make private exhibitions therein. These probably covered two acres more. So that the whole machinery exhibits, including boiler-houses, pumping-works and heavy machines not under shelter, covered an area of not less than sixteen acres.

The main hall consisted of a central roof, resting on a double line of arches, above which were the windows which lighted the interior. Upon each side of this central portion were wide aisles outside the arches, covered with lean-to roofs, which rested against the walls above the arches, but below the windows. Along the centre of this hall was set up a high iron frame-work which carried the shafting by which power was furnished to the numerous machines in motion from the various engines on exhibition. With the exception of a small line of cold-rolled shafting put up to drive the shoe machinery exhibited in the American department, there was no power carried into the side aisles. They were devoted to steam-pumps, hammers and machinery not in motion. As the different nations were arranged geographically, as in the Industry Palace, comparisons were easily made.*

The relative space occupied by each of the different nations is given in the note to page 76 of these reports.

In regard to the character of the various exhibitions, it may be said in general terms that the American display was more interesting, and attracted more notice than any other. While to Americans the prominent feeling was one of regret that a far greater number of our labor-saving inventions and machines were not there, foreigners were much amazed that among so small a number of exhibits there was so much that was original. The power of our American inventors of seeing the precise object to be attained, and of producing a machine which will attain that object in the most direct and simple manner, regardless of the way in which the same or similar things have been done before, was a matter of general comment.†

* The Exhibition building in London, in 1851, covered 800,000 square feet; in 1862, 971,288 feet. At Paris, in 1867, 1,581,725. The Exposition at Vienna, including the main building, the machinery hall, the east and west agricultural hall and the art-buildings, covered about 2,000,000 feet, or nearly 50 acres.

† The following extract from a report of Prof. Renleaux, Director of the Industrial Academy of Berlin, illustrates this point:—

"In the department of inventions there were displayed but a small number of very extraordinary novelties. In this department America held the first place. Her display of machinery was almost wholly original in its character. * * * * * Upon the whole it may be affirmed that England has in part lost her late and undeniable superiority, or that she is soon to lose it. The young and vigorous activity across the ocean * * * * * makes, with her original talent, the greatest progress. So that ere long we must look to the west rather than to England. * * * * * The American aims direct at the desired end, using those means which seem to him the most simple, whether new or well known. * * * * * The American constructs, in fact, in accordance with the strictest rules of abstract thought, looking on one side only to the end which he has marked out for himself., weighing on the other side the methods already in use, or producing new methods without feeling the influence of what has been done, and finally strikes direct for that object. * * * * * A proper consideration of this course of action suggests the most instructive hints for our institutions of technical science."

The terms of the award of the Diploma of Honor, given to Sellers of Philadelphia, is to the same effect. It was given,—

"For preëminent achievements in the invention and construction of machine tools, many of which have been adopted as patterns by the constructors of tools in all countries."

To the same effect is the declaration of Mr. Charles Hibbs, one of the artisan commission of Great Britain to the Vienna Exposition:

"There is in the American work such an evident adaptation of means to ends, such a direct aim at the *use* to be made of the weapon and its various parts, such a palpable thrusting aside of all considerations but those of serviceableness and durability, that the merest glance below the surface impresses one strongly with the thoroughly practical character of the transatlantic mind."

Of the quality of our work, as well as of its ingenuity, we had every reason to be proud. It is an undoubted fact that to-day the average character of our machines excels in this respect that of every other nation.*

The English exhibition of machinery was much smaller and more meagre than was to have been expected. It is possible the distance discouraged their manufacturers, but a more prominent reason would seem to be the degree to which the Germans are beginning to copy from them everything good brought to their notice. There is also observable, I think, less energy in pushing themselves and their productions than in former times. In this they present a great contrast to the Germans, who, especially since their late wars, seem to be awakening in every direction. As the German marine is said to be taking the place of the English in many waters, so in the matter of manufactures they are very ambitious of replacing the English, at least on the continent; and it seems to be the general testimony of the English observers that they will have to bestir themselves if they would prevent this.

Although this industrial activity has manifested itself, especially under the stimulus of the great events of the Austrian and Prussian wars, it is in reality principally a result of the system of thorough, universal and enforced education which has been established in the different countries of Germany for the better part of a generation, and which is now beginning to show itself in a class of workingmen far more sober, industrious, intelligent and educated than the average English workman. It is true they have not yet acquired all those details of manual dexterity which are the inheritance of some classes of Englishmen, but they are fast learning all that can be acquired by instruction from English foremen now employed in many of the continental establishments.

While, however, the continental factories are producing machinery in considerable quantities, and at very moderate cost, they are almost absolutely dead, so far as any originality or invention is concerned. To an American, the lack of ideas

* "I was surprised to find so small a space allotted to a nation (America) which, if not producing the best machines in the world, certainly stands second to none, and it must be admitted, turns out machinery of faultless workmanship of modern design, and tools of the newest and best description,—a fact which is proved by the number of continental manufacturers making tools exactly the same as their (American) patterns."—*Artisan Reports on Vienna Exposition, p.* 177. Manchester.

of their own is curiously manifest; nearly all of their forms, styles, and even details of construction, are borrowed from the English or the Americans. In fact, they seem rather to pride themselves on skilful copying, and in the Exposition they displayed, with an air of satisfaction, machines constructed exactly from American tools, which they must have taken to pieces for the purpose. Such was the case with a prominent Prussian house, which presented exact duplicates of the manufactures of some of our New England tool-makers. It is satisfactory to learn that the Prussian government, in placing their orders lately for some tools, passed by this establishment and gave the work to the American house, whose ideas it had stolen, to the extent of more than a million dollars. Were it not that we stand in much the same position in regard to copyright matters, as the Germans in inventions, we might with reason complain of the morals of these gentlemen. As it is, they meet any objections of American inventors with this comparison.* In searching for the cause of this great difference in inventive power between the Germans and other continental nations on the one hand, and the English, and still more the Americans on the other, the prominent influence appears to rest in the stimulus of our patent system. Of the influence of this constant possibility of wealth, through invention, we can form no conception till we see the work of countries whose industrial class is without it. It is stated, and with great probability, that two-thirds of our whole manufacturing capital in the United States is occupied in the production of objects covered by patents. The inventive power of our people, and the influence of our patent laws, as shown in our exhibits at Vienna, made a great impression on the continental mind. Had our authorities caused us to be adequately represented, and had we shown a fair amount of our peculiar labor-saving inventions, the impression would have been profound. As it is, through the means of the Patent Congress, an excellent opportunity was found for illustrating the matter, and the writer fully believes that they are awakening to the importance of the influence of an adequate recompense to invention as a stimulus to industry.

* In the Patent Congress, held at Vienna, this was the constant comparison most disagreeably advanced in reply to the arguments of those who were in favor of a patent system in Europe.

Among other points which were had in consideration, and on which an endeavor was made to obtain some information, was that of wages of mechanics in Europe, and in connection with this topic the prices at which their manufactures are sold. This last topic will have the more importance for us if, as is to be hoped, we shall before long, through the influence of the Centennial or otherwise, begin to regain the exporting business which we had before the war of the rebellion.

The following are the rates of wages ascertained in Austria and in other parts of Europe. In Austria the wages were reported to be as follows, the amounts reduced to American currency, at a premium of ten per cent:—

Engineers and mechanics per day,	$1 35
Cabinet-makers and joiners,	1 05
Plumbers,	48
Laborers,	40
Farm laborers per year, board, lodging etc., included,	27 00

Hours of labor per week, sixty to sixty-five. In the year, including Sundays, seventy-six holidays.

Cost of living in the large towns per year: Board, $200; Lodgings, $53; Clothing, $32.

In Vienna the wages in a large locomotive-works were given: Ordinary mechanics, $1.32; Best mechanics, $1.80.

The following were the rates of wages in different European countries, as gathered from workmen at the various stands. It is reduced, as above, to present values in American currency:—

England, skilled men in engine and machine-shops (nine hours),	$1 68
France, skilled men (ten hours),	1 05
Belgium (ten hours),	94
Switzerland (ten hours),	1 25
Italy,	1 14
Sweden and Norway (eleven hours),	1 19
Germany,	1 30
Bohemia (eleven hours),	1 00
Hungary (eleven hours),	1 56

Note.—See Artisan Reports (British) to Vienna Expositions. Manchester: 1873. Pages 44–199.

Group thirteen, was divided in the Exhibition catalogues into the following sub-divisions :—

1. Prime movers of all kinds.
2. Machines for transmitting power.
3. Machinery for working various kinds of material, iron and wood-working machinery, and machines and tools for every variety of special work, as spinning, weaving, etc., paper, sugar, ice, etc., etc.
4. Other machinery not included in the above, as blast engine-pumps, fire-engines, etc.
5. Materials and parts of machinery.
6. Railway machinery and apparatus, including locomotives.
7. Mountings, fittings, supplies, etc.
8. Vehicles not connected with rail.
9. Statistics of production, etc.

The writer will not attempt to describe the great mass of exhibits displayed at the Exposition, and included under these various heads. Attention will only be drawn to some of the leading points suggested by their study, and to a few machines which by their novelty or importance would be particularly deserving our notice. The great collection of special machinery in the third department could only be properly presented by specialists in each industry, and the writer, except in the cases of the general iron and wood-working tools, will not undertake to speak of them. Some are noticed by other writers in their special reports ; others belong to industries on which adequate reports could not be obtained.

Beginning with the topic of prime movers, we speak first of boilers. Thirty-five of these were exhibited at Vienna. Those in use, which, contrary to the plan in Paris, were furnished by the various nations, each for their own motive-power, were placed in detached buildings on the north side of the machinery-hall, and the steam was carried under ground to the various engines which used it. To prevent accidents from explosion, the various boilers were all placed in pits, properly walled up and roofed over with neat buildings, whose gable-ends towards the machinery-hall were open. A breast-high balustrade ran across the front, over which the working of the boilers could be easily studied.

The boilers themselves embraced all the prominent types, cylinder, flue, tubular, and those known as tubulous, or containing the water within small tubes. The cylinder boilers were mostly variations of what is known as the French, or elephant, which consists of one cylinder of large diameter, connected by large tubes, or pipes, with two more smaller ones above it.* The flue-boilers were best represented by the Galloway and Adamson exhibits. The former are well known by the cross-tubes, of a long tunnel shape, which extend across the flues. The latter are similar, except that the cross-tubes are not all perpendicular.

The tubular boilers were represented by one of the ordinary American type, in our department, contributed by Pitkin & Co., of Hartford, Ct., by some of a nearly similar character in use by the Germans, and by those exhibited by Cater & Walker, of England. The latter received the products of combustion after they had passed under the boiler into a smoke-box in the body of the cylinder near the rear end, whence they passed by a number of longitudinal tubes to another smoke-box near the front, and were finally delivered into the smoke-stack, at the rear, by another series of tubes.

Among the tubulous boilers were those of Howard & McNichol among the English, and Belleville among the French. The McNichol is used particularly in connection with paper-pulp machinery, and was designed for the purpose of carrying the very high pressures desirable.

One striking variation from our practice was in the large diameters of the boilers used, especially by the English. The boilers spoken of above (Galloway's, Adamson's and Cater's) were five feet in diameter.

Another point, especially marked among the Germans, was the manner in which they added to their main boilers supplementary boilers, or heaters, into which the water first passed. In some cases small boilers; in others, coils or

* A number of these boilers are in use in one of our large mills in Massachusetts. Of them the Agent said that, in a test, they showed the poorest results of any boilers tried, but in practice had proved about the most economical and the least troublesome.

special tubular boilers, containing nearly as much heating surface as the main boiler, were placed in the flues. By thus causing the colder water to meet first the coolest gases, they undoubtedly use their heating surface to the best advantage. The writer was unable to learn whether they had had enough experience in this practice to have encountered the difficulty which has made trouble with us; to wit, the rapid rusting of the heaters containing the cooler water.

As no experiments nor tests were made, little knowledge could be gained of the comparative merits of different systems of boilers. It is suggested here, that should the Philadelphia Exposition include exhibits of working-boilers, as did the Vienna, that it would be advisable that the United States government should detail a number of officers to make thorough experiments therewith.

A large number of engines were to be seen in the Exposition grounds, probably over a hundred and twenty, including marine, winding and blowing engines, portable engines in the Agricultural Hall, and stationary ones, of various types, in the Machinery Building. Some of these were very large. A pair of rolling-mill engines, exhibited by the Prag machinenbau actien gesellshaft, had cylinders 43 by 81 inches, and were calculated for a piston-speed of 850 feet per minute.

An upright compound blowing engine, by the Societé Cockerill, of Liege, had a blowing-cylinder 118 inches in diameter by 7 feet 4$\frac{3}{8}$ inch stroke; the steam-cylinders being 28.74 and 41.73 inches diameter. This is the one hundred and third engine of its type built by the Company.

A number of steamboat engines were shown, of different sizes, adapted to the coast, river and lake traffic of Europe. With one exception, we believe, these were compound; that is, after using the steam at high pressure in one cylinder, it is exhausted into another larger cylinder at much lower pressure. These engines were, many of them, for side-wheel boats; and those for this purpose were all, or nearly all, oscillating; the cylinders being situated perpendicularly, or at an angle under the wheel-shaft. Of the dozen or more portable engines, the majority were exhibited by the English, who have a large and flourishing exporting trade extending to all parts of the world. Austria, Hungary and Russia afford to them a market something like that which we find in the same region for our mowers and reapers.

These portables were very thoroughly built, with large boilers and very large fire-boxes. The engines were almost universally steam-jacketed. Of the eighty or ninety engines in the Machinery Hall by far the majority were slide-valve, with a cut-off on the back of the main valve. Of these, the better class were arranged to alter the cut-off valve by hand. A few were governed by the automatic variations of the cut-off valve, either through a link or through a movement of the eccentric. In three cases of the latter type of engines the governor was placed on the main shaft, in one way or another, the shaft being also the governor shaft, and the momentum of the balls being resisted, of course, by springs.

Quite a considerable proportion of these engines were built with the Corliss style of frames, which seem to be much in favor in Europe; and some eight were fitted with the Corliss valve and cut-off, with such variations as the experience of different makers suggested.*

Although the Corliss cut-off and valve have been adopted by at least two English engineering firms, there were no exhibits by them, except of slide-valve engines, and it may be stated generally that the English look much more universally than we, to simplicity and endurance as the first qualities in their machines. The continental builders have quite generally adopted this type for engines, for such purposes as cotton and woollen-mills, and other situations where economy is a serious consideration.

The question of the adoption of steam-jacket was examined by the writer. The English makers, with one exception, had their cylinders on this principle, on every engine which pretended to be built with an eye to economy.† Even their portables were, with the exception of Garrett & Sons', designed

* The extent to which this engine has been adopted by the continental builders, who have copied it from the English makers, is another example of the necessity to our inventors of a better patent law in Europe. It is true the jury, in this branch, had the grace to give to Mr. Corliss one of the nine diplomas of honor accorded to the United States, although he himself exhibited nothing.

† Mr. Bourne, an eminent English authority, in the last edition of his work on steam-engines, goes so far as to assert that the advantages of any considerable rate of expansion are wholly lost without the use of the steam-jacket.

in this way. It is to be borne in mind, that the leading English firms have for a long time been in the habit of consulting the scientific men of their technical schools, and have adopted the principle of steam-jacketing after a most thorough understanding of its advantages, which are a subject of the most exact mathematical demonstration, depending upon the degree of expansion. Following their lead, the principle has become one of general adoption among the English engineers. It has equally come into use with the leading continental manufacturers, who study economy of fuel, and we believe all the variable engines of the Corliss type and many with slide-valves, were thus built. The marine and boat engines, it is needless to say, were all designed in this way.*

The marine engines were, in addition to this, with one exception, on the compound principle. The attention that this subject is now receiving from our steam engineers, the fact that it is in use on all the principal transatlantic lines, and that the United States navy and some of our leading lines have adopted it, led the writer to look into the subject as carefully as circumstances would permit.

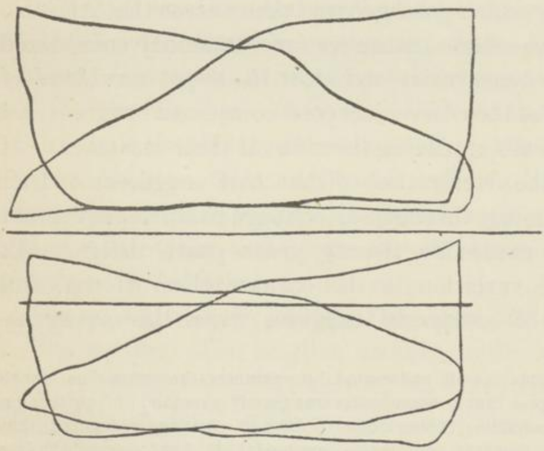
The steamer by which passage was taken across the Atlantic, was one of a line whose managers are commonly considered among the most conservative and slow to adopt new ideas of any in Europe, but they have accepted compound engines, and are, as fast as possible, placing them in all their steamers. It was said to be the declaration of the chief engineer of their line, that after going through all changes and improvements which had been made for twenty years past, their books showed but little variation in the consumption of coal until the introduction of compound engines, when the saving ap-

* Although the principle is well understood by engineers, the writer has met so many persons who suppose that a steam-jacket was merely a method of protecting a cylinder from outside radiation, (better done by felt and cleating or lagging), that he ventures to explain, that it is not for this purpose at all, but to correct the loss from condensation of steam within the cylinder, which condensation is a consequence of the cooling effect of a rapid rate of expansion when the cut-off valve is closed. The expansion of a volatile liquid by means of an air-pump will freeze water; in the same way the expanding steam robs part of itself of its heat, and condenses it into water, thus diminishing the pressure more than it should, and at the end of the stroke robbing the cylinder of heat by again turning the water condensed on its surface into steam, which flows directly into the exhaust without doing any work, leaving the surface of the cylinder cool to be warmed by the fresh steam at the cost of fresh condensation. The steam in the jacket supplies the heat to prevent this, at a less loss than if thus wasted in the cylinder.

peared at once to be very great. The following will give an idea of the form of indicator-card which was made and the power developed in actual every-day work, during the passage spoken of. The consumption of coal was reported on the day in question, at thirty-eight tons for an indicated horse-power of 1,800, besides which all the steam used in the vessel for heating, cooking, running pumps, etc., is to be allowed for. The boilers in the vessel with this engine were unquestionably much too small for the most economical working, having a heating surface of only 7,100 feet, or about four square feet per horse-power.

The builders of this class of engines claim on trial trips much greater economy than was here shown, as low in fact as one and one-half pounds of coal per indicated horse-power per hour. And the Messrs. Randolph & Elder, the great pioneers of this system, have publicly declared their expectation of getting the economy reduced to one pound.* The character of cards taken from this class of engines is illustrated by the set of cards here inserted.

INDICATOR-CARDS OF A MARINE ENGINE.



Cylinders, 51 inches and 86 inches in diameter — 4 feet stroke. Revolutions, 54½ per minute.
Coal used in twenty-four hours, 38 tons. Steam in boilers, 54 lbs.

To an American the most remarkable among these engines were those designed for paddle-wheel steamers for the river and the lake traffic of the continent. These were oscillating

* See note on next page.

engines, of which mention has already been made, with their cranks at right angles, the steam passing from the high-pressure cylinder into an intermediate receiver. To illustrate the extent to which this form of engine has come into vogue of late years for a class of steamers quite like those of our coasts and rivers, mention may be made of constructions of Escher, Wyss & Co., of Zurich. This firm, though situated far from any

NOTE.—The following table, prepared at the instance of the Engineering Department of the Navy, will show the results of practical experience on this question :—

Table exhibiting for comparison, the cost of the power, in pounds of steam per horse-power per hour, of a number of compound and non-compound two-cylinder engines; the quantities, as ascertained by indicator measurement, being corrected by adding, in the case of the non-compound engines, the known condensations in the cylinders, for their several measures of expansion as determined by the experiments of the Navy Department; and in the case of the compound engines, the quantity condensed in the steam-jackets, as estimated upon the basis of an experiment made with the pumping-engine of the Brooklyn Water-Works in 1860.

DESCRIPTION OF ENGINE.	Pounds of steam consumed per hour per total horse-power.*	Pounds of steam condensed in the steam-jackets per total horse-power.†	Pounds of steam condensed per total horse-power.‡	COST OF THE POWER IN POUNDS OF STEAM PER HORSE-POWER PER HOUR.			Pounds of steam consumed per total horse-power.§
				Total.	Indicated.	Net.	
The 60×36-in. Navy Engines,—							
Of the U. S. S. Guerriere,	23.67	–	4.99	28.66	35.70	40.56	–
U. S. S. Delaware,	25.96	–	4.00	29.96	36.40	41.03	–
U. S. S. California,	24.50	–	5.10	29.60	35.40	41.00	–
U. S. S. Congress,	25.95	–	4.40	30.35	35.55	40.85	–
The 50×42-in. Navy Engines,—							
Of the U. S. S. Alaska,	23.40	–	4.10	27.70	35.30	41.40	–
U. S. S. Benecia,	23.50	–	4.30	27.80	35.20	40.30	–
The 36×36-in. Navy Engines,—							
Of the U. S. S. Resaca,	23.80	–	5.00	28.80	34.80	43.00	–
U. S. S. Swatara,	23.00	–	4.20	27.20	33.70	38.60	–
The Compound Engines,—							
Of the Steamer ———,	15.9	2.18	–	18.08	22.53	27.16	29.18
Steamer Italy,	16.7	2.18	–	18.88	21.49	26.10	31.57
Steamer Spain,	16.6	2.16	–	18.76	21.85	26.54	32.77
Steamer City of Bristol,	16.2	2.11	–	18.31	21.01	25.85	28.07
Steamer Gracia,	18.3	2.32	–	20.62	21.97	26.31	–
Steamer Patagonian,	15.9	2.04	–	17.94	21.16	25.99	29.42
Steamer Batavia,	17.6	2.27	–	19.87	24.78	30.09	34.14
Steamer Egypt,	17.7	2.28	–	19.98	24.89	29.42	32.00
Mean of the 60×36-in. Engines,	25.02	–	4.62	29.64	35.76	40.86	–
50×42-in. Engines,	23.45	–	4.20	27.75	35.25	40.85	–
36×36-in. Engines,	23.40	–	4.60	28.00	34.25	40.80	–
Mean of the Navy Engines,	23.95	–	4.47	28.46	31.75	40.83	–
Compound Engines,	16.86	2.19	–	19.05	22.46	27.18	31.02

* Inclusive of the quantity condensed in the production of the power.

† Calculated upon the basis of an experiment with the engine of the Brooklyn Water-Works.

‡ Due to all causes other than the production of the power.

§ Developed in the lower-pressure cylinder, inclusive of the quantity condensed in the steam-jackets.

navigable water, except their own little lake, by their experience, their good workmanship, and above all, by the reputation which their engines of this style have acquired for their economy, have contrived to gain a trade which extends all over Europe, onto the Rhine and the Danube, and to the Black and Mediterranean seas, and even to South America. From 1860 to May, 1873, they built one hundred and thirty steamboat engines; of these ninety-one were compounded.

Of the stationary engines a very small exhibition was made by the English, and although compound engines are largely in use with them, their leading manufacturers did not generally appear. Of the two engines built especially for economy, one by Galloway, was on the compound principle. The French had only two stationary engines, of which one was compounded. A portable, whose size and weight would entitle it to rank among the stationaries, was also compounded, the cylinders being in the steam-dome.

In the German department were several compound engines.

The compound upright blowing engine, exhibited by the Cockerill works of Liege, in Belgium, was the most striking machine in the Exposition; it has been described on page 413 of this report. But few compounded engines were shown by the Austrians or other nations of eastern Europe, though they were not without examples.

In reviewing this whole subject, it seems probable that as the economy arising from the introduction of steam-jacketed compound engines into the marine of this country is perceived, and as our large manufacturers investigate the advantages of this type of engines, as shown in Europe, that these improvements will be demanded here and will be carefully studied into by our engine-builders, and that economy in steam during the next twenty years, will be sought more by these modifications, and less by complicated and expensive-running valve-gear.

A few general facts may be noticed in regard to the engines of all the European nations. Wherever their governors or their valve-gear were driven by gears, one of the pair was always made with inserted wooden teeth. Nearly all the engines carried their piston-rods completely through the cylinder, so that the heads were as far as possible supported on the rods. The valve-stems were, in the majority of cases, arranged in the same way. The larger portion of the engines on view were fitted with condensers, and a favorite position for them was directly behind and in line with the cylinder, the prolongation of the piston-rod from the rear of the latter serving as the pump-rod. Beyond these minor points there was very little to be seen that would be particularly interesting or suggestive to an American builder.

The following are examples of the prices of engines of different makers; price in United States currency, at ten per cent. below gold :—

	Diameter of Cylinder. (inches.)	Stroke. (inches.)	Price in U. S. Currency.
Small English engine, well finished. The 12-in., with steam-jacket,	4 6 12	8 12 24	$186 00 266 00 760 00
Same, semi-portable boiler included,	4 6	8 12	399 00 585 00
German build (Berlin), semi-portable,	6 9	10 13	827 00 1,142 00
A French (Paris) semi-portable,	6 9	10 13	770 00 1,212 00
A variable cut-off, very well built, with steam-jackets. Condenser extra.	14 18 34	32 40 60	2,460 00 3,130 00 8,877 00

Iron Working Tools.

Of tools for working iron there was a large display in the Machinery hall. As we have already stated, the American department, although very limited in extent and in the number of exhibitors, was still the most interesting portion of the mechanical exposition, and contained more that was original than all the rest. The tools of Sellers, of Philadelphia; of Messrs. Pratt & Whitney, of Hartford, Ct.; Brown & Sharpe, of Providence, R. I.; and Styles & Parker, of Meriden, Ct., were universally praised for their workmanship as well as their originality. Massachusetts, though undoubtedly the largest producer of machine-tools of any State in the Union, had none whatever on exhibition, with the exception of a case of twist-drills, from the Morse Twist-drill Co. of New Bedford. The high reputation these drills have acquired throughout Europe is an excellent illustration of the character of our best grades of work. It is well known to many, that the manufacturers of these drills are enabled to import the highest and most expensive quality of steel, paying upon it a duty of fifty per cent. and all expenses, turn it into drills, reëxport it to Europe, and sell it in the foreign markets in competition with any manufacturers there;—a most instructive commentary upon our labor-saving machinery! It is the more to be regretted that our State had no display there, as many of our tools are better suited in price, as well as in character, to the German market, than those which were taken there from other States.

We quote for comparison a few prices of machine-tools, accompanied, as far as they could be ascertained, with the weights. Prices as before in American currency at ten per cent. below gold:—

Machine-Tools, Prices, Weights, etc.

A Prominent German House.

Lathes.				Planers.			
Swing (inches).	Length of bed (feet).	Weight (lbs).	Price, American Currency.	Width (inches).	Length they plane (feet).	Weight (lbs).	Price.
12½	6½	–	$354 00	30	7⅔	–	$823 00
20	9	–	750 00	46	14	–	1,863 00
24	12	–	946 00	90	28	–	8,932 00
40	24	–	2,266 00	–	–	–	–

Another Leading German Maker.

13	6½	1,830	$374 00	25	4	3,112	$599 00
17½	9	3,570	546 00	34	7½	9,384	1,007 00
22	13	5,700	823 00	52	11½	17,480	1,740 00

Machine-Tools, etc.—Continued.

ENGLISH HOUSE, CONSIDERED RATHER ROUGH WORK.

Lathes.				Planers.			
Swing (inches).	Length of bed (feet).	Weight (lbs).	Price, American Currency.	Width (inches).	Length they plane (feet).	Weight (lbs).	Price.
12	6	1,344	$272 00	24	4	–	$522 00
16	10	3,920	474 00	36	8	12,880	1,022 00
20	12	5,040	638 00	54	12	24,640	1,852 00
24	14	7,400	894 00	–	–	–	–

ANOTHER ENGLISH HOUSE, OF HIGH REPUTATION FOR WORKMANSHIP.

12	6	–	$489 00	–	–	–	–
16	10	–	654 00	–	–	–	–
20	10	–	859 00	–	–	–	–
24	16	–	1,062 00	–	–	–	–

A PHILADELPHIA FIRM—FOR COMPARISON.

16	9	2,000	$450 00	24	5	4,000	$650 00
20	16	3,600	765 00	36	8	7,000	1,100 00
–*	–*	3,700*	875 00*	–	–	–	–

A FIRM IN NEW YORK STATE.

16	9	2,050	$375 00	–	–	–	–
20	10	2,700	625 00	36	12	12,000	$1,300 00
24	12	5,000	825 00	–	–	–	–
30	16†	8,500	1,350 00	–	–	–	–

* Same with gap. † Hardened boxes and bearings from $70 to $90 extra.

NOTE.—With the exception of the first list, all foreign lathes above cited are made with a gap.

The following extract from the "London Engineering" will be interesting, as giving a foreign estimate of our machinery:—

"It will be seen from what we have said, that the American exhibits of machine-tools are of special interest, and that they are decidedly characterized by great originality of design. In this respect they are, in fact, distinguished beyond any other collection of tools at Vienna. * * * The workmanship, too, of the various machines shown is excellent, and every care appears to have been taken to insure accuracy. The only fault, in fact, which we have to find with the American machine-tools is, that some of their frames are not what they should be. With a few exceptions, and notably Messrs. Sellers,—whose frames are excellent,—our American friends are apt to run a little wild in the matter of frames, and we miss in their designs the solidity and simplicity which distinguish the productions of our leading English firms. Hollow or cored frames are not so largely used in the United States as they are now with us; and the ribbed frames which are adopted, although probably amply strong enough for their work, are apt to be distinguished by many unnecessary curves and twists. This is especially noticeable with the legs for supporting the smaller machines."

In respect to the weight of frames, it is remarkable that while our New England makers uniformly agree in declaring that the excessive weight of English tools is wholly unnecessary, they have yet, for the last ten years, been constantly adding to the weight of their machinery; and are still far behind the manufacturers of Philadelphia and Wilmington, and even those of the Western States. It was the declaration of two distinct manufacturers of the Middle States to the writer, made within a few days, that New England tools had a very unfavorable reputation in their part of the country. This reputation arose, no doubt, from the fact that New England tools are too light for the heavy work required of them in the Middle States. Our tools are heavy enough for much of the work in New England, but should some firm, of good reputation for workmanship, add largely to the weight and strength of their tools, they would bring back to Massachusetts a class of orders now wholly given in other directions.*

Passing by the United States department of the Machinery hall, the visitor from America would have found elsewhere very little that was new or instructive. A few general remarks are suggested by a review of the productions of other nationalities. Lathes are very generally built with a gap under

* See weights of Philadelphia and New York tools, p. 421.

the face-plate, so that a larger swing can be had when the tool is desired for facing. When not wanted for this purpose, the gap is filled with a block, which slides in, having upon it a continuation of the ways. Gears are not cut, even on the best tools of the makers of highest reputation, on the theory that the outer scale is the best portion to resist wear. The working-handles about the machines are of horn, turning loose upon their centres. Planers are much more universally built with double heads than with us, even those of comparatively small size. Those in the Exposition were also universally fitted with a cord, or other arrangement, for mechanically lifting the tool so as to clear its point in running the platen back. Many tools for slot-drilling were exhibited, and this appears to be a tool in much more general use than with us, in European shops.

Overhead travelling-cranes were in use in the Exposition, and the whole work of removing the exhibits, to and from the cars which brought them, was done with these. The writer found, also, the new and well-arranged machine-shops, in England at least, generally fitted up in this way. The cranes were largely used also in foundries and in lumber-yards, and universally in the freight-yards of railways. As is generally known, these travelling cranes consist of two parallel rails supported overhead on walls or piers from forty to sixty feet apart, on which travels a truck. This truck is composed of two beams with wheels under the ends on which another truck traverses from one side to the other. This last truck carries the hoisting apparatus. Most commonly they were driven by a high speed hide-cord, passing through them from one end of the building and so arranged as to give all the motions through friction-gears at will.

Very fine examples of the material for conveying power by wire-rope were also on exhibition, with plans of localities where the same has been applied. A set of wheels were shown of over twenty feet diameter, with the rope used. This form of conveying power, which is admirably adapted to the purposes of water-power, has not received the attention in New England which it deserves. It is largely used in Europe, and from 50 to 500 horse-power is conveyed to distances of nearly a mile. In some cases smaller powers are led off in various directions from intermediate stations on the way. It is estimated that to convey, say 25 horse-power, costs by wire-rope eight cents per foot; the same, by belt, $1.40 per foot.

Of the few tools which deserve attention for their novelty, one was a locomotive double-wheel lathe, in which the wheels are supported and turned on their own axles. On the head-stocks of the lathe are cast brackets, bearing V-shaped adjustable boxes, in which the journals of the axles revolve. Around the rear of these boxes, on a portion of the bracket which is turned for the purpose, revolve the face-plates, driven by a powerful gearing. These face-plates are made in two parts, in order to get over a collar on the bracket which holds them in place, they merely serving as drivers to the wheels. A pin set up against each end of the axle prevents end motion. This lathe was exhibited by the Saechsische Maschinen-fabric of Chemnitz (formerly Richard Hartmann & Co). The same firm displayed a drill and slotting-machine, adapted for heavy work. The drill-spindle, which lies horizontally, has an automatic feed; the carriage which holds it, slides up and down upon the side of the standard which supports it, and the standard itself moves horizontally on its bed. The last two motions serve for drilling slots, either horizontally or vertically, and also for adjusting the tool in front of heavy work for drilling. Several tools were exhibited by Johann Wagner & Co., of Dortmund, for railroad work. One of these was a very heavy milling machine, with travelling-head, for milling the ends of rails. Another, a similar machine, carrying a saw for sawing off the ends of rails, cold; still another,—a tool with three horizontal drills, the drills having a short transverse motion and self-feed, for drilling oval holes near the ends of rails. By expansion gears, the distance of the holes from each other can be varied.

The same firm exhibited some tools adapted to planing the spokes of locomotive wheels and to drilling the rims from the inside. Other tools were shown by Sharp, Stewart & Co., and others, for planing the inside of the rim and like operations. As such tools would not be applicable to our modes of work, a description is not necessary.

The Deutsche Werkzeugmaschinen-fabric of Chemnitz, exhibited a novel machine for planing on an arc of a circle either convex or concave, adapted to crank boxes, etc. It resembled a heavy upright drill. The spindle was very heavy, and carried at its lower end a slotted arm, in which could be fixed a holder with cutting tool, with such radius as the work demanded. This spindle received a reciprocating turning motion by means of a proper gear, passing through such an arc of a circle as it was set to, and there reversing itself and turning back, with a quick, return motion. It also had a self-acting down feed. In this way the tool would plane round the portion of a circle of any given diameter it was set to, within the radius of the arm. The horizontal table for the work was adjustable in all directions.

A common machine in the Exposition, and in the English work-shops, was a frame of gang-drills for drilling a line of holes at once. These were generally driven by a long screw, running along the top of the spindles and gearing, into a skew gear on each of them.

A very fine bolt-heading machine was exhibited by De Bergue & Co., of Manchester. The rods being cut up after heating, by knives on the machine, were dropped into holes in the rim of a heavy revolving wheel, which carried them successively under the punch which headed them, after which they were dropped out below. The details of the tool were well worked out, and the production was guaranteed at forty-five bolts per minute.

A machine for planing the teeth of heavy gears, was shown among the tools of the Chemnitz Werkzeugmaschinen-fabric. The arrangements for adapting it to the size and form of gears were good. The tool-holder in this machine oscillates on a centre, and the form of the tooth to be cut is determined by an arm which follows the surface of a copy or guide.

This short list, it is believed, includes nearly all the tools in the Exposition which would be really new to a New England visitor, and which would be likely to be of any value to us. It is not impossible that there are tools like them already in use among us. To the writer they were most of them new, and have been thought worth a brief mention.

Wood-Working Machinery.

If, in iron working tools, Massachusetts had no representation at the Exposition, we were more fortunate in wood-working machinery. The special machines exhibited by Mr. Baxter D. Whitney, of Winchendon, for pail-making, jig-sawing, planing, for turning, etc., attracted a crowd whenever they were in motion. Quoting again from English testimony in speaking of the pail machinery :—

"Apart from the ingenuity displayed in the conception of this manifold machine, the manner in which it has been carried out reflects the highest credit upon Mr. Whitney. Every one of his exhibits indeed shows the hand and mind of a master, and every other exhibitor of wood-working machinery can, and doubtless will, learn a good deal from these tools."

A dove-tailing machine, shown by Mr. G. Hall, of Florence, was also much admired, and a band-saw of Richards, London & Kelley, of Philadelphia, attracted attention from its workmanship. Beyond these there were only exhibited some collections of the ordinary wood-working machinery of the United States. Of these it was declared in the "Engineering":

"Most of the other machines exhibited fall so far below, even a liberal standard of average merit, that we can scarcely believe that they are to be accepted as the representatives of this branch of industry in the United States."

The writer has quoted this statement from a paper certainly disposed to be favorable to the productions of our country, and it is, indeed, the conclusion of an article in which praise has been accorded to many ingenious details in the machinery. The remarks apply mostly to exhibits from other States than our own, but are quoted from a feeling that the lesson may be brought home to ourselves. It is pretty certain that there has not with us been that improvement in weight and style, nor in workmanship, within these latter years, in wood-working machinery, that there has in iron. Improvements in design, and a perfection of workmanship, are to be found in work made in other parts of the United States, which we cannot equal.

It is a question how far tools of this class will gain in productive power, through increased weight and accuracy of workmanship, but the writer cannot doubt that there is a demand for something of each, much beyond the average of our New England wood-working machinery.

Beyond the American department there was in this department little of interest, except in the English; and those machines which were the best in their design and arrangement, are by a firm who are said to have had a leading American manufacturer as superintendent. The machinery was solid and heavy, and contained nothing of value which cannot be found in a better form in, for instance, the productions of Richards, London & Kelley, of Philadelphia. A few special machines were shown, adapted to the continental market, for making parquetry floors. These consisted of a hand-matcher with a vertical spindle, the work carried by the cutter on a horizontal sliding table, and of a surfacing machine, which is simply a lathe with a large face-plate.

Perin's band-saws attracted attention among a collection of otherwise inferior wood-working machinery in the French department. Some of these were very heavy, and adapted with side rollers for re-sawing lumber. Beyond the French there was nothing of value in wood-working machinery in the Exposition.

In reviewing the whole subject it may be said, of the matter of steam-engineering, that the questions of steam-jacketing and compounding should receive careful attention on the part of our engineers, but that many crude and unsuccessful experiments have been made in the United States which have failed from imperfect understanding of the conditions of success, and the subject should be approached through a thorough study of the work and the publications of the English engineers. And the writer does not doubt that, when the principles at the bottom of the system are here well understood, the ingenuity of our people will suggest many improvements over present forms.

In iron, and especially in wood-work in machinery, although our machines are most admirable for ingenuity and convenience, there is need of a more thorough study of the work of outside manufacturers on the part of our makers. Massachusetts having been the first of the United States to build up a manufacturing business in these departments, she is too much confined to her original forms and styles. Perhaps, too, her manufacturers are too closely devoted to the details of their business. Time devoted to travel, and an investigation of the ideas of others, is not lost. Perhaps it is one of the best results of international expositions that it brings manufacturers of each district to study the best work of every other.

HAMILTON A. HILL.

AMERICAN IDEAS IN EUROPEAN MACHINERY.*

BY ELMER P. HOWE.

Group XIII.—Machinery.

The first impression of an American, entering the Machinery hall at the Exposition, was one of disappointment. Outside the American department, there was a conspicuous lack of novelty in the exhibited objects. In the small space allotted to the United States, there was more to attract the thoughtful, or the casual visitor, than in all the long hall beyond. The reason for this is not hard to find. For, laying aside certain tools which are adapted for the use of some particular country, there was no machinery but such as was well known in the United States, and such valuable improvements of late date as appeared, were generally of American invention, or have been adopted and to some extent developed in American practice.

It will not, I trust, savor of a boastful spirit to briefly examine the prominent mechanical exhibits with the view of discovering to what extent ideas from this country have been employed. In this attempt, as it will be almost impossible to

* While to Europeans the American department of the Machinery hall was by far the most interesting, from the great number of novel and labor-saving inventions it contained, the rest of the long building, was equally striking to the American visitor, from the lack of original machinery. The peculiar ability of the American mind in the matter of invention, is, for the first time, fully realized, in passing through the foreign departments. Coupled with this poverty of inventions of their own, the visitor from this country was struck with the frequency with which he came across well-known American ideas and machines among the exhibits of the different European nations. So common was this that the commission thought it worth while to suggest an examination of the Exhibition, with a view of presenting a brief catalogue of American inventions which have within a few years been adopted in Europe. This has been done partly with a view of showing how grand a field the Old World would become for our inventors, could some reasonable patent protection be had in Europe. From this examination the following article arose.—Editor.

state with accuracy the locality of every invention discussed, it will be assumed that the credit of an invention is due to the country where it is first made practical, rather than to the one where it is designed and patented.

Thus, the band-saw, one of the most useful of modern wood-working tools, was patented in England in 1808, in essentially its present form, but its use did not become general until it was introduced by the French, forty years later. The band-saw is, therefore, justly credited to the French.

Commencing with English machinery, among the steam-engines there was to be seen a small machine with a Corliss bed and ordinary slide-valves. It is known, however, that the Corliss engine is regularly built in England by at least two leading firms, and has become an accepted type in their steam engineering. In machine tools, Sharp, Stewart & Co., the rivals of Whitworth, exhibited an iron planer with Sellers' worm-gear and belt-shifting mechanism. The standard wood-working tools take advantage of our Daniels and Woodworth patents. Among the special machines, the Armstrong dove-tailer and Richards mortiser were prominent. The sewing and knitting machines were but variations of those made by our well-known firms. In general machinery and small fittings, quite a list of American inventions were noticeable; Pickering, Huntoon and Porter governors, Ashcroft safety-valves and gauges, Berryman feed water heater, Blake stone-crusher, Dudgeon hydraulic jacks and punches, differential pulley blocks, Stephens' vise, Peet valves, Cameron special pumps, Cope and Maxwell valveless steam-pumps, Dows soda water apparatus, twist drills, ratchet drills, self-centering chucks, etc. A late English invention exhibited was a complete copy of the idea of the Merrill atmospheric hammer, except that the cylinder instead of the piston was the moving part.

American iron working machinery has been copied very little in France, Belgium and Switzerland, apparently because they have not yet advanced so far as to perceive the need of our new ideas. There were Swiss imitations of twist drills and American chucks, but, as far as could be learned, they have not yet affected the exportation of the genuine American productions. In the Swedish department were two lathes, almost exactly reproduced from those of the Putnam Machine Co., Fitchburg. The imitation extended to the form of the name-plate and table of gears. A firm from Berlin exhibited a lathe made from the designs of Pratt, Whitney & Co., Hartford, and a universal milling machine after Brown & Sharpe, Providence. The best manufacturers, it is fair to say, condemn this undisguised piracy. A German company, among many imitations of English tools, had a Sellers planer, of the same design as the one spoken of in the English department.

The large establishment of Heilmann Du Commen, in Alsace, acknowledge their indebtedness to the United States in many points of detail. The products of this firm illustrate the value of international expositions. Since the Paris exposition they have changed the design of many of their best tools, and have introduced improvements obtained there. This made their collection one of the most valuable in the German section. They are really French, however, as they have not been under German rule long enough to acquire the language. The Shaw & Justice spring-hammer, Burleigh rock-drill and air-compressor, Cameron and the Earle direct-acting steam-pump, were shown by German firms. The Danks furnace was shown in model by a German manufacturing firm.

Among the best steam-engine builders, the Corliss was the favorite model. Although there were but eight exhibited, six were in operation. Of these, three were almost exact copies from Mr. Corliss' pattern; the others were changed, whether advantageously or not is not to be decided here. Two were from Switzerland, one from Belgium, three from Austria, and two from Germany. Quite a number of other engines were fitted with automatic variable cut-off of one kind or another; in whatever form used, undoubtedly an American invention. There were several others with Corliss beds. Three engines (two in the Austrian department and one in the German) were fitted with the Rider expansion-valve.

The locomotives and railway appliances were most widely at variance with our practice. One Austrian builder had a locomotive with four large drivers and a four-wheeled bogie.

A large business is done at Buda-Pest, Hungary, in chilled cast-iron car-wheels. The trade has increased from 16 in 1853, to over 26,000 in 1868. They are most used on Saxon, Austrian and Russian roads. Ordinary American cars, with six-wheeled trucks, are employed in Würtemburg and on a few Austrian lines, generally for second and third class passengers. A system for warming cars by circulation of hot water, very similar to that in use here, was shown by a Geneva builder.

In wood-working machinery English models have been very closely adhered to on the continent. In the Swedish department, however, there were two poor imitations of the moulding machines made by R. Ball & Co., Worcester, and a planing machine, with fixed cutters, on a plan which has been condemned here. A Hungarian house exhibited a continuous rotary planer for surfacing short boards. The design is American and worthless.

The application of machinery to the manufacture of boots and shoes is peculiar to our country; consequently the exhibits in this industry were but inferior copies of well-known machines. An exception might be made in favor of Lemercier, in the French department, who displayed an original machine for fastening on soles and heels by brass screws, and a lasting machine which was rather a hindrance than a help.

Sewing machines were exhibited by a great number of continental firms, as well as English, and their manufacture has become a standard business. It is, however, flattering testimony to the skill of our mechanics, that the American-made machines are sold in very large numbers in the European markets, at much higher prices than those of domestic make.

American breech-loading guns were shown in great numbers (the manufacture of European government shops), but it is needless to say not so well made, and apparently not so cheaply as our work.

Another prominent manufacture, founded on American invention, was that of Rubber in its various forms.

Of Agricultural implements, some are made according to the traditions of the country; some are copied from the

English. The mowers, rakes, harvesters and lawn-mowers, are American.

Such are some of the American ideas which would attract the attention of the ordinary visitor in passing down the Machinery Hall of the Exposition. Doubtless the specialist in almost any department would find others, but these, numerous and prominent in themselves, are the more striking, because they do not appear to be matched by corresponding invention on the part of the various nations which have adopted them.

Undoubtedly our superiority is due to two causes: our higher grade of education and our patent system. In education they are rapidly improving. In special technical education they are to-day our superiors; and they can adopt our patent system.

ELMER P. HOWE.

RAILWAY TELEGRAPHS AND ELECTRIC SIGNALS.*

BY ROBERT B. LINES.

GROUP ——.

The practical value of the electric telegraph is nowhere more apparent than in its application to the running and control of railways.

One of the principal claims made by Prof. Morse for the invention which he at least had the merit of first bringing into practical commercial operation, was the facility which it would offer to railways for the speedy and safe transaction of their business. While it cannot be said that the railways of either Europe or America have yet received the full benefit of this important and now, indeed, indispensable auxiliary to their management, it is certain that much has been done by the aid of the telegraph which could not have been done without it, and much of the progress made by railways within the past thirty years is due to its powerful assistance. While it has rendered possible that direct control over hundreds of miles of track, which is such a striking feature in our railway management, its detailed application has also shown it to be the most valuable, if not the only, means of maintaining safety in the midst of the immense traffic in freight and passengers which its use has aided in building up.

In America the railways have been and are still, to a great extent, too much dependent for their telegraphic facilities on contracts with telegraph companies, frequently disadvantageous to the former from the commencement, and always, as

* The attempt which has been made in this article to reduce the large drawings with which it was accompanied, by the aid of the Heliotype process, has not succeeded as well as was expected, owing to the excessive reduction necessary to bring the illustrations within the size of the page; the lettering, particularly, is imperfect. It is believed, however, that the interested reader will find no difficulty in understanding the plates by aid of the context.—EDITOR.

traffic increases, involving great difficulties in their practical working. In many cases, railways have been required not only to yield the right of way, but also to furnish and distribute the poles for, and otherwise to aid the erection of lines, the property in which vests in a telegraph company. The line once established, the railway is to transport men and material for its maintenance or extension and to share the expense of its operation. In return for these services it receives a partial use of the wire for its own business, the telegraph company receiving the profits from all other despatches.

This use of a railway wire for commercial business, still common in some sections, gives rise to constant disputes between the employés of the two companies, and not infrequently is productive of great delay and danger to the business of the railways. On most important lines, however, the railways of America have followed the example of those in Europe, and secured for themselves the exclusive use, if not the ownership, of one or more wires along their routes, operating them independently. Such cases alone come properly within the scope of this report, as where the control of a wire belongs to, or is even divided with a company operating it for commercial purposes, railway telegraphy can hardly be said to exist.

The telegraphic service of railways may be divided into two classes, general and special. Although this paper relates almost exclusively to the latter class, a few words with regard to the former may not be out of place.

The first class includes all messages on the ordinary business of the road, such as orders to station-masters, directions in regard to cars, to the distribution and working of forces, etc. Under this head may also be classified the regular reports to the central office and the whole system of "train despatching," or "running by telegraph," which has become so common, and been brought to such apparent perfection in the United States, but which, so far as I am able to learn, does not exist abroad.

In Europe there are generally several wires set apart for the exclusive use of railways, both for the general and the special services. In France, one wire connects the principal, another the secondary, and a third, or "omnibus" wire, all of the stations. For the ordinary service, at least on this latter wire, the "cadron" or alphabetical dial system is principally used, and as its operation is simple and quickly learned, the station-masters or other employés are fully capable of managing it. In America, on the contrary, the instrument used is almost invariably the Morse sounder or embossing recorder, which, although more rapid, and, possibly, in the hands of skilled operators, familiar with its code, more satisfactory, requires, to be properly served, a much longer training and higher capacity. The record of the embossing Morse instrument is also much inferior to that of the ink-writer, so generally used in Europe, and the American code is much more liable to error than the European.

With us the railway office is, to a great extent, the school of the Morse operator, who leaves it as soon as he becomes proficient, to seek a higher salary with a telegraph company, and to divest himself of the opprobrium attaching among the fraternity to a railway "plug."

With the American Morse instrument and code, consequently, the ordinary telegraphic service on railways is either conducted at a large cost to the companies, or is left to the hands of unskilled employés, to the prejudice of safety. There may be circumstances in the condition and traffic of our railways which render it necessary that a minute knowledge of and control over the movements of trains should always exist in the central office: in other words, that the system of "train despatching" should continue. If this be the case, supposing, which is probably true, that the Morse is the instrument best adapted for such service, the railways should secure, at any cost, the best telegraphic talent. I am convinced, however, that when such exceptional circumstances disappear, as they will with the improvement of tracks and the more regular growth of business, it will be found to the interest both of economy and safety to adopt a simpler instrument for the general service, and to rely on special signals for the prevention of accident.

While the general use of the telegraph is to railways a convenience greatly augmenting their capacity for business, the employment of special signals, electric or otherwise, is a matter of necessity to the public, whose safety is at stake. As very few accidents are due to natural or inevitable causes, it follows that there must be somewhere responsibility for them, and it may be said that the surest method of preventing them would be to concentrate this responsibility upon some one person against whom penalties may be directed. To a limited extent this theory may be correct. Were the remedies of the law always obtainable, however, and always rigidly enforced, they could afford no adequate compensation for the terrible consequences of railway accidents. The policy of prevention must, therefore, be almost entirely dissociated from any idea of remedy.

In some European railways there are employed immense numbers of flagmen, at short distances, to protect the trains. Even if this were the best system, it would be obviously impossible to guard every step of a railway in America by human agency. Machinery of some sort must, therefore, be trusted to; and thus far electricity seems to offer almost the only practicable solution of the question.

The "special" telegraphic service, or railway signal system, as it exists in Europe (or rather on the continent), is very fully represented at the Vienna Exhibition, but the apparatus exhibited by the different countries is variously classified. In some cases it is placed in Group XIII., with "Machinery and Means of Transport," in others, in Group XIV., with "Philosophical Instruments," or Group XVIII., "Civil Engineering and Architecture," and still again in "Additional Exhibitions," such as those of the Austrian railways. Aside from this, the exhibits of different countries in the same group are so far apart that it has been exceedingly difficult to make a comparative examination. In many cases, also, there are no pamphlets or explanations accompanying the apparatus, and no one in charge to work or give information in regard to it. I have endeavored, however, to investigate as thoroughly as possible not only the systems represented here, but others which are not exhibited, and trust the result may not be without value.

In a recent French report upon this subject (*Resumé des conferences sur la telegraphie electrique, par M. Amiot,* *Inspecteur, etc.)*, railway signals were divided into four classes, as follows: —

1. For the "covering" of trains (i. e., to indicate by optical signals that a train has passed a signal-station and that another must not follow).
2. To signal the movement of trains (electrically).
3. To signal from trains in case of accident.
4. To communicate between the various portions of a train.

Having in view, however, the prime object of the signal-service, a more logical division of the subject would seem to be one based on the actual course of trains from station to station and the character of accidents to which they are liable.

Aside from those arising from the imperfect condition of the track or rolling stock of a railway, which can only be avoided by frequent inspection, the dangers to which trains are subject are principally occasioned by —

1. The displacement of switches or semaphores at stations.
2. Vehicles, etc., upon the track at common road-crossings.
3. Collision of trains in motion, following or meeting each other, on the same track or at junctions.
4. Causes within the train itself.

The signals themselves cannot be so readily classified as the dangers which they are intended to avert, inasmuch as some of the apparatus may be used with equal facility to attain several of the objects desired. For the purposes of this report, however, it will be sufficient if I explain their actual uses, merely suggesting others to which they may be applied.

From this stand-point (i. e., of the purposes they are designed to serve,) railway signals may be considered in six groups, viz.: —

1. Signals of the movement of trains.
2. Signals giving knowledge of or control over the position of switches or semaphores not visible to the person requiring such knowledge or control.

3. Signals of warning at grade-crossings of common roads.
4. Signals "covering" the position of trains in motion from trains following, meeting or crossing.
5. Signals between the various portions of a train.
6. Signals to be used in case of accident.

Through the first four of these classes runs a general, or rather a special subdivision, and one of great importance, if not to the present, at least to future systems of railway signalling. Until recently, signals between stations and trains in motion have been on the one hand purely optical, as the display of flags, lights or semaphores from stations, and on the other optical or aural, as the display of flags and lights and the blowing of whistles on trains. Since, however, it has been found practicable to communicate *electrically* between stations and rapidly moving trains, the possibilities of railway signalling have been greatly extended.

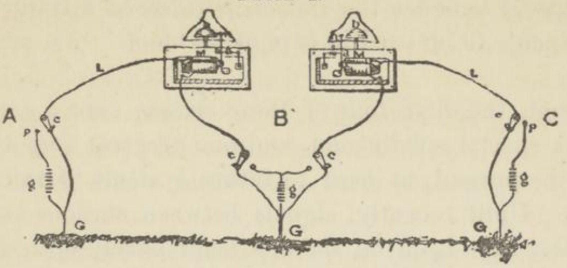
I. Signals of the Movement of Trains.

I have not thought it important to consider at much length the various devices employed to indicate from point to point the forward movement of trains. When there are special functions to be performed (and it is to such points only that I desire to apply the general term "station"), the stations are usually connected by the ordinary telegraph, and announcements of the arrival and departure of trains may, of course, be made in the ordinary manner by message.

In a purely "signal" service, however, each "station" and intermediate "signal-box" is on an equality with every other, and a method of communication is necessary which can be employed and interpreted by signal-men as well as by skilled telegraph clerks. This may be easily attained by making each such point the terminus of an electric "circuit," in which is inserted a "bell-sounder." This is an ordinary electro-magnet, the armature of which is extended upwards and furnished with a hammer, which strikes upon a bell when the circuit is closed. As this apparatus, though simple, forms an important part of many of the signals in use for other purposes, a brief diagram and description of it may not be out of place here.

To illustrate the arrangement of signal stations between which the movement of trains only is desired to be shown,—

PLATE I.



Let A, B and C (Plate I.) be three adjacent signal-stations, or boxes. A and C are, of course, fitted up exactly as B; but it being only necessary to describe one set of apparatus, those at A and C are omitted from the drawing. M M are magnets placed upon the lines L L, which, after passing through the coils of the magnets at A, B and C, are connected to the ground G, through the commutators, or switches, *c c c c*. In their normal condition, therefore, there is no electric current passing on the lines on either side of B. This is the ordinary arrangement of what is called an "open circuit."*

Suppose now that a train passes A, whose approach he wishes to signal to B. By turning the switch *c* to the left, the current from the galvanic battery *g* is thrown on the line through the point *p* and the switch. The magnet M, being influenced by the current, attracts the armature *a*, and the hammer *h* at the upper extremity of the armature strikes against the bell *b*. The stroke, of course, continues as long, and is renewed as often, as the switch is thrown upon the point *p*. The instrument is enclosed in a box, as shown in the figure, and placed against the wall of the station, or at any other convenient spot, the bell and armature being protected from exposure by means of a zinc cap *z*.

* Objection has been made to the use of the open circuit with one wire for signals, on account of the momentary signals which might be produced by atmospheric electricity seeking its way through the wire to the ground, or by what are known as "earth currents." But as the object of the above description is simply to illustrate the action of the "bell-sounder" under the influence of any electric current, these objections need not here be considered.

It only remains to devise a simple code of signals by strokes, in order to convey to the man in charge at B the necessary intelligence from A or C, and *vice versa*. The difference in tone of the bells indicates to the signal-man from which side the train is approaching. The number of strokes, and their combination, may inform him of the character of the train, whether freight or passenger, and of the company to which it belongs, in case the track is occupied by two or more companies. The agent is thus given from a distance all the information which is usually conveyed from the train itself on its near approach, by means of different colored flags, lights, etc. He has, therefore, ample time to make all necessary preparations, and on the passage of the train, signals its coming in like manner to his neighbor.

A system like this requires, as will be seen, the closest attention on the part of the signal-man; and it is usual to include in the code a sign of acknowledgment, without receiving which the signal is not regarded as complete by the sender. The direct action of the magnet upon the bell-hammer, which constitutes the simplicity of the above apparatus, practically limits the size of the bell employed to that of an ordinary office or dining-room call-bell. When it is necessary to sound a larger bell to attract the attention of a distant attendant, machinery must be introduced, in which electricity operates, not as the direct motive-power, but as an agent to release a mechanical force strong enough to produce the desired result. One of the best and most generally employed systems of this class is that of Leopolder, which is in use on the Nordbahn and other Austrian railways, and on the Northern Railway of Italy from Turin to Venice.

I am indebted to Mr. Leopolder, and to the *Allgemeine Telegraphenbau Gesellschaft* of Vienna, of which company he is a member, for a drawing of his apparatus.

The system is operated by opening instead of closing the circuit. When the apparatus is in its normal position the circuit is closed. The wires of the magnet are connected, one to the neighboring signal-station and battery, and the other to the ground. When the circuit is thrown open the current ceases to act on the magnet, and the armature, being no longer attracted, is drawn up by the tension of a spring attached to its lower arm.

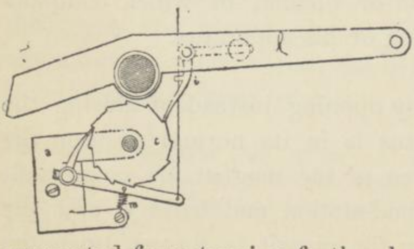
Fixed to the armature, on its upper side, are two arms which sustain a lever. On the rising of the armature and lever the latter releases a wheel which it allows to make one revolution, upon which it falls into its normal position. This wheel gears into a larger notched wheel, turned by a weight, the gears in such relation that the larger wheel advances one notch to each revolution of the smaller. These notches lift an arm having a hammer at its extremity, which strikes upon a large bell. It also operates another arm provided with a punch, which perforates a sheet of paper passing between rollers. The number of signals given upon the bell is thus accurately registered on the paper.

The registering part of the apparatus is called the "control," which term, however, is used in Europe indifferently, to designate a register of signals at the receiving station, or an automatic acknowledgment returned to the sending station. It is also applied, at least by the French, to the motive-power, or "controlling" force.

The system Leopolder, with the "control" attachment, is exhibited in the separate "Nordbahn Ausstellung," or collection of the Northern Railway of Austria. It having been introduced into Italy before the adoption of the "control," the latter was added, in substantially the same manner, by Sig. Montelli, one of the engineers of the Alta Italia Railway. In addition to this, however, a further modification was introduced by Sig. Montelli, and the apparatus, thus modified, is on exhibition in Group XIV. of the Italian department.

Plate II.

A

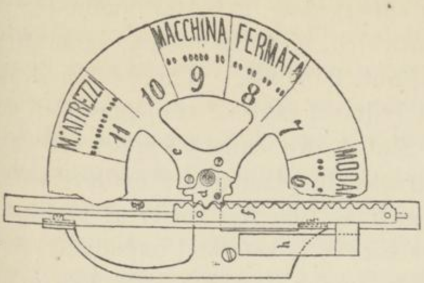


When the bell-lever *l* (Plate II., A) falls to deliver the stroke, it carries with it a catch *i*, which strikes against a tooth of the ratchet-wheel *c*, and carries it forward one tooth. The wheel is prevented from turning farther by a spring *a*, held against it by the tension of the spiral *m*.

The wheel *c* turns on the same axis as a cog-wheel *d* (B), the cogs of which, twelve in number, fit into those of a sliding bar *f*, *d* turns the large disc *e*, which is divided into twelve compartments or spaces, on eleven of which are printed the eleven code or dot-signals used on the Alta Italia Railway, with their meaning in plain Roman characters. The twelfth space is left blank.

PLATE II.

B



For every stroke on the bell, therefore, the disc is turned one space to the right, and the signal exposed at the top agrees with the number of the strokes. The attendant, hearing the sound of the bell, perhaps from a distance, comes to the signal-box, and having satisfied himself as to the signal, pulls a cord which releases the spring *a* (Plate A), and the disc, impelled by the weight *h* (B), falls to the position shown in the cut, with the blank space exposed at the top. The apparatus is simple, inexpensive, and little liable to error.

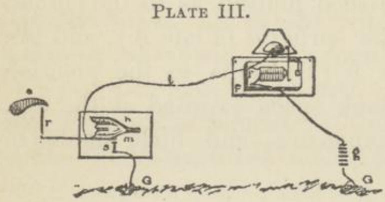
Messrs. Siemens & Halske, the widely-known electricians and instrument-makers of Berlin, have also, in their admirable collection, a similar apparatus to that of Leopolder, in which the control consists of an ink-writing Morse register. The apparatus is enclosed in a circular iron box surrounding the bell-support, and is so arranged, that on shutting the door of the box, the circuit is closed automatically should the person sending the signal have forgotten to close it.

The use of the foregoing apparatus presupposes the existence of a code, and this admits of its being employed, not only to signal the *movement* of trains, but also to give distress signals, which I have classed by themselves as Group VI., and, in a limited way, to answer the purpose of signals classed under Group II., or even, with a more extended code, of a speaking telegraph. There are two sets of apparatus, however, employed to signal the movement of trains, on which no code can be used.

The first of these belongs to that class of which I have spoken, as having such an important bearing on the future of railway signalling; i. e., electrical signals between stations and trains in motion. Although rude in its construction, and destined, doubtless, to be superseded by better methods, it illustrates the principle, on which, it seems to me, signalling in America must be carried out, if at all. Where labor is so scarce, and the demand for reduced rates of transportation so urgent as in the United States, we cannot expect railway companies to protect their tracks, by placing at short intervals, agents and signal-houses such as line the roads of Europe. Moreover, if the use of machinery is safe and expedient, the safest and best is that which, under proper guards, leaves as little to human agency as possible. I will not, however, enlarge upon this point at this stage of my report.

The apparatus alluded to is that employed by the *Compagnie du Nord*, near Mauberge, in France. It consists simply of a heavy spring or lever *a*, Plate III., securely fastened to the side of the rail in such a position as to be pressed down by the flange of a driving-wheel passing over it. The spring when depressed, pushes down a rod *r*, which is bent at right angles, and which carries at its end a flexible piece of metal *m*. This piece of metal which is connected with a line wire *l*, presses upon the standard *s*, which is connected to the ground. The arm of the rod *r* is attached to the under side of a small pair of bellows *b*, inclosed in a box beneath the track, as shown in the diagram. When the circuit is closed through *m* and *s*, the bellows is forced open, and closing only gradually, prolongs the signal given on the distant "bell-sounder," which would otherwise last only so long as the lever *a* is depressed.

PLATE III.



The bell is of the class known as the *sonnerie à trembleur*, or trembling-sounder. Its construction is similar to that of the simple "bell-sounder" before described, with this exception; that the circuit is arranged so that as soon as the hammer strikes the bell, it furnishes a shorter route for the current than through the helices of the magnet, or, as it is termed, "cuts the magnet out." The magnet ceasing to act, the armature is drawn back by the force of the spring. But this re-establishes the circuit through the coils, the armature is again attracted, and the hammer again strikes the bell. It is evident that the armature will continue to vibrate and the bell to ring as long as the circuit is closed at *m s*. The train thus announces its own approach by signal, which, it is true, lasts only as long as the train is passing, but which can be made permanent if necessary, by the introduction of a very slight modification in the apparatus.

The use of the lever at the side of the track was introduced in America, by Mr. Thomas Hall, in 1869, in connection with apparatus which will be hereafter alluded to.

The trembling-sounder, here described, fills an important place in the signal systems of Europe. On the continent, the law generally requires gates to be placed at grade crossings of common roads, which are shut for a certain time before the passage of every train. On some of the lines in France, the gatekeepers are advised electrically of the approach of trains by the use of the trembling-sounder, in order to close their gates. The attention of the gatekeepers, which might not be drawn in time for them to interpret any preconcerted code, is attracted by a continuous signal, which has but one meaning. As it is unnecessary that the gatekeepers should know either the character of the train or the direction from which it is approaching, a number of signal-boxes are sometimes placed on the same circuit and operated at the same time. The principal use of this arrangement is in the vicinity of towns, where crossings are near together. The signals, in the arrangement described, are of course sent from fixed stations. They are not properly "warning-signals," of which I propose to treat under Group III.

The trembling-sounder is again extensively employed throughout Europe for giving notice at stations of the position of outlying switches and semaphores, and it is, therefore, proper to introduce the second branch of my subject by a short notice of its application to such purpose.

II. SIGNALS GIVING KNOWLEDGE OF OR CONTROL OVER THE POSITION OF SWITCHES OR SEMAPHORES NOT VISIBLE TO THE PERSON REQUIRING SUCH KNOWLEDGE OR CONTROL.

The apparatus classed under this head may be divided into:

1. Instruments simply giving *information* at a distance, by means of electricity, of the position of switches or semaphores, draw-bridges, etc.; and
2. Instruments by which the position of semaphores may be *changed or controlled* at a distance through the medium of electricity.

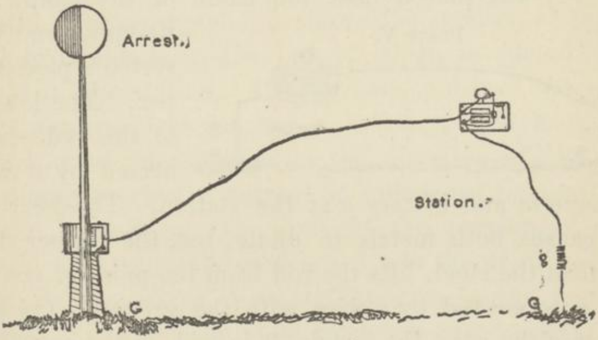
In technical parlance, the former are designated, both by French and German engineers, by the name of "Control." Since the introduction of the latter, however, a modification of terms would seem to be necessary.

While heavy switches are necessarily turned by hand, the lighter optical signals, consisting generally of a metal arm or disc placed at a convenient height at the side of the track, are frequently manipulated at a great distance from the stations by means of a wire running on pulleys at the top of posts some two feet above the ground. These semaphores are sometimes out of sight of the stations, and their position cannot always be known with certainty at the latter.

This arrangement, almost universal in Europe, has not been found of itself sufficient. When there are sharp curves in the immediate vicinity of stations, neglect of the signal-men to perform their duty or failure of the signal to work properly has been a not infrequent cause of accident. Still, on busy lines, where the position of semaphores (which are necessarily placed some distance outside the switches), must be frequently changed in pursuance of advices received by speaking telegraph or by signals of the first class, they must be manipulated from the stations. The danger thus presented (in case of breakage of the wire or other failure of the distant semaphore) to a train lying quietly at a station of being run into by another, has caused in Europe the very general introduction of electrical apparatus for its prevention.

The system of Mayer & Wolff, telegraphic instrument-makers of Vienna, which has been adopted and is exhibited by the Nordbahn Railway of Austria, is one of the simplest of this class, belonging to subdivision *a*. The semaphore is a disc of the ordinary class, which is turned from the station in the usual manner by a crank and wire. Around the support of the semaphore is a small circular box of metal, used to protect the connecting points of an electric circuit from exposure to the weather. As the semaphore turns to the position of arrest, a projection upon one side of the support touches within the box a brass spring, which is insulated from the semaphore and its metal support, and connected by a wire to the battery at the station. The support itself is connected with the ground, and thus an electric circuit is formed. Plate IV. illustrates the arrangement.

PLATE IV.



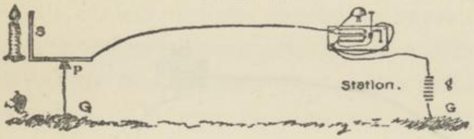
In circuit at the station is a trembling-sounder, which rings as long as the disc is in position of arrest and the projection on its support touches the spring. One of the advantages claimed for this particular apparatus is, that the bell does not commence to ring until the disc is very near the position of arrest, thus rendering false or accidental signals improbable.

Where the semaphore adopted is an arm instead of a disc, it is evident that by changing the position of the connecting points from the side of the support to the top near the fulcrum of the arm, the above system could be used equally well. In that case, however, inspection of the points, which is necessary from time to time in order to keep the connections perfect, would be more difficult.

The use of the foregoing or similar apparatus is the cause of that constant ringing of bell-signals which is so often noticed by the traveller in Europe while his train is waiting at a station. On the single-track routes of the *Compagnie du Midi*, in France, the discs were almost constantly in position of arrest. Hence, to avoid the incessant ringing of the bell, a simple method was devised by which the action of the apparatus might be suspended by hand at the station and reëstablished at pleasure.

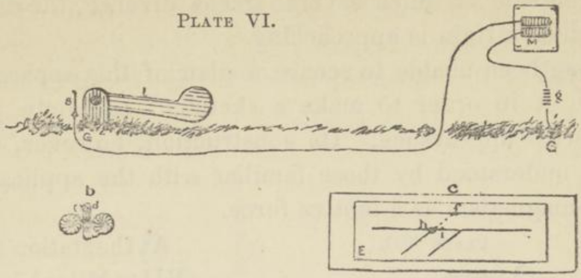
On the above line and also on the line of the *Compagnie de Lyon* a further modification of the apparatus was introduced. Signals at night being given by means of lights, it was thought necessary to keep the stations advised as to the condition of the light, which might by accident become extinguished, For this purpose a bent rod of steel *s* (see Plate V.) was placed near the flame of the lamp, and in its upper end was inserted a piece of copper. The lower arm of the rod was connected by a wire to the *sonnerie* and battery *g* at the station. The heat of the lamp causes both metals to dilate, but the copper dilating more than the steel, lifts the rod from the point of contact *p*, which is connected by a wire with the ground. On the extinction of the lamp the metals, it is said, in the course of fifteen or twenty seconds resume their natural dimensions. The lower arm of the rod falls on the point *p*, the circuit is established and the bell at the station rings. This apparatus is the invention of M. Boucher. Similar contrivances, the inventions of Messrs. Whitaker, Lewis, and others, with the thermometer attachments, have been patented in England. In the Italian department of the Exposition, near the model of the Mont Cenis Tunnel, is an apparatus employed by the Alta Italia Railway for showing to a station the position of anoutlying switch, which, although equally simple, is on a somewhat different principle from the foregoing systems.

PLATE V.



The arrangement is shown in Plate VI. : *l* is the lever of the

Plate VI.



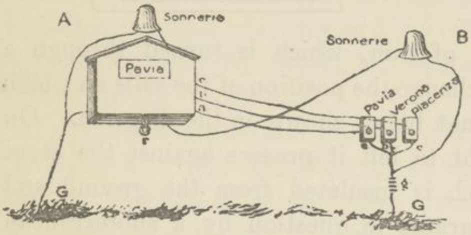
switch, a heavy piece of iron, which is turned through a semi-circle in order to change the position of the rails on which it acts, the connection not being shown in the diagram. On being turned from right to left it presses against the stout metallic spring *s*, which is insulated from the ground and connected (in the apparatus in question by a subterranean wire) to the magnet M, and through it to the battery *g* at the station. The switch-lever being connected with the ground, thus closes the circuit of the battery, which acts upon the electro-magnet. *b* shows the position of the magnet M as it stands in the box *c*, which is placed against the wall of the station. Between the poles of the electro-magnet a permanent magnet *d* is hung, with its poles so arranged as to be attracted in the direction of the dotted lines when the electro magnet is influenced by the current from the battery *g*. The axis of the permanent magnet is carried up through the card-board E to the point *h*, where a needle *i* is secured to it at right angles to the permanent magnet *d*. The position of the main and side tracks is traced on the card-board.

The apparatus being thus shown, its operation will be easily understood. As soon as the switch-lever is thrown over to change from main to side track, it presses against *s*, closing the circuit. The electro-magnet M attracts the permanent magnet *d*, which swings from left to right, carrying with it the needle *i*, which is thrown over to the point *f*. The position of the switch is thus indicated in the clearest manner at the station.

There is another interesting and useful instrument in the Italian department, employed on the upper Italian railway for the purpose of indicating to their principal stations from points outside at which several tracks diverge, the direction from which a train is approaching.

Having been unable to secure a plan of this apparatus, or to open it in order to make a sketch, I can only present its external appearance. Its construction, however, will be readily understood by those familiar with the application of electro-magnetism as a motive force.

PLATE VII.



At the station A Plate VII. (Milan) is an apparatus consisting of a *sonnerie à trembleur* and a flat case or box hung on the wall in the office of the station-master. The case is connected by three wires to three circuit-closers *a*, *b* and *c* at the junction, and by a fourth to a *sonnerie* which serves as a "control" for the signal-man.

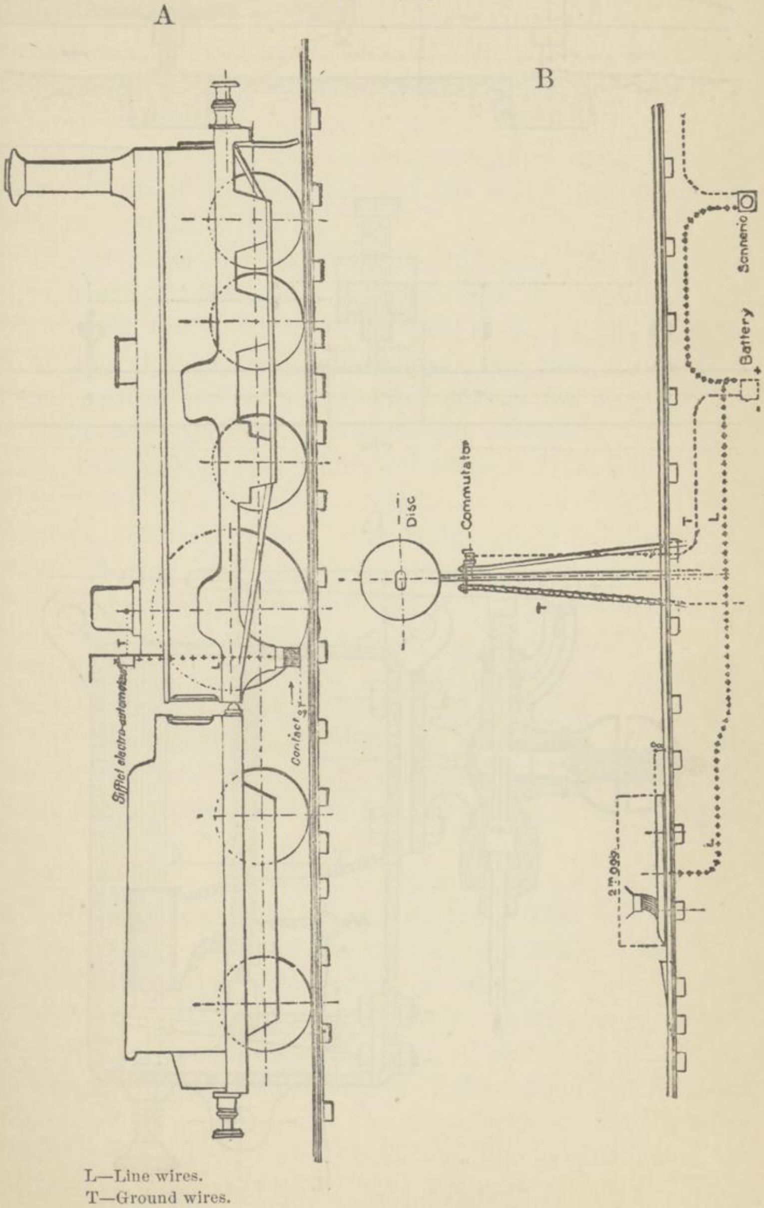
On the arrival of a train, say from Pavia, the signal-man presses down the button at *a*, throwing the current from the battery *g* upon the line. The circuit is through an electro-magnet in the case, thence through the magnet of the trembling-sounder to the ground. The magnet in the case turns a disc so as to display the word "Pavia" at the window of the case, and at the same time the *sonnerie* rings, attracting the attention of the station-master. The latter, by putting down the ring *a*, returns the disc to blank, arrests the ringing of his own bell, and at the same time closes the circuit of the fourth wire to B, thus indicating, through the *sonnerie* at that point, that the signal has been received and understood.

The battery *g* may of course be placed at the station as well as at the junction.

I have been much indebted to the courtesy of Sig. Orestes Lattes, an engineer of the Alta Italia Railway, and a member of the Italian Commission and International Jury, for facilities given me for the examination of the interesting exhibit made by his company.

An apparatus of a totally different character from the others of this class, and in some respects of entirely novel construction, has been lately adopted by the *Chemin de fer du Nord* of France, and is exhibited in the case of the *Administration des Telegraphes*, in the French department, with other apparatus of the same manufacturers, *Digney fréres*, of Paris. It

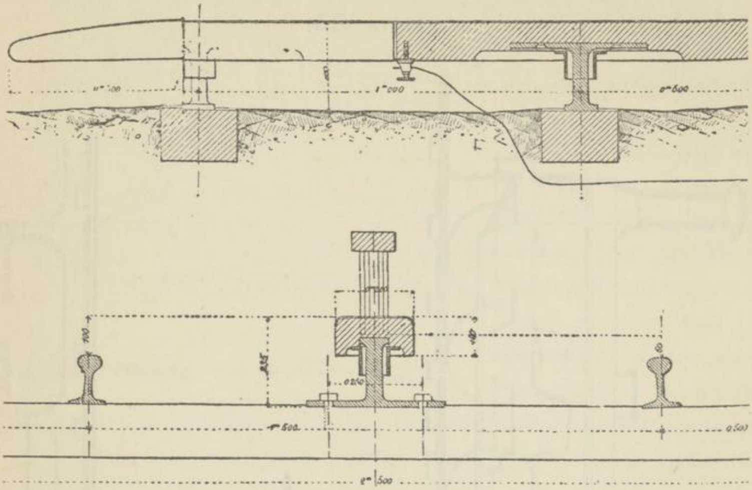
PLATE VIII.



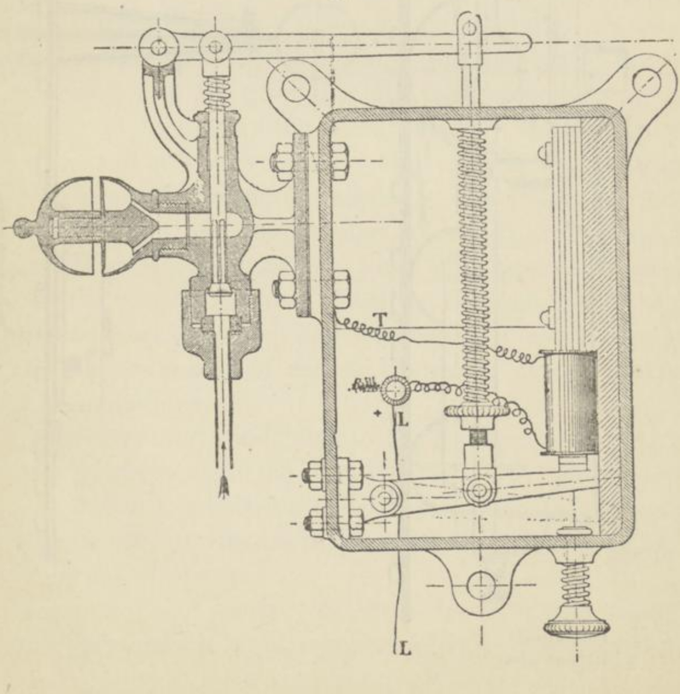
L—Line wires.
T—Ground wires.

PLATE VIII.

C



D



is called the "*Sifflet électro-automateur*," or Electro-automatic whistle, of Messrs. Lartigue & Forest. Its object is, by blowing the whistle of a coming train, to warn it of the position of a switch or optical signal which it is approaching, but which, by reason of fog, heavy snow, or even rain, or the extinction of a lamp at night, cannot be seen by the engineer. It belongs, therefore, to the class of signals between stations and trains in motion, to which I have alluded, and is a step in advance of all the apparatus just described in Group II, which give notice of danger, it is true, but whose warnings may, by reason of the distance of the switch or semaphore from the station, arrive too late.

The invention consists of two essential parts, the first being the means by which contact with the train is established, and the second the apparatus employed to sound the whistle. While in this particular instrument the two are coupled together, it is evident that the first part of the invention, if, as seems to be the case, it is uniformly successful in its operation, is capable of very wide application. I am assured by French engineers that the contact has never failed during nearly a year's experience, with trains going at a speed of sixty miles an hour (which is very often attained by the London express), and with the ordinary obstructions of snow, dirt, and even heavy ballast, upon the track.

Plate VIII., on preceding pages, represents the apparatus which is thus described.

Fig. A shows the locomotive and the manner of making contact; B, the connections to the distant semaphore; C, the fixed contact-plate, and D, the whistle upon an enlarged scale.

The whistle is of brass, in communication with the boiler, and carried in a metallic box on its top. This box contains a lever parallel to that of the whistle, to which it is attached. This second lever is influenced by a stiff spiral spring, which tends to lower it, and consequently to let the vapor escape. It carries at its extremity, however, an armature of soft iron in contact with an electro-magnet of the "Hughes" pattern, composed of a permanent horseshoe magnet, the arms of which are prolonged by cylinders of soft iron surrounded by helices of silk-covered wire. The cylinders become the poles of the magnet, and their attraction counterbalances the action of the spring.

If a current of electricity is made to pass through the helices in a certain direction the armature is momentarily repelled, the lever falls, and the whistle sounds until the engineer, by pressing on a button which is shown on the under side of the box (Plate D), arrests it in returning the lever to its original position (i. e., in contact with the magnet).

The current of electricity is produced in the following manner: —

The wire of the magnet is connected on one side with the body of the engine and by the intermediary of the wheels and rails with the ground. The other extremity is prolonged by a wire which, descending under the engine, is connected to a *metallic brush*, insulated and fixed in such a position that the end is lower by several centimetres than any projection on the engine.

This brush (Figs. A and B) is composed of stiff brass wires, of about No. 8 gauge, strongly set in an insulating substance, but terminating at their upper ends in a brass plate, which is again protected on the upper side by insulation. The connection is made by wire to this plate.

On the track, at any desired distance from the disc or semaphore, is placed a "fixed contact," composed of a piece of wood (see Fig. C), placed longitudinally between the rails and supported by iron standards at such a height as not to be touched by any projection on the engine.

This piece of wood, covered with an insulating compound, has on its upper surface a sheet of brass, which, by means of a wire of any desired length, is placed in communication with the positive pole of a galvanic battery (see Plate B). The negative pole is connected to a commutator fixed on the semaphore in a manner similar to that used in Mayer & Wolff's system (see Plate 4), which connects it with the ground when the disc is turned to "arrest." (The "*sonnerie*" shown in Fig. B is the station-alarm, and has no connection with this apparatus.)

On the passage of the engine the brush presses strongly against the fixed contact. If the distant semaphore is at "line clear," there is no effect produced. If, on the contrary, it is turned to "arrest," the sheet of brass is in communication with a source of electricity, and, on the passage of the locomotive, the metallic brush completes the circuit through the helices of the magnet, the armature is repelled, and the whistle is made to sound in the manner described.

This apparatus is said not to have been at all deranged by the shock of contact, and the brushes, after eight months' usage, show scarcely any traces of wear.

The contact between the rails is the one adopted by the *Compagnie du Nord.* Where very heavy snow-falls or other obstructions are to be feared, however, the contact might easily be placed at the side of the engine, at a convenient height from the ground.

It was feared, at first, that owing to the speed of trains the contact would not be sufficiently lasting to produce the desired effect, and accordingly the first trials were made with fixed contacts of over four metres in length, which permitted a contact lasting from one-fourth to one-fifth of a second at the highest speed. It was found, however, that a length of two metres in a fixed contact was sufficient to give the necessary signal, and this is the length adopted.

Various applications of the apparatus (in its entirety) are suggested by the inventor, not only for railways, but for the service of mines and the marine. The important uses to which the contact alone may be adapted will probably suggest themselves in the course of the following pages.

The apparatus of Group II, above described, is employed for the purpose of giving information merely of the position of a switch or semaphore. We now come to subdivision *b*:—

Instruments by which the position of semaphores may be *changed or controlled* at a distance through the medium of electricity.

Mr. W. H. Preece, the well-known Superintendent of British Postal Telegraphs, himself the inventor of a very ingenious system of signals, which will be hereafter described, says, in an able review of this subject, published in 1865: "If it were possible to work an out-door signal by electricity the system would be perfect, but inasmuch as the power of electricity is but circumscribed, we have not yet attained that production of force which is necessary to actuate with any degree of certainty our exposed signals. We are, therefore, compelled to adopt the nearest approach to this, and to rely upon small electrical instruments, which direct the signalman how to exhibit his out-door signals by displaying the signals which they themselves ought to give."

Since the date of the above, the difficulties alluded to have been ingeniously overcome by several inventors. In the number of apparatus the Austrians, so far as I know, have taken the lead. They have, in fact, the only instruments of this class at the Exhibition. It is only recently that electrical signals for such purposes have been permitted in Austria. There are now, however, two systems in operation, and a third is completed and shown at the Exposition.

The first of these is that of Mr. Hohenegger, an engineer of the Nordwestbahn, by which company the signal is exhibited and employed. It is also used on some roads in Hungary.

I am indebted to Mr. Hohenegger for a diagram of the apparatus which is shown in Plate IX. The machinery is in many respects similar to that of the system Leopolder, page 441, but its adaptation is so different and so interesting that it merits a separate description.

Plate IX. A shows the external appearance of the semaphore, looking down the line; B, page 458, the internal apparatus, and C the connection to the station.

The arm of the semaphore moves through an arc of forty-five degrees, and carries on its left extremity a smaller arm, in which are set two circular pieces of glass, one red and the other green, which pass in front of a fixed lantern, accordingly as the arm is raised or lowered. The lamp is raised to its position by means of a chain shown in the figure. At night, therefore, a red light signifies that the line is clear, and a green one that it is blocked.

The source of electricity is a magneto-electric or induction apparatus (Plate C), which is placed at the station. The slightest turn of the crank produces a sufficient current to operate the semaphore. To prevent accidental signals, therefore, the circuit is broken at *a*, and it is necessary to depress the button *a* (which is set even with the surface of a

PLATE IX.

A

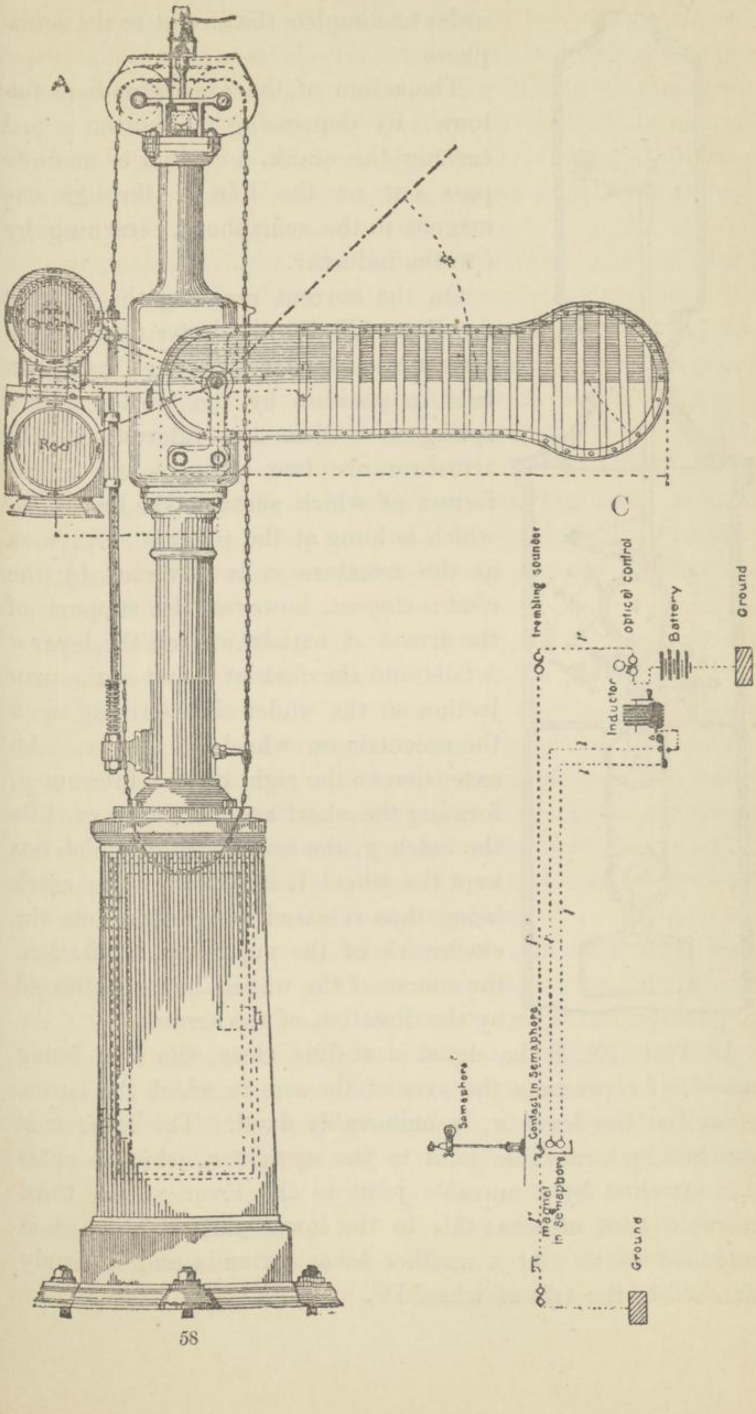
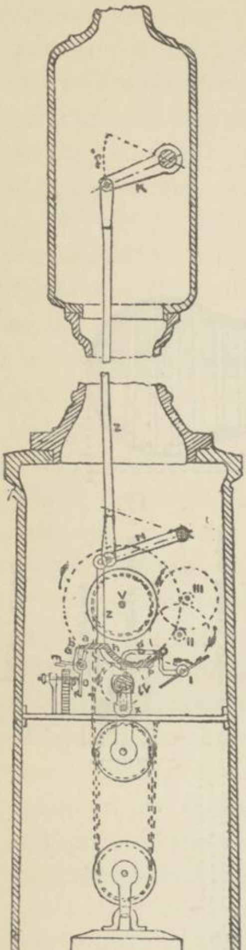

A
Green
Red
C
trembling sounder
optical control
Battery
Ground
Inductor
Contact in Semaphore
Semaphore
magnet in Semaphore
Ground

PLATE IX.
B



small box upon the table, and can only be moved by pressure of the finger) in order to complete the circuit to the semaphore.

The action of the apparatus is as follows: By depressing the button *a* and turning the crank, a current is made to pass out on the line *l*, through the magnet in the semaphore, returning by *l* to the inductor.

On the current reaching the magnet (*f* Plate IX. B), the latter attracts the armature *m*, which until then has been held in position by the tension of the spring *o*. Near the fulcrum of the armature are two arms, *b* and *c*, the former of which sustains the lever *a h*, which is hung at the point *p*. As soon as the armature *m* is attracted by the *electro-magnet*, however, the support of the arm *b* is withdrawn and the lever *a h* falls into the fork of *b* and *c*, the projection on the under side striking upon the eccentric on wheel IV. below. An extension to the right of the fulcrum *p*, forming the short arm of the lever, lifts the catch *g*, the lower arm of which has kept the wheel I. in arrest. The catch being thus released, the weight sets the clockwork of the apparatus in motion, the course of the wheels being indicated by the direction of the arrows.

In Plate IX. B the signal is at line clear, the arm being raised. *l* represents the axis of the arm to which the latter, as well as the lever K, is immovably fixed. The lever K is attached by a movable joint to the upright Z, which is in its turn attached by a movable joint to the lever N. A third movable joint attaches this to the lower part of Z, which is extended to X. At X another lever extends and is firmly attached to the axis of wheel IV.

As wheel IV. revolves, therefore, in the direction of the arrow, the upright z is raised, and the semaphore lowered to "arrest." At the end of a half turn, however, the eccentric on wheel IV. has raised the lever *a h* to its original position. There being no longer any current passing through the electro-magnet *f* (for, as I have said, the slightest turn of the crank is sufficient to set the machinery in motion), the spring *o* lifts the armature *m*, and the arm *b* again supports the lever *a h* at the point *a*.

An instant after, the bent arm of the catch *g*, which has been kept in its raised position by a second eccentric on wheel IV., falls into the notch. The lower, or straight arm of *g*, is thus raised, intercepts the wheel I and blocks the machinery. The joint X is now above instead of below the wheel IV., and the semaphore is maintained at the position of arrest.

It is evident that another current of electricity will again release the clock-work, and the wheels moving again in the same direction, will bring the apparatns back to the position shown in the diagram, and change once more the position of the semaphore.

The number of times this can be repeated, depends, of course, upon the distance which the weight has to descend before "running down." In almost all of the signals yet constructed, the clock-work has been placed by Mr. Hohenegger at the top of the apparatus, instead of near the base, as here represented. The construction here shown has been lately adopted on account of the difficulty in winding up the apparatus at such a height, but the change has, of course, rendered more frequent attention necessary.

The use of two wires in this signal, which on a short line would not be a matter of much moment, on longer circuits would, of course, add greatly to the expense of the apparatus. Its object is to avoid the giving of false signals by lightning or "earth currents," to which the system would be liable if the earth formed part of the circuit. I do not think this danger sufficient, however, to justify, or rather to require the use of a second wire in case of the signal being employed at a considerable distance.

It will be seen by reference to Fig. C, that a third wire is employed for what I suppose must still be called the "control," i.e., for notifying the station that the semaphore has obeyed the current from the induction apparatus. The connections of this third wire are not shown in the plates representing the semaphore. They are easily understood, however, by reference to previously described apparatus. When the arm of the semaphore falls to "arrest," it closes a galvanic circuit which rings a "trembling-sounder," and also actuates a magnetic needle, or "optical control," at the station. An atmospheric current would, of course, act upon these control signals, but its influence would be only momentary.

The use of this third wire, which is connected to the earth in the ordinary manner, is necessitated by the employment of the other two, forming a complete metallic circuit. All of the operations, including the "control," might be performed on one wire, and, it seems to me, with entire safety—certainly in carrying out the particular purpose for which this signal is used at present. This, it must be remembered, is the prevention by optical signals, of collision at a station, and the particular danger to be apprehended is that the signal may be accidentally changed, not from "line clear" to arrest, as that would only produce delay, but from "arrest" to "line clear."

Now, a cardinal principle of every signal system should be, as Mr. Preece has well expressed it, "that any derangement of the apparatus, or the accidental delivery of a false signal, shall at once indicate danger and produce safety." The use of the third wire only prevents the "accidental delivery of a false signal." If, therefore, the system of Mr. Hohenegger could be so arranged as to carry out this object with one wire, the other two would become superfluous.

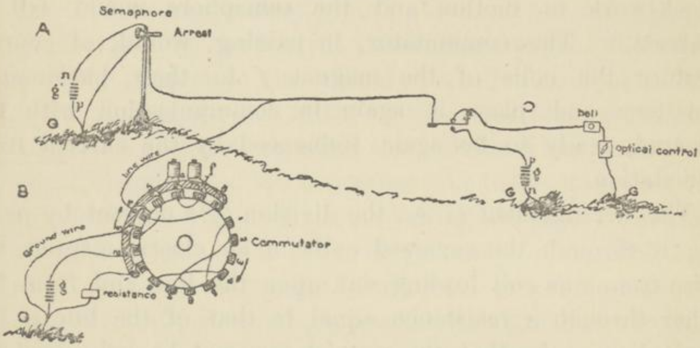
At present, the bell at the station sounds when the arm of the semaphore is at "arrest," thus indicating to the station-master that the signal is performing its duty and stopping approaching trains. Suppose, now, there were only one wire from the station to the semaphore, operated by a galvanic instead of an induction current, and having the ends connected to earth in the ordinary manner. A diagram (Plate X.) will perhaps best illustrate the position of the apparatus.

A train being at the station, the station-master presses down the button a, throwing the current of the battery g

upon the line, setting the clock-work in motion and bringing the semaphore to arrest, which is the position of the diagram. The button *a* returns, of course, to its normal position, there is no current upon the line after the signal is given, and the "control" signals remain quiet.

Now, if an atmospheric current comes upon the line, it discharges itself in the earth, influencing, of course, both the "control" signals at the station and the magnet *f* of the semaphore (Plate VIII., Fig. B), both of which, however, are protected from damage by "lightning-arresters." The magnet *f* turns the signal up to "line clear." The object now would be to advise the station-master, who may not notice the momentary signals given by the lightning upon his "control," of the

PLATE X.



dangerous position of the semaphore, as he is advised, under the present three-wire system, of its proper position at arrest; namely, by sounding continuously his "control-signal." The same amount of attention which he now gives to the "control" to assure himself that the semaphore is in the proper position, would, of course, suffice if the "control" were used to warn him of danger.

Suppose the commutator of the semaphore, instead of, as at present, closing an extra "control" circuit when the arm is turned to arrest, were, *when the arm is turned to "line clear,"* to break the direct connection of the magnet *f* with the ground and to bring in circuit an extra battery, g^1, at the same time *reversing the direction in which its current should pass around one of the coils of the magnet f* and throwing the current through that coil, by way of a *resistance equal to that* *of the line to the station*, into the ground. The current from g^1, dividing equally between the two coils of the magnet *f*, passing in one direction through one and in the opposite direction through the other, would not affect that magnet.

It would, however, ring the bell at the station and attract the attention of the station-master, who would hasten to set the semaphore again at "arrest." By pressing down the button *a*, he would bring the station battery in circuit. The current from this battery, added to the half of that from g^1, circulating in the coil of magnet *f*, which is attached to the line, would overcome the contrary influence of the other half of the current from g^1, which passes in the opposite direction through the other coil of *f* and the artificial resistance, to the ground; the magnet *f* would again be influenced to set the clock-work in motion and the semaphore would fall to "arrest." The commutator, in passing, would, of course, restore the coils of the magnet *f* to their harmonious relations and place it again in communication with the ground, ready to be again influenced by the current from the station.

This arrangement (i. e., the division of a current by passing it through the reversed coils of an electro-magnet, the wire from one coil leading out upon the line and from the other through a resistance equal to that of the line to the ground, in order that the magnet may not be influenced by its own, but only by a distant battery), is the principle of the duplex telegraph of Mr. Stearns, now quite extensively employed in America.

A rough sketch of the commutator suggested is shown at Plate X.

A wheel, turning in the direction shown by the arrows and making a half turn for every signal, is added to the clock-work in the semaphore. It is furnished with sixteen insulated metal cogs, connected to each other by wires, as shown in the diagram. Above and to the left of the wheel is a semicircular band, on which are secured eight insulated metallic springs, which press against the cogs and connect them to wires leading in the different directions shown. The wire from spring No. 1 leads to the resistance coil and ground, No. 2 to the extra battery g^1 and ground, No. 3 to the ground direct, and No. 4 to the main line from semaphore to station. Nos. 5, 6, 7 and 8 are attached to the ends of the coils of the electro-magnet *f*, by which the clock-work is put in operation.

The arm being at the position of "arrest," the circuit from the line wire passes through springs 4 and 8 (their corresponding cogs being connected) to one coil of the magnet *f*, thence by 7 and 6 through the other coil of the magnet in the ordinary direction, thence through 5 and 3 to the ground.

If now a current is put on at the station, or comes accidentally upon the line, the clock-work is released, the wheel makes a half revolution and brings the cogs numbered from 1 to 8 opposite their respective springs. The circuit may then be traced from the battery g^1 to 2, thence to 6 and 7, where it divides, part of the current passing through the right hand coil of the magnet in the ordinary direction to 8 and out on the line, ringing the bell at the station, and the rest going in the opposite direction through the left hand coil, back to 5, thence through 1 and the resistance coil to the ground.

A simpler method of accomplishing the same object, if practicable, might be to have the commutator merely cut out one coil of the electro-magnet *f* when the arm is thrown up to "line clear," and so to proportion the strength of the batteries g^1 and g, and the resistances of the magnet *f*, and that employed for the "control" bell, as to permit the extra battery g^1 to sound the bell without being able to influence the magnet of the semaphore through one coil. The battery g coming in aid would add sufficient strength to the current to draw down the armature of the magnet *f*, release the clock-work and restore the semaphore to "arrest."

The use of these or similar contrivances in systems of distance signals worked by electricity and clock-work would save the expense of two wires, and, in the Hohenegger system, of an induction apparatus. The cost and care of an extra battery at the semaphore would be added. The consequences of atmospheric electricity would not be avoided, but rendered harmless by the prompt alarm sounded at the station. Of course, when the signal is accidentally changed from "line clear" to "arrest," no damage, but only delay, is occasioned.* The danger arising from derangement of apparatus is to a greater or less extent inherent in any system.

I am indebted to the Allgemeine Telegraphenbau-gesellschaft, of Vienna, for a drawing of the apparatus of Mr. Schönbach, an engineer on the Westbahn, by which railway the system is employed and exhibited.

The construction is identical with that of the system Hohenegger, with this exception, that the upright lever, instead of raising and lowering a semaphore arm, is used to turn a wheel with a toothed axle. The teeth of the latter fit into the cogs of a horizontal wheel, the axle of which is extended upwards and attached to a circular disc, which it turns half round whenever the clock-work is released by the magnet.

Herr Ritter von Bergmüller, of Vienna, exhibits a third signal of this class, which is of much cheaper construction than the others, the clockwork being all of iron. The armature moves horizontally between the two poles of the electro-magnet, releasing a series of catches controlling the clock-work, which turns the disc of the semaphore. The winding apparatus is in the same position as in the Hohenegger and Schönbach systems, but the weight descends several feet below the ground, giving it a fall of perhaps six feet. Herr von Bergmüller states that seven signals can be given for every inch of the weight's descent, so that it needs to be wound up once for every five hundred signals.

In 1866, Mr. Thomas Hall devised a method of connecting an electric circuit with a switch or drawbridge in such a manner that when the rails of the track were displaced the circuit would be closed thereby and a danger-signal shown by means of a semaphore, operated by an electro-magnet, while at the same time a continuous alarm would be sounded

* In bell signals, on which a code is used, the danger of atmospheric electricity imitating or changing the signals is very slight; where the trembling-sounder is employed, a continuous ringing cannot be produced; and where a signal is given by and the "control" returned to a train in motion, as might be done by combining the automatic whistle with any of the systems in Group II. *b*, the intervention of lightning at the moment of receiving the "control" is exceedingly improbable. If in all of these cases, however, delay only and not danger is occasioned, its rare occurrence would be more than compensated by the saving in wires.

by a vibrating electric-bell at one or more points. This was put in successful operation within a year or two at several points on the New York and New Haven, and other roads. The semaphores consisted of a disc of colored cloth, stretched over a hoop and placed upon one end of a swinging-lever, the other end being provided with a counter-balance, and the disc is displayed by means of an electro-magnet, the armature of which was connected by a series of compound levers with its axis.

Mr. Frank L. Pope, the well-known electrical engineer of New York, has kindly furnished me with a drawing and description of his new signal, which, although not on exhibition at Vienna, has taken the first prize at the Cincinnati Industrial Exposition, and is already, if I mistake not, in operation on several American railways.

The signal is based on a different principle from any yet described, except that of Mr. Hall. It uses but one wire for the signalling and "control," and has in this respect a decided advantage over the European systems.

It also dispenses with all clockwork, using the direct force of electro-magnetism to turn the disc. This too, I doubt not, gives the system considerable advantage as regards both first cost and cost of maintenance or attention. The first cost of the European systems, however, I have found it impossible to obtain, in most cases, with any accuracy, and even were it obtainable, the prices here would afford no criterion of the cost in America.

For ingenuity of construction in an electrical point of view, also, the system of Mr. Pope far surpasses any of those heretofore described.

PLATE XI.

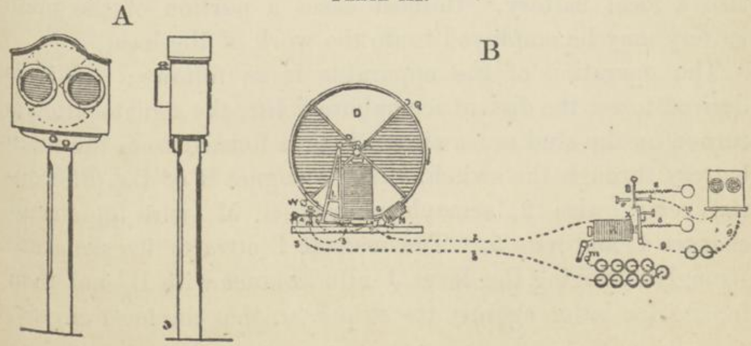


Plate XI. illustrates the appearance and working of the apparatus.

The external appearance of the semaphore is shown in Fig. A. It is placed on a post at the right-hand side of the track, at a suitable height from the ground; the signal is exhibited through two openings, each twelve inches in diameter, covered with glass, and illuminated at night by a lamp fitted with a reflector at the back of the signal-box.

The interior mechanism of the semaphore is shown in Fig. B. D is a disc about thirty inches in diameter, divided into four quarters, alternately white and red. An adjustable counter-weight, W, attached to the periphery of the disc, keeps it in the proper position to show red, indicating danger, except when under the influence of the electric current. Thus a white signal can only be shown when the machinery and battery are in perfect working order.

The disc is made to turn through one-fourth of a revolution by means of an electro-magnet M, the armature of which is attached to the short arm of the angular lever L, having a fulcrum at *l*. The long arm of this lever is connected by the pitman P with the crook K on the axis of the signal-disc. Thus the disc will turn and show a white signal whenever the magnet M is charged by the electric current. N is a supplementary magnet for locking the signal in position, when set white, as hereinafter explained.

The apparatus at the station may be at any required distance from the semaphore. It consist of a secondary or station-signal, which in principle and external appearance is a miniature copy of the distant semaphore—a differential relay, a signal-switch for operating the semaphore, and a main and also a local battery. In most cases a portion of the main battery may be employed to do the work of the local.

The operation of the apparatus is as follows: If it is desired to set the distant semaphore *white*, the signal-switch is turned on the stud *m*; a circuit is thus formed from the main battery through the switch, wire 1, magnet R of the differential relay, wire 2, semaphore magnet M, wire 3, circuit charger 4, and wire 5. The magnet R attracts its armature strongly, bringing the lever J into contact with B, and then forcing the latter against the stop *e*, so that the local circuit, which operates the small signal, is broken at z, notwithstanding it was at the same instant closed at x.

At the same time the magnet M turns the semaphore disc D in the direction shown by the arrow. Just before the disc D completes its movement, and after the white signal has been fully exhibited, a projection at o, on the lever L, comes in contact with a corresponding projection on the circuit-charger 4 and lifts it up, breaking the previously existing electrical contact at n. This cuts the battery current off from the magnet M and instantly transfers it to the locking magnet N. This occurs just as the soft iron armature Q on the disc comes in contact with N, and the latter being now strongly magnetic, seizes Q with great force and locks the signal disc firmly in its new position. The magnet N is, however, wound with a much finer wire than M, and the insertion of this great amount of extra resistance in the circuit weakens it to less than half its original strength in the relay R. When this occurs, the spring S, which is adjusted with a strong tension, pulls the lever J away from the relay-magnet until it is itself arrested by the stop z. At this juncture the local circuit is completed through wires 8, 9, and 10, and levers B and J, and the station-signal turns to white also, respecting the movement of the semaphore.

It will be seen that the system of Mr. Pope, which requires a permanent current to maintain the semaphore at "line clear," entirely avoids the danger from atmospheric currents, which seems to have been a bugbear of European systems, and that it fulfils as completely as possible the cardinal condition of Mr. Preece, that "any derangement of the apparatus, or the accidental delivery of a false signal, should at once indicate danger and produce safety."

Were it required to deliver the signal from a passing train, the object might perhaps be accomplished by substituting for the magnet M a magnet such as that used for the automatic whistle (Plate VIII.), the armature of which should be attracted by the combined force of the permanently magnetized cores and of a current of electricity sent in one direction, and again repelled (on the arrival of the train at a second contact where the semaphore should be changed) by the combined force of the spring and a current sent in the opposite direction.

The locking-magnet N could be placed on a local circuit, to be opened and closed at n by the lever L. As a very slight weight would be sufficient to keep the disc in position of "arrest," a slight force in the locking-magnet would seem to suffice to counterbalance it, and this force would be easily overcome by the stronger impulses given to the armature through the large magnet M. In this case the latter would be wound with small and the locking-magnet with large wire.

III. Signals of Warning at Grade Crossings of Common Roads.

There are no signals of this class on exhibition at Vienna, but the subject is too important to be passed over in a review of railway signals. Ordinarily in Europe, as I have said, gates are required to be kept at the crossing of highways, and they are generally closed in obedience to electrical signals sent from fixed stations.

The use of gates may be the only means of securing safety to those who cannot or will not take heed of optical or aural signals, and assure themselves that no train is near before crossing the track. Where signals are sent from fixed stations to the persons in charge of the gates, the large number of attendants required along a line where grade crossings are frequent, is a source of great expense to the railway. If several crossing signals are connected in one circuit, as is sometimes the case in France (see signals, class 1), an unnecessary delay may be caused to traffic on the highway.

The employment of gates is, therefore, not always desirable, or even practicable, in America. The frequency of accidents shows, however, that the means of prevention at present employed are not sufficient. When casualties of this kind are not due to the wilful carelessness of the traveller on the highway, they are generally occasioned either by his inability to see the approaching train or hear its signal, or by the neglect of the engineer to sound its whistle or bell in time.

What is wanted, therefore, is an aural or optical signal (or both), *placed at the crossing*, which shall be sounded or displayed without the aid of attendants whenever a coming train reaches a certain distance from it, and shall continue to sound or be displayed until the train has passed.

In 1869 Mr. Hall patented a method of using his signal and alarm apparatus, before described, at highway crossings, the electric circuits in this case being controlled by the moving train, through the agency of levers placed in close proximity to the rails, and in such a position as to be depressed by the wheels of the train as it passed.

This object may also be accomplished by means of a combination of the "automatic whistle" contact with a "*sonnerie*," and, if necessary, with a Pope's or Hohenegger's semaphore.

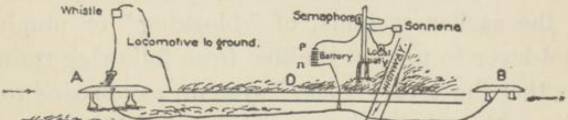
In case both the *sonnerie* and the semaphore are employed, the latter only need be actuated by the momentary current, and the arm or disc may be used to close a local circuit which shall actuate the *sonnerie* until the semaphore is again changed.

If the aural signals are thought to be sufficient, then a relay must be introduced like the magnet of the "automatic whistle," the armature of which shall keep the secondary circuit of the *sonnerie* closed until a current in the opposite direction to the first, reverse the position of the armature.

If the automatic whistle, as well as its brush contact, were employed on the engine, it would serve, of course, as an additional alarm to the traveller on the highway, and would warn the engineer as well that he was approaching a crossing.

Plate XII. shows the arrangement of the circuits for both a *sonnerie* and semaphore signal. The Hohenegger semaphore is shown, that being adapted to momentary signals; with some such modification as that suggested, however, the Pope system could be used equally as well.

PLATE XII.



The train approaching in the direction shown by the arrows, closes at A the circuit of the semaphore, which, turning, closes the local circuit of the *sonnerie*. Then passing the crossing of the highway and touching the fixed contact B, it turns the arm of the semaphore back to "line clear," the local circuit opens, and the *sonnerie* ceases to ring.

A is supposed to be at some distance, say a mile, from the crossing, while B is close by. For trains going the other way, two "fixed contacts" would be required, at C and D, but on a double track all four might be connected with one wire to the semaphore. The "fixed contacts" would, on a single-track road, have to be set, not in the centre, but at the sides of the track, so that trains going in either direction would only touch two of the four—the movable contact being also, of course, placed near the side of the engine.

If the *sonnerie* alone were used, there would be needed two batteries at the semaphore instead of one, and the direction of their poles would be reversed in order to give reverse signals on the magnet of the primary circuit before spoken of. A and C would be connected to the positive pole of one battery, and B and D to the negative pole of another. The additional cost would be trifling.

IV. Signals "Covering" the Position of Trains in Motion from Trains Following, Meeting or Crossing.

This class includes all electrical apparatus applied to the "block system," and to the system of "interlocking points" at junctions, and is perhaps the most important division of the subject of railway signals.

The term "block," as applied to railway signals, has become fixed in railway parlance, at least in England, and is used to designate a system under which the road is divided into sections, of greater or less length, protected by signals which allow only one train to be on a section at any given time. Mr. Preece thinks that the term arose from the necessity, in the earlier systems, of "blocking" or pinning over the signal-lever to protect the line from following trains. He suggests that the term "*space*" system, as opposed to that of "*time*," would probably be more accurate.

The "time" system, as employed in England, detained a train for five minutes after a preceding one had passed the signal-station, and exhibited a "caution" signal for five minutes more. Regard being had, however, to the difference in the speed of trains, and to the various accidents or delays which may happen between two signals, and which often cannot be notified to a following train in time to prevent a collision, it will be seen that the "time" system affords little or no safeguard.

The question has been very thoroughly gone into by Mr. Preece and by Colonel Tolland, Government Inspector of Railways in England. As long ago as 1862, the latter gentleman said:—

"An interval of time, as a means of avoiding collisions between trains, is, in my judgment, worse than useless; it is deceptive and thoroughly uncertain, as an interval of half an hour at one station may have entirely disappeared before the train arrives at its next appointed stopping-place; whereas, an interval of space, no matter how short, between following trains, if preserved, will always prevent a collision from taking place."

At a very recent discussion of the subject before the Society of Telegraph Engineers in London, in which both these gentlemen participated, the conclusion arrived at was almost unanimous, that the "block" system, strictly carried out, was the only certain preventive of collision. If the block is absolute, and no other is safe or entitled to the name of block, there seems to be no alternative for the use of electricity in working and maintaining it. The employment of signal-men, within sight of each other, is not to be thought of, and yet it appears to be the only way to carry out the principle of the block without electrical aid.

The only approach to an equivalent of the block in America has, until lately, been found in the system of "train despatching," but this requires, to be effective, a corps of skilled telegraphers, which cannot always be procured for railway service.

On some of the English railways, trains are run at intervals of three minutes under the block system. On the London and North-Western, the signal-stations are two miles apart, and on the Charing Cross extension of the South-Eastern Railway, less than a mile. While none of the American roads, probably, have anything like a corresponding traffic, there are many where trains run too frequently to permit of their being blocked at telegraphic stations irregularly located, and sometimes at long distances from each other. The train-despatcher's order to a following train is, therefore, to "run as section two" of the preceding one, or to "proceed, keeping a sharp look-out" for it to the next station, and "wait for orders." This at once introduces all the danger and uncertainty of the English time system.

I do not wish to disparage the manner in which the train-despatching system is conducted. Where skilled American telegraphers are employed and properly remunerated, they do their work better than any others in the world. Such men cannot be had for railway service, however, in sufficient numbers to allow a telegraph office at every point where the block system would establish a signal, and a large traffic cannot, therefore, be worked with safety by "train despatching." Were a simpler telegraph employed for the ordinary service, the block system adopted for the running of trains, and each worked by railway employés, economy and safety would, probably, both be advanced by the change.

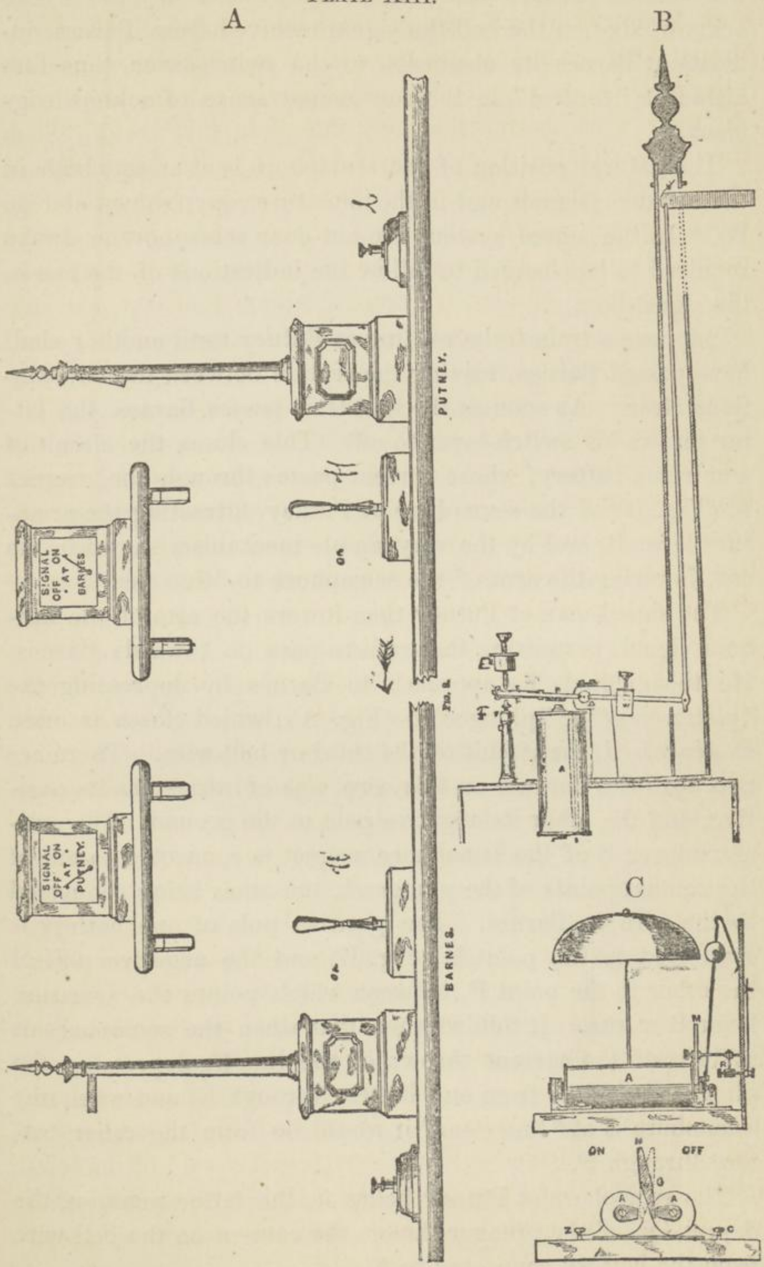
Various forms of the block are in use in England on the different railways, none of which are on exhibition at Vienna. From the simple needle to the most complicated apparatus, however, the instruments in use have merely one purpose,—that of sending a *signal* from one signal-station to the man in charge at the next, who controls the movement of the semaphore.

The system of Mr. Preece, which is adopted by the Metropolitan Railway, comprises three wires, two of which are employed for the block-signals proper, one for each line of rails, and one for movement-signals (see class 1) and acknowledgment of the block-signals. On the third wire a "bell-sounder" is employed, with a code to indicate the character of approaching trains, etc.

The apparatus is shown at Plate XIII. as working between Barnes and Putney. The semaphore and switch-lever (Fig. A) are miniature copies of those used for out-door signals worked by hand. They are inclosed in a box or placed on the counter in the signal-house at each station.

There are, according to Mr. Preece, two fundamental requirements of the system: one being that the signal-man at one station shall have "sole and complete control" of the semaphore at the other; the other being that "every signal shall be properly acknowledged, and that the acknowledgment shall not only imply the due receipt of the signal sent, but that it has been correctly understood and properly acted upon."

PLATE XIII.



To fulfil these requirements, the switch-lever at Barnes must "control" (in the sense of change) the position of the semaphore at Putney, and the semaphore at Putney must, with the aid of the Putney signal-man, whose business it is to acknowledge on the bell the signal received from Barnes, indicate at Barnes its obedience to the switch-lever, thus furnishing a "control" in the continental sense of acknowledgment.

The natural position of the semaphore is at arrest, both in the out-door signals and in the miniature copy (shown at Fig. B). In the signal system the out-door semaphore is always required to be changed to follow the indications of the one in the signal-box.

Suppose a train to be waiting at Putney until another shall have passed Barnes, leaving the section between the two stations clear. As soon as the first train passes Barnes, the latter throws his switch-lever to off. This closes the circuit of a galvanic battery, whose current passes through the magnet A (Fig. B) of the semaphore at Putney, attracting the armature lever B, and by the very simple mechanism shown in the cut, lowering the arm of the semaphore to "line clear."

The signal-man at Putney then lowers the arm of the out-door signal, permitting the train to pass on towards Barnes. He then signals its approach to Barnes by depressing the "piston-key" or "plunger" *b* (Fig. A), which closes as often as depressed, the circuit of the third or bell-wire. There are two batteries for use on this wire, one of which has its positive, and the other its negative pole to the ground. The armature lever B of the semaphore magnet is connected to one of the contact points of the plunger *b*, the other being connected to the wire to Barnes. The positive pole of one battery is connected to the point E (Fig. B) and the negative pole of the other to the point F, between which points the armature lever B works. It follows then that when the semaphore is at "arrest" the current thrown on the line by depressing the plunger would be from one battery through E, and when the semaphore is at "line clear" it would be from the other battery through F.

The semaphore at Putney being in the latter position, the depression of the plunger throws the current on the bell-wire from the battery connected to F.

This current first actuates a bell-sounder at Barnes (Fig. C) in the ordinary manner, announcing the approaching of the train from Putney. In addition to the ordinary hammer-armature, however, there is a permanent magnet M swinging between the poles of the electro-magnet, as shown in Fig. D. When the battery from E is on the line, this magnet swings over to the left, and when the battery from F is on, it is then thrown to the right, in consequence of the different polarities given to the electro-magnet by the change of the direction of the current. The axis of this permanent magnet is prolonged as in the Italian switch-control heretofore described (see Plate V.), and works a rack and pinion movement, shown in the cut, which controls a needle-indicator on the outside of the case. The movement of the indicator is, of course, the reverse of that of the magnet. (Fig. A.)

The permanent magnet at Barnes once thrown to "off" by the signal-man at Putney, is not again disturbed except by a reversed current from the battery through E, which cannot be put on the wire while the semaphore at Putney indicates "line clear." Any number of signals may, therefore, be made on the bell at Barnes indicating the character, etc., of the approaching train.

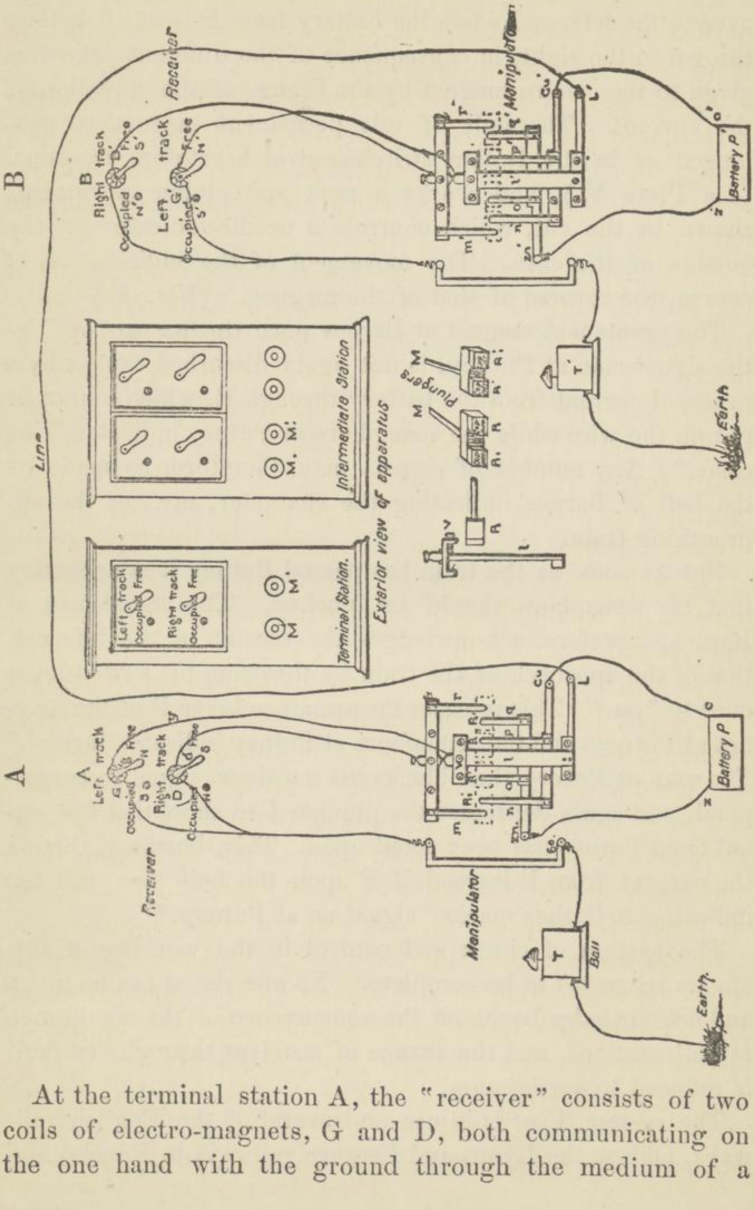
But as soon as the train has passed Putney it is necessary that his semaphore should be blocked. The signal-man at Barnes, therefore, acknowledges the receipt of the information of the approach of the train by throwing his switch-lever over to "on." This releases the armature lever B of the magnet at Putney, and the semaphore at Putney indicates "arrest." The man at Putney then blocks his out-door signal to correspond, and again depresses the plunger *b* to show that the signal from Barnes has been acted upon. This, however, throws the current from E instead of F upon the bell-wire, and the indicator at Barnes marks "signal on at Putney."

The system of check and control in the working of this apparatus seems to be complete. No one signal can be given and acknowledged without the concurrence of the signal-men at both stations, and the chance of accident through its fault is reduced to a *minimum*.

The system Tyer is in use on several of the English railways, and on the Lyons and Eastern railways in France, and is highly spoken of by the managers as well as by M. Amiot, the French inspector of telegraphs, in his report to which I have alluded.

Plate XIV. illustrates its general appearance and working.

PLATE XIV.



At the terminal station A, the "receiver" consists of two coils of electro-magnets, G and D, both communicating on the one hand with the ground through the medium of a "trembling-sounder" T, and on the other hand with the manipulator, to be hereafter described. Each of these coils is placed above the centre of a permanent horseshoe magnet, whose poles N, S, touch lightly the exterior surface of the platina, under the indications "occupied," "free," and contains a core of soft iron, at the upper extremity of which a light needle, d, g, also of soft iron, vibrates freely between the two poles of the permanent magnet.

The receiver at the intermediate station B does not differ from that of the terminal station except in that the coil D^1, giving the signals for the right track (in going from B to A) is placed above the coil G^1, which gives the signals for the left line of rails.

The manipulator is the same at both stations. It comprises two buttons, M and M^1, which, when pressed down, move two rods, held by spiral springs. Each of these rods is furnished at its farther extremity with two insulated rectangular pieces of copper R, R_1, R^1, R^1_1, placed in front of a series of seven upright metallic springs, m, n, o, l, p, q, r. The centre spring l, connected at the bottom with the line wire, touches at the top, when neither of the buttons M, M^1, are pressed down, upon a screw V, connected to the wire of the "left track" coil G. The six other springs are connected together by metallic bands, two by two, as shown in the cut, and communicate as follows: —

The two inside springs m, r, with the wire of the "right track" coil, D, the two springs *n* and *p* with the copper pole of the battery, and the springs *o* and *q* with the zinc pole.

When the right-hand button M^1 is pressed, the copper rectangles at the end of its rod connect the springs *l* and *p*, and *q* and *r* as shown in the dotted lines of the cut, at the same time breaking the connection between *l* and v and insulating the former from the coil G, with which it communicated.

In the same manner the left-hand button M, if pressed, would insulate *l* from G, and connect *l* with *o*, and *n* with *m*. The effect of this would be, as will be easily seen by tracing the connections, that when the button M^1 is pressed, a positive current will be transmitted on the line L and a negative current through the coil D and the *sonnerie* T. In pressing the button M, exactly the opposite effect will be produced.

Supposing N and S to represent the north and south poles of the permanent magnet, it will be easily seen that on the pressure of the right-hand button M^1 at the sending station, the negative current sent through the coil D would develop a north pole at the near extremity of the soft iron core of that helix, which polarity would be communicated to the free end of the needle *d*. This needle, attracted by the south pole S, and repelled by the pole N of the permanent magnet, would be thrown over to the indication "free," while the positive current sent over the line through L, thence through L^1, l^1, to the coil G^1, at the receiving station, would develop a south pole at the free end of the needle g^1, which would be thrown over to N^1, *i, e*, to the indication "free," as at the sending station.

The pressure of the left-hand button M would, by reversing the direction of the currents, have a contrary effect on both the needles *g* and d^1, indicating "occupied." The same effects would be produced by pressing M, and M^1_1, at the other station upon the needles d^1 and *g*.

Each signal sent from either station sounds the bells T and T^1, calling attention to the signal.

Suppose a train now to leave the station A for B, no other being on the line between the two and all the needles being therefore at "line free." The agent at A having covered the train by his out-door signal, presses the button M^1. The needles *d* and g^1 being already at "free," this would simply ring the bells of the two stations without changing the indicators.

The agent at B, thus advised of the coming of a train, acknowledges the signal by pressing his left-hand button M_1. He also rings the *sonneries* T^1 and T, at the same time throwing over the needles d^1 and g^1 to "occupied." The needles at both stations thus indicate that one line of rails is occupied, and that at A is a reminder that the outside semaphore should be at "arrest."

When the train arrives at B, the agent there presses the button M^1_1 and brings back to "free" the two needles d^1 and *g*, again ringing the bell T to notify A of the arrival of the train.

If when one train is coming from B to A, another passes A on the second track for B, the agent at A, instead of pressing M^1 to advise B of its departure, which would throw the needles d and g^1 to "free," presses the button M, *towards which the needle d is now inclined as in the case before described it was inclined towards* M^1.

It is not necessary to repeat the rules adopted for the entire system of signalling, which are the same as in any "block" system. To carry them into effect on the apparatus, the following special directions are given:

1. To signal the *departure* of a train, press upon the button towards which is inclined the needle of the "right track."

2. To acknowledge this signal, press upon the button under the indication "occupied."

3. To announce the *arrival* of a train, press upon the button under the indication "free."

The two instruments necessary for intermediary stations are generally inclosed in one box, as shown in the cut.

The system of Mr. Tyer, in a telegraphic point of view, is very ingenious and possesses the great advantage of requiring but one wire. Like Mr. Preece's system, each signal requires the concurrence of the agents at both stations before it is completed. There is, therefore, very little danger from atmospheric electricity. Unlike Mr. Preece's system, that of Mr. Tyer does not give the man at one station "sole and complete control" of the indicator at the other. But the control spoken of by Mr. Preece is only electrical, and might easily be overcome by mechanical means. It being suggested that the signal-man might "tie down the arm of the semaphore with a string," Mr. Preece very aptly replied that he might also "neglect his duty, disregard his signals, and swear that the semaphore was down when it was really up."

In the Tyer system a signal-man to change his own signal must also change that of his neighbor, and this is probably as good a control as putting it out of his power to interfere electrically with his own indicator.

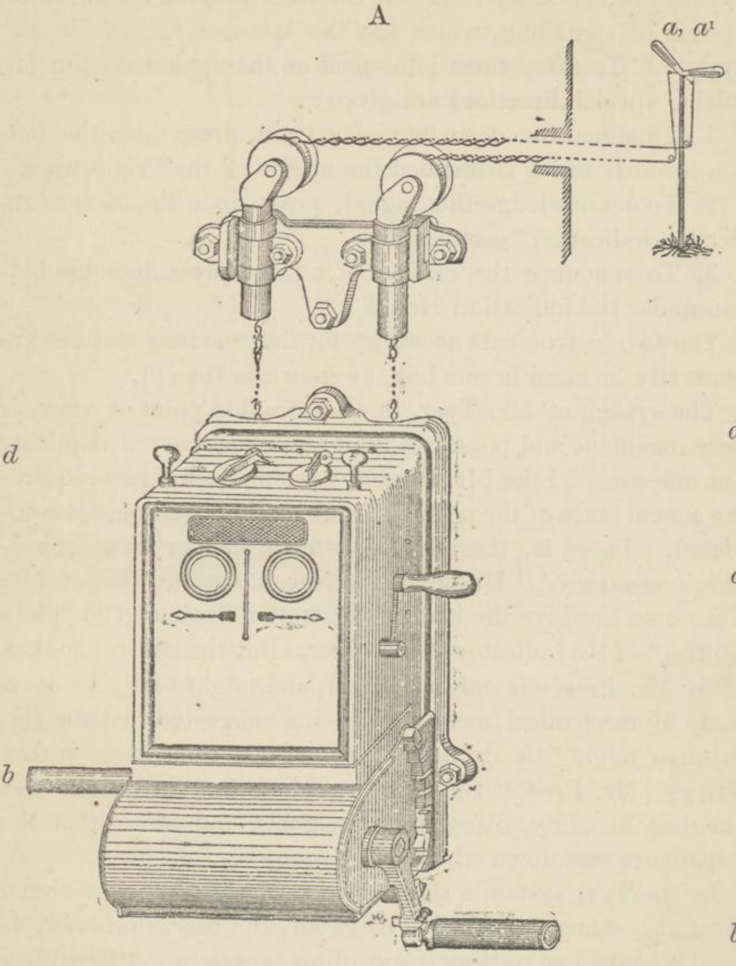
The new system of Messrs. Siemens & Halske, exhibited both in the German and English departments at Vienna, goes a step farther towards the control of the signal-man than either the Preece or Tyer system. By the kindness of Dr.

Werner Siemens, of Berlin, I have been furnished with drawings of this apparatus which are here presented.

A shows the external appearance of the apparatus at an intermediate station, the arms a, a^1 of the semaphore being

PLATE XV.

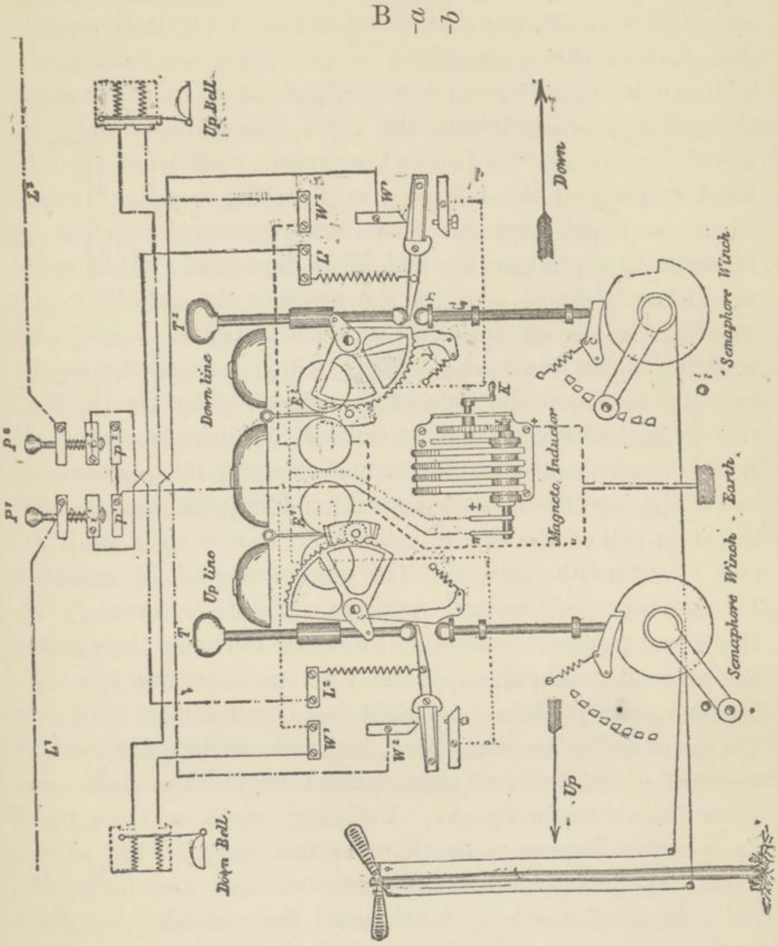
A



worked by the cranks b, b^1. The arm a gives the signal for up, and the arm a^1 for down-trains. The crank c is used to turn a magneto-electric apparatus in the box, from which currents are transmitted in one direction or another, accordingly as the commutator knob or plunger d or d^1 is pressed down. The discs shown on the face are controlled by the current, and show white or red as the line is clear or blocked on their respective sides. B shows the internal mechanism and connec-

PLATE XV.

B



tions, with the addition of duplicate sets of bells and plungers (P^1 and P^2), not shown in A, which are used for signalling the forward movement of trains. There are other forms of the apparatus, but this is the most complete, and was the one chosen for exhibition at Vienna.

The figure shows the up-track "blocked" and the down-track clear. A "down" train, we will suppose, is about passing the station. The signal-man has four things to do:

to set his out-door signal at block, so as to prevent a second train passing down; to set the disc in his box to correspond with the semaphore; to notify the station above him that the train has passed, in order that the latter may unblock his signal; and to notify the station below that the train is coming. The first of these operations is performed by turning the "semaphore winch" from left to right, so as to rest against the point *f*, which lowers the right arm of the semaphore, signifying "block." (This is the present position of the left-hand winch and the left-hand arm on the "up-line" side.) The second and third operations are performed together, as follows: The plunger marked T^2 is depressed (which could not before be done), carrying down with it the metallic spring *a*, which is cut off from W^1 and connected to *b*, and also carrying down the spring rod G, which presses the pawl *c* into the notch on the axis of the winch. The handle K of the magneto-inductor is then turned, which causes alternate positive and negative currents to flow along the commutator marked + and the wire in connection therewith, and through the right coil of the electro-magnet E^2, thence by *b*, *a*, L^1, i^1 and P^1 out on the line L^1. The electro-magnet E^2, actuated by alternate positive and negative currents, alternately attracts and repels an armature swinging between the ends of the two coils. On the upper end of this armature is a bell-hammer, which strikes the right hand and centre bells; on the lower end is an escapement which works into the teeth of the half-white, half-red index placed behind the right hand glass disc shown in fig. A. A sliding weight on the stem of the plunger T^2 presses down upon the opposite end of the index, and, as the escapement moves back and forth, the index is raised, tooth by tooth, until the red takes the place of the white behind the glass, and the box-signal corresponds with the semaphore. The depression of G has allowed a lever *l* to press against the shoulder H on the rod, and, as the index rises, its axis, half of which is cut out, prevents the lever *l* from returning. The rod G, therefore, holds down the pawl *c*, *and prevents the out-door semaphore from being unblocked until the index is brought back to white, or "line clear*." This will be understood by reference to the left side of the diagram.

Now, whenever the plunger T^2 is depressed, the sliding-weight on its rod presses on the tail of the index and prevents its descending, the index can only be brought down again and the semaphore released by a current from the station below when T^2 is up. This brings us to the third operation performed by the signal-man, which is to notify the station above, by unblocking his box-signal and releasing his semaphore, that the train has passed. The "up-line" side being blocked on the diagram, the method of unblocking will appear if we trace the course of the circuit on that side from wire L^1, P^1, i^1, L^1, a, W^1, through "down-bell" W^1 and the right coil of the electro-magnet E^1 to the ground. The alternate positive and negative currents move the escapement on the lower end of the armature, and the index, not being pressed by the sliding-weight, which would give it an upward bias, falls, by its own weight, tooth by tooth. White, or "line clear," is shown behind the glass; the lever l is released by the half-turn of the axis, and this releases, as well, the spring rod G and pawl c, permitting the signal-man to turn his semaphore also to "line clear."

From the above explanation it is evident that the signal-man cannot advise the preceding station of the passage of a train until he has first blocked his own semaphore; and that, having once blocked his semaphore, he cannot unblock it until he has received clear and unmistakable notice from the succeeding station that the train has passed there. Two motions—depression of the plunger and turning the handle of the inductor—are necessary for any signal, and, as a succession of alternately positive and negative currents is required to move the index, no signal can be delivered by lightning or other accident. For convenience, one coil (or rather one magnet; for the two coils are not connected as in ordinary electro-magnets) is used on each side for arriving, and the other for departing, signals.

To signal the forward movement of trains from one station to the next, the upper plunger, say P^2, is depressed and the handle of the magneto-inductor turned. The current then goes from the commutator marked T to P^1, P^2, and i^2, where it divides, a portion going out on the line, and the rest through L^2, W^2, up bell, and the left coil of E^2 to the ground.

But half of the spindle, where touched by T, is cut away; hence, only one current is transmitted, and, as the armature of E^2 requires alternate positive and negative currents to attract and repel it, rocking the escapement, the index is not moved either at the transmitting or the receiving station. The only effect, therefore, of turning the crank when the upper plungers are depressed is to ring the bell at the station above or below, as the case may be, thus advising the signal-man of the approach of a train.

As far as safety is concerned, the apparatus of Messrs. Siemens seems to fulfil the requirements of a block-system more completely than any other yet introduced in Europe. No accidental signals can be given, and neglect of duty on the part of the signal-man causes no danger, but only delay. Danger may arise, as in any of the systems yet described, from the train breaking in two without the knowledge of the engineer or of the signal-man, who, on its passage, would unblock the signal of the preceding station while cars might be standing on the track between the two. There is also the chance, always remote, that the signal-man will wilfully do wrong, and, his own block being on, signal to the preceding station that the train has passed, when, in fact, it has not. The adoption of induction instead of galvanic currents, the control by one signal-man over the semaphore of another, and the use of but one wire, give this system an advantage over the preceding block instruments. It has, however, in common with them, the disadvantage of being quite expensive, and requiring the constant attention of a signal-man at each station.

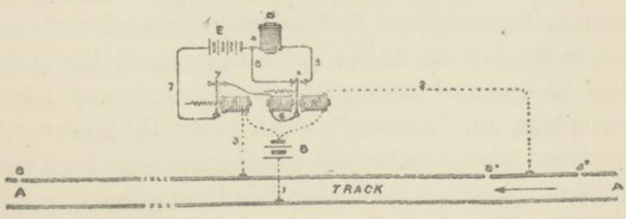
These last two considerations would probably alone be sufficient to prevent the adoption of this or indeed any of the block systems yet described, on American railways.

Within the past five or six years, the automatic signal of Mr. Hall, before described, has been, by a slight change in the relative position of the semaphores and circuit-closers, made to serve as a block system. The semaphores, enclosed in suitable cases, are placed at intervals of about a mile along the track. Thus, when a train passes one of the signal-stations, the wheels of the locomotive will depress a lever, close an electric circuit, and display a danger-signal, which is provided with a detent, serving to retain it in this position after the train has passed. When the train arrives at the next signal, this operation is repeated, and at the same time a second circuit is closed, running back to the first-mentioned signal, and releasing or reversing it. Thus each train is supposed to maintain a danger-signal at least a mile in the rear at all times.

Although this system dispenses with the expense of attendants, it still requires two wires, the lever is liable to be displaced by the shock of passing trains, and the failure of a wire or battery may cause a failure to display the danger-signal at a critical moment. Like previous systems, it does not provide for the breakage of a train, and it is not adapted, without considerable modification, to a single track railroad, it being what is called a "non-following," but not a "non-meeting" block. The system which seems to obviate these objections the most completely, has been produced by Mr. F. L. Pope, of the Electric Railroad Company of New York.

Mr. Pope's system is based on the electrical law, that a current will divide itself between two conductors, in proportion to their respective conducting capacity, and by numerous carefully conducted experiments, he found that the conductivity of a mile or more of ordinary fish-jointed rail exceeds that of the cross-ties and ballast between the tracks, even in very wet weather. Bearing this fact in mind, it will be easy to understand the system.

Plate XVI.



In Plate XVI., A A represents a railway track. One rail forms a continuous conductor, while the other is divided, electrically speaking, into sections, by means of insulated joints a a^1 a^2. The long sections a a^1 are a mile or more in length, while the alternating short sections a^1 a^2 are only about fifty feet in length. The trains are supposed to move in the direction indicated by the arrow. The electric magnet S which operates the semaphore, together with the semaphore itself and its fixtures, are placed 200 or 300 feet in advance of the short section a^1 a^2. The semaphore is the same shown in Plate XI., under class 2.

Opposite the signal apparatus, a battery B is connected to the continuous rail of the track by a wire, 1. From the opposite pole of the battery, two wires, 2 and 3, are conducted to two relays, R and R^1, and thence to the long and short sections of the other rail, a a^1 and a^1 a^2 respectively. These two relays control the local circuit 4, 5, 6, 7, which operates the semaphore, by means of the local battery E.

The normal position of the semaphore indicates "danger." But whenever a current is passing through the magnet S, it will indicate "safety," until the current is interrupted, when a counterbalance weight returns the signal to its former position.

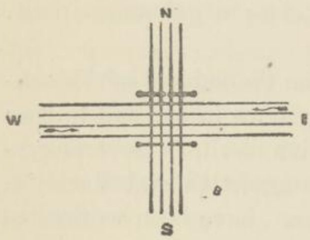
When a train, passing in the direction of the arrow, reaches the short section of rail, its wheels and axles form an electrical connection with the opposite rail, closing the circuit of the relay R^1, the armature of which in turn closes the local circuit at x. A moment afterward, the advancing train reaches the long section at a^1, actuating the other relay R in the same manner, and closing the local circuit at y. The local circuit being now complete at x and y, the electro-magnet S is charged, and a safety-signal shown, which indicates to the engineer that he may proceed with safety. As soon as the last car of the train has passed the point a^1, the relay R^1 opens, breaking the local circuit and returning the semaphore to "danger." The relay R, however, will remain closed while the train is passing over the long section, and the local circuit will, during this time, pass through the wires 6, 7 and 8, including the retaining magnet M. If, therefore, another train should enter upon the short section a^1 a^2, it would be unable to close the local circuit at x, and thus cause a safety-signal to be shown, because the armature of the relay R^1 would be held fast by the attraction of M.

In this system it will be seen that the circuit closers, being composed of sections of the track itself, are not subject to wear or derangement; a safety-signal cannot be shown unless every battery is in working order, and every wire unbroken; nor can a safety-signal be given when any part of a preceding or meeting train remains upon the section of track between two signal-stations.

Experiments have been made on a prominent American railway with an apparatus for block and other signalling, the invention of a Mr. Rousseau, based on the well-known principle of the deflection of the magnetic needle by the proximity of a mass of iron. An ordinary compass needle is placed on a post at the side of the track, and on the passage of the locomotive it is deflected, so as to close a galvanic circuit, by which a semaphore is operated.

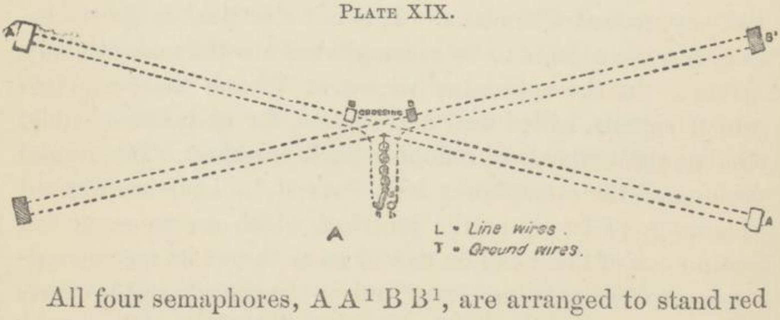
Enough has been said, probably, on the subject of "block-signals," to illustrate the different systems in use and to give the reader an idea of their comparative merits. Several systems, such as Clark's, Walker's, Spangoletti's and Varley's, requiring the services of a signal-man, have been worked in England more or less satisfactorily. Of two new automatic English systems, Carr's and Binney's, I have been unable to secure descriptions. The latter, however, seems to resemble, in some respects, the system of Mr. Pope. The points of an American system, Robinson's, are covered it is claimed, by Hall's and Pope's instruments.

When the block is worked at junctions, it is known in England as the system of "interlocking points." The best known, perhaps, of these systems, is that of Messrs. Saxby & Farmer, the invention of an employé of the North London Railway, named Chambers. It is not electrical in its operation, but the objects to be accomplished are the same in every system. In the apparatus shown at Vienna there are two sets of signals, called near and distant, for each line of rails, making eight signals at a double-track crossing. The normal position of the semaphores is at "arrest." They are worked by a range of levers at the junction, which are so connected that no one of them can be moved so as to put its corresponding semaphore at "line clear," unless the signals on the crossing tracks are at "arrest." The levers and semaphores are numbered, and on each lever are also painted the numbers of the levers and semaphores, which must be at "arrest" before it can be moved. Hence, if the engineers obey the signals, there is no danger of collision. Delay, and not danger, is produced by the neglect of the man in charge of the levers. Where there are switches, as in the case of a branch line, each switch is connected to the same lever as its semaphore, and the signal cannot be put at "line clear" unless the switch is right. In the model shown at Vienna, there are also gates which close across one line of rails, as for instance, those running north and south, when trains are crossing east and west, and *vice versa*.



In electrical interlocking systems, the "circuit" on which each semaphore is placed, is carried through the "points" of the other semaphores or switches, which must be closed in order that the first semaphore may be worked. Messrs. Siemens & Halske, have an elaborate apparatus on exhibition at Vienna, in which each switch and its corresponding semaphore is connected to a sliding-bar and a lever at the junction station. By means of the electrical apparatus used in Siemens' block-signals, no switch or semaphore can be moved until all the switches and semaphores on crossing tracks are placed at "arrest." Mr. Pope's electrical semaphore has been adapted to the interlocking system, the connections being made in the following manner:—

PLATE XIX.



All four semaphores, A A[1] B B[1], are arranged to stand red by the action of gravity, when no current is passing. The switch S being turned on the point *a*, gives the right of way on the semaphores A and A^1. Turning it to b would reverse the arrangement. It is obvious that the battery can only be on one pair of signals at a time, and that a white signal on one road necessarily involves a red one on the other. By placing S between the studs a and b, all the signals may be kept at red, except when a train on either road is to be passed over.

5. Signals Between the Various Portions of a Train.

The signals embraced under this head are so few and comparatively so unimportant, that, but for the distinctiveness of their object, they would scarcely be entitled to separate classification. In Europe, where the cars are divided into compartments and the passengers locked therein, a necessity may sometimes arise for immediate communication between the passenger and the guard or conductor; but even in such cases the ordinary American bell-rope would seem to be as certain and convenient as the electrical and pneumatic apparatus in use on some European roads. I have seen at the Exposition an elaborate piece of mechanism, worked by compressed air, by means of which a passenger in danger was enabled to ring a bell in the conductor's car, and to light a lamp at the door of his own compartment at the same time, so that the conductor might know exactly where his assistance was needed. It does not seem probable, however, that such an apparatus could ever be required on American railroads. To warn the conductor or engineer of the breaking of a train the bell-rope would also seem sufficient; or, if not, an arrangement similar to that used by Mr. Pope in his block-signalling system would obviate all danger.

Electric brakes have from time to time been invented, but, so far as I know, never applied with anything like the success which has attended the operation of the air-brake system. One of these, the invention of M. Achard, is on exhibition at Vienna. Frequent experiments have been made with it on various French railways, but none have been altogether successful. Neither the brakes, however, nor the various contrivances for electrical gas-lighting, etc., on trains, properly come within the scope of this report.

6. Signals to be Used in Case of Accident.

The sixth of the classes into which I have divided railway signals is also small, and contains little which has not already been alluded to under another head. Only one apparatus constructed solely and specially for a "distress-signal" is on exhibition at Vienna.

On some of the French roads, a Morse or other speaking telegraph is carried on each train, to be attached to the line in case of accident. On others, as that of the *Compagnie du Nord*, a dial telegraph is placed at intervals of about two and one-half miles. The number of these on the lines of that company, is between two and three hundred. They are arranged like the Siemens signal, described in class 1, so that shutting the door of the signal-box, closes the circuit automatically.

Messrs. Siemens & Halske have in their case, at the Exposition, an apparatus consisting of an upright iron standard, surmounted by a signal-box, in which is placed appropriate clock-work. These boxes are placed at short intervals along the road, and on each train is carried a set of keys of different length, corresponding in number to the number of signals embraced in the code. Each key, therefore, has its corresponding signal in a code, similiar to that used in the system of Mantelli (Plate II). In case of an accident, the signal desired is produced by inserting the proper key in an aperture in the signal-box. The clock-work is released, and an electric circuit is automatically closed and opened a certain number of times, according to the length of the key. Whenever the circuit is closed, a bell is rung at the box, and another at the station from which assistance is expected. At the latter, the closing of the circuit also automatically releases a series of clock-work, carrying a strip of paper, as in the ordinary Morse register, on which paper the code signal is printed.

Where accidents result from, or lead to, the displacements of rails, it would seem possible (by an application of the principle of Mr. Pope's block-signal), in the one case, to prevent them by advising a coming train of the displacement, or in the other, to notify, by electric and automatic means, a station from which assistance may be obtained.

ROBERT B. LINES.

RAILWAY SWITCH AND SIGNAL APPARATUS.

BY ELMER P. HOWE.

GROUP ——

The frequent recurrence of railroad accidents caused by misplaced switches, or by deceptive signals, has made the problem of their construction and management of great importance, and on its exact and certain solution depends the safety of the travelling public, and the avoidance of great pecuniary loss to the railroad companies.

The electric-bell systems and telegraphic communications adopted almost universally in Europe, and to some extent in this country, regulate the departure of trains, and serve to inform the conductor as to the condition of the track he is to traverse. They thus diminish the chances of collision. Their value, however, is between stations, as they do not afford security while entering or passing through places where there are many branches and crossings.. To guard these, semaphore arms and suspended balls are used, which, in their various positions, denote the state of the track. On roads where the traffic is limited, they can be watched by one man, and a tolerable degree of security is afforded. As tracks are multiplied, and as at terminal stations the number of trains and shifting locomotives is larger, the general oversight is more difficult, and there is greater probability of mistakes arising from the forgetfulness or incapacity of signal-men. Moreover, with the increase of traffic more employés are necessary; an objection of great weight in this country. The desideratum is, then, to have all the signals and switches under the immediate supervision of one man, with as few assistants as possible, and to have machinery so arranged that there shall be no incongruity between the position of the signal and that of the switch.

In England the following regulation of the Board of Trade is in force, in respect to all new lines and new junctions upon old lines: —

> "The signal handles and levers of the switches at junctions shall be brought together under cover upon a properly constructed stage with glass sides, ... enclosing the apparatus. They should be so arranged that, while the signals are at danger, the points shall be free to move; that the signal-man shall be unable to lower his signal for the approach of a train until after he has set the points in the proper direction for it to pass; that it shall not be possible for him to exhibit at the same moment any two signals that can lead to a collision between two trains; and that after having lowered his signals to allow a train to pass, he shall not be able to move his points so as to cause an accident, or admit of a collision between two trains. Every signal-man should be able to see the arms and lamps of his home as well as his distance signals, and the working of his points."

The system devised by Messrs. Saxby and Farmer, of London, and exhibited in the English department at the Exposition, seems to satisfy the requirements of this regulation and is a great improvement upon all systems yet used. It was exhibited at Paris in 1867, and since then has been thoroughly tested and adopted on the best English lines.

In order to understand the application of this apparatus, it may be well to examine a simple case, where, as in Figure 3, Plate I., a branch line starts from a double track main line. The relations of the tracks are easily comprehended from the figure. There are switches at 5 and 6, with their corresponding home signals $\frac{3}{8}$ and $\frac{4}{7}$, and distance signals at 1, 2, and 9. The machinery for operating these (Figures 1, 2, Plate I.) is contained in a glass house, which is raised from the ground, so that the operator can easily command a view of the tracks in every direction.

For the case under consideration there are nine levers used, which are connected with signals or switches as the case may be. Their uses are shown by reference to the fol-

PLATE I.

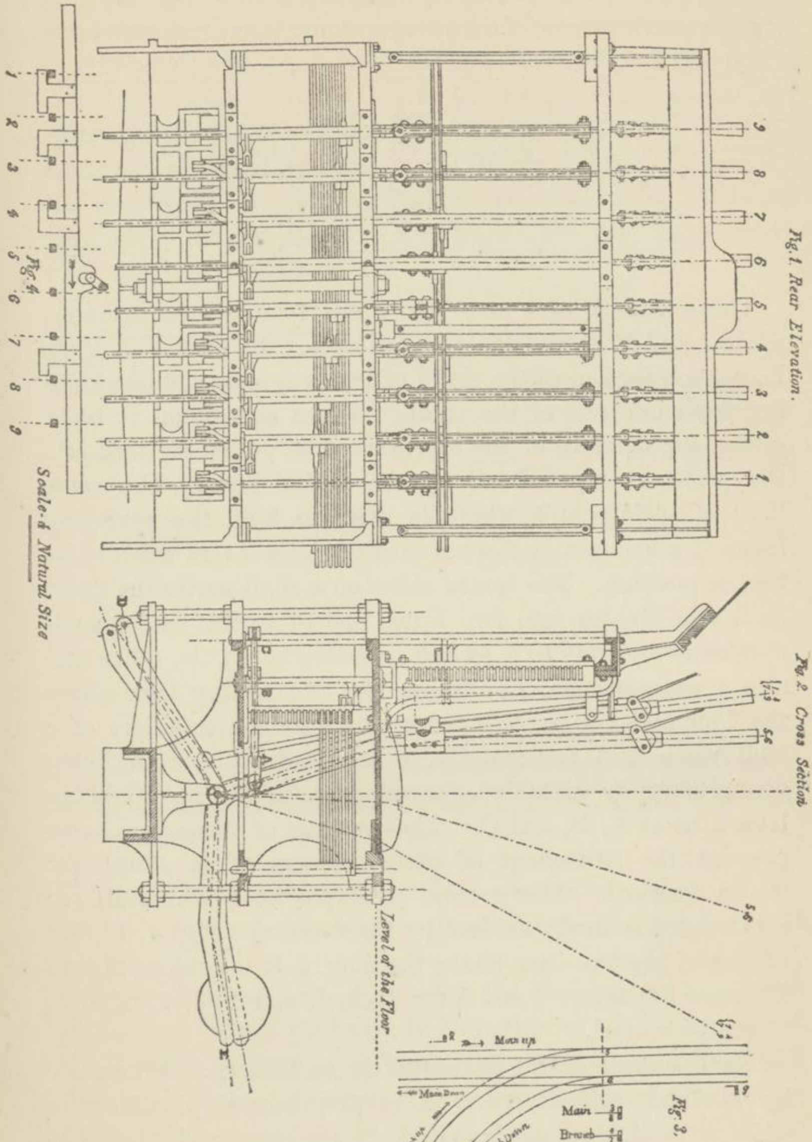


Fig. 1. Rear Elevation.
Fig. 4.
Scale-4 Natural Size
Fig. 2. Cross Section
Level of the Floor
Main up
Main Down
Branch Down
Main
Branch
Fig. 3.

lowing index-plate. The numbers denote the manipulating levers : —

Up-Track Signals.				Main Up.	Main Down.	Down-Track Signals.		
Distance.		Switch.		Branch Up.	Branch Down.	Switch.		Distance.
Branch.	Main.	Main.	Branch.			Branch.	Main.	
1	2	3	4	5	6	7	8	9

Those from 1 to 4 and 7 to 9 are to move semaphores, while 5 and 6 are for the two switches. In Figure 2, Plate I., a cross-section of the stand of levers is shown to one looking from one end of the cabin. When any signal is to be given, one or more of the levers must be pulled forward into the positions represented by the dotted lines. The same kind of spring-catch which is used to hold the reversing lever of a locomotive fastens each of these levers when in its proper position. The levers move on a shaft under the floor. Each one divides into two arms, one of which, as D, communicates by rods to a switch or semaphore; the other carries a counterpoise, E. There are two sliding bars above the floor and six beneath, which act like the tumblers of a lock when laid horizontally, a longitudinal motion being given them by suitable connections with the manipulating levers, as at A, B, and C. The purpose of these bars is to prevent the movement of certain levers while others are drawn forward. The general principle upon which all are constructed is made evident by the drawing (Fig. 4, Pl. I.) of one of the two bars above the floor. It is evident that in Figure 4 the levers 1 and 4 are locked, and 2, 3, 5, 6, 7, 8, 9, can be moved.

The operation of the apparatus is as follows: When the levers stand vertically, that is, in their normal position, the *main up* track and the *branch down* are open and free; but the semaphores all stand at "danger." If, now, a train is coming up on the main track, the signal-man will pull forward levers 2 and 3, which raise the semaphores (at 2, 3,

Fig. 3, Pl. I.), and inform the engineer that the way is clear. By this movement, the levers 1 and 4, which work the signals for the branch up, are locked, by means of a sliding bar (Fig. 4, Pl. I.), and cannot be moved until lever 5 has been pulled, the main track closed, the distance and home signals at 2 and 3, Fig. 3, placed at "danger," and a junction effected with the branch. Yet levers 6, 7, 8, 9 can be used, because they affect the main and branch down lines, and do not interfere at all with the train in question. The following table gives the combinations which allow the passage of trains over the four tracks :—

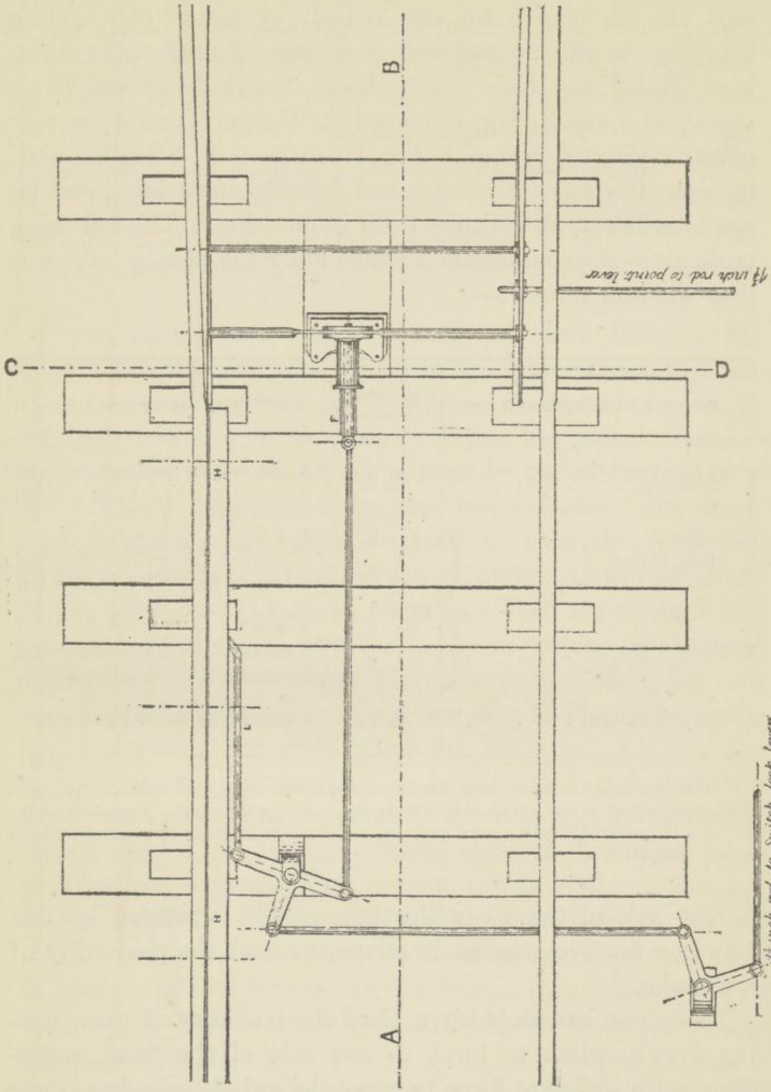
To allow a Train to pass on the—	Pull forward Levers—	The following levers will be locked:
1. Main Up, ...	2, 3.	5 cannot be pulled forward. Therefore 1 and 4 are locked.
2. Main Down, . . .	6.	1, 4, 7.
	9, 8.	5 cannot be pulled forward. 6 cannot be pulled backward.
3. Branch Up, . . .	5.	2, 3, 8.*
	1, 4.	5 cannot be pulled backward. 6 cannot be pulled forward.
4. Branch Down, . . .	9, 7.	6 cannot be pulled forward.

* At the first sight one would think that lever 9 in this case ought to be locked, but a glance at the track will show that a train coming down the main track would be carried off on the branch, since switch 6 is in its normal position, and there would be no interference with the branch up-track.

Any one of these combinations can be arranged by one man in a few seconds, as it seems, without the possibility of a mistake.

Every one has probably noticed the tendency of cars passing over a switch to lurch to one side of the track, sometimes with sufficient force to move the switch rails from their position. Some way of guarding against this contingency is therefore necessary. Many contrivances are in use, which are under the direct control of the signal-man, and which therefore afford only a conditional security. The one adopted by Messrs. Saxby and Farmer cannot be moved during the transit of the train. This "safety locking apparatus" is represented in Plate II. A lever is added to those already in

PLATE III.



the signal-cabin, called the "switch-lock lever," from which motion is communicated to a fastening bolt, F, as is shown in the drawing. This bolt slides in a stationary guide, and, when the switch is properly placed, fits into holes in the flattened portion of one of the switch stay-rods. A comparison of the plan, and the section upon the line C D, will serve to make the details plain. There is also a long flat bar, H, of wrought iron, held alongside of the rail, supported by short links, which move around studs fastened to the lower part of the rail. These permit the motion of the bar through an arc indicated by the dotted lines. A rod, L, joins this bar to one of the bell-cranks of the locking apparatus, so that the motions of the fastening bolt must be isochronous with those of the bar. When the links stand vertically, the bar is parallel to the surface of the rail, and about $\frac{1}{4}$ of an inch below it. In the drawing, the fastening bolt is withdrawn. When the "switch-lock lever" is drawn, the fastening bolt will be inserted, and at the same time the bar will rotate into the position denoted by the dotted lines. If, now, a train pass over, the rims of the car-wheels will rest on this bar and hold it down, so that, as long as there is a wheel on the rail above the bar, the bolt cannot be withdrawn, and consequently the switch cannot be shifted.

This contrivance is rapidly coming into use on English roads, where some such arrangements are required by law on new lines. The bar need only be as long as the longest distance between two car-wheels. With their short cars, this does not make an inconvenient length. To extend between the trucks of our long cars, would require a cumbersome bar, and it would be only with great difficulty kept clear from dirt and snow, since there is no ready way of covering it. However, if this appendage be deemed impracticable, the locking apparatus proper could be used, since it adds an element of security, and is simple, practical, and not likely to get out of repair.

At the Cannon-street station, in London, perhaps, there is a greater complication, arising from the number of trains and the narrow space in which the tracks are located, than at any other similar place in the world. The following description is taken from the London *Engineer*. It needs only to be explained that the "points" or "facing points" correspond to our switches.

"The lines from London Bridge and from Charing Cross take circular sweeps which bring them to a junction near the Borough Market. The lines so joined, as well as others parallel to them, run along the handsome bridge which connects the Surrey side with Cannon Street. Along the bridge run four main lines and one engine line; in all, five pairs of rails.

"Between and among these straight lines curved lines meander, touching one pair of rails, cutting across another pair, but, upon the whole, effecting junctions of each with all, and so furnished with points that trains can be run from any one line to any other, as may be required. The five principal lines, as they approach the station, spread out into various branches, so that altogether, nine lines enter the station, one to each of its eight platforms, and the ninth for the accommodation of locomotives. Those branches have also their points, and it results that on the bridge and at the station there are in all thirty-two pairs of points, which serve to guide locomotives and trains to and from the several platforms, and along the various routes which communicate with them. The existence of all these branches necessitates signals, the chief of which number sixteen for up lines and eight for down lines, besides five distant signals and six subsidiary signals; making a total of thirty-five signals. The number of operations which those points and signals have to conduct may be understood from the fact that, at the most crowded time of the day, eighteen trains arrive and eighteen depart within the hour. The locomotive which brings a train in is at its head, and consequently at the inner end of the station. To bring the train out again, the first locomotive is detached from the inner end, and another locomotive is attached to its outer end, and when it has drawn out the train, the supplanted locomotive moves leisurely out from the platform, and waits quietly by to supplant, in its turn, a brother locomotive, on the arrival of a succeeding train. In this way, for every arrival and departure there are required two movements of locomotives; and thus, in the crowded hour, no less than 108 operations of shifting points and signals have to be performed, or, on the average, one in every thirty-three seconds.

"To sum up, we find that thirty-two pairs of points, and thirty-five signals, some of them two hundred yards distant, have to be worked, sometimes to the extent ef 108 operations per hour, and generally to 80 or 90."

To accomplish this, there is a glass house erected at a short distance from the entrance to the station, over the track, containing thirty-two switch and thirty-five signal levers. During the day, two men are required to tend them, and at night only one. In twenty seconds, the switches and signals can be arranged to transfer a train from one outside track to the platform on the other side. This is the most complicated movement that is required, and involves an alteration of about twenty-five switches and signals. Information in regard to the arrival and departure of trains is communicated to the signal-men by telegraph. The despatches are received by two instruments, one at each end of the glass house. One apparatus rings a bell; a boy in attendance consults the index, and immediately calls out the name of the train which is to come over the bridge into the station; the proper movements are made by the signal-man as soon as the train appears, and it enters the station without delay. The other telegraphic instrument is for the general business of the road. All messages received are noted, so that an accurate record of the movements of trains is kept. By means of this Saxby and Farmer system, in this compact arrangement, the immense business at this point is transacted with speed and safety, with astonishing ease and precision. In the old way, with isolated switches and signals, at least thirty men would be needed, and the greatest care and attention would have to be exercised to avoid accidents.

It remains to consider the durability of the mechanism, and what may occur if any part should break. Since the normal position of the semaphores is at "danger," the breaking of a signal-rod would either leave the arm unmoved, or it would return by its own weight to the point indicating "danger." Therefore, no break or derangement of the semaphore mechanism can occasion anything worse than delay. As there are a number of rods and bell-cranks used to convey the motion of the manipulating lever to the switch proper, quite an expenditure of force is required to overcome the friction. Now, if a part give way, the increased ease of operating the lever would make it evident to the signal-man that something was wrong, and he would therefore leave the signals unchanged. Here, again, no evil consequences would result. If any considerable obstruction should prevent the moving of the switch into its proper position, not only would it be evident to the signal-man, but he could not move the lever far enough to unlock the signal-levers, even if he desired to do so. When there is "lost motion" in the connecting tackle, or when dirt and snow stop the switch before it comes into place, the fault, though not revealed by the working of the switch-lever, will be detected when the locking apparatus is used, since that lever cannot be drawn, unless the switch is correctly placed.

In all these contingencies no harm can result, since a train will always be stopped by the "danger" signal before reaching the switch. The apparatus, in short, besides insuring safety when it is in order, is a guard against any derangement in itself.

Since its adoption in England, but one accident has occurred, out of the many which have been attributed to switches, at a point where this system is in use. This is important in view of the fact, that in the (English) Board of Trade report on accidents in the year 1871, Captain Tyler attributes the majority to defective signal and point arrangements, or want of locking apparatus. The Wigan disaster, last summer, on the London and North-western line, is the exceptional instance. An excursion train passing over facing points was divided, and the majority of the cars went off the track entirely, or else on to a side track. The mechanism for moving the points had been inspected shortly before, and was found uninjured after the accident. The points were also found to be placed rightly for the transit of the train. As near as I have been able to ascertain, the locking apparatus described above had not been applied at this point, though in use on other parts of the road. Whether the accident was caused by the faulty action of the switch mechanism, or whether the signal-man attempted to move the switch before the train had all passed over, it is impossible to decide, before the court of investigation shall have published its conclusions. It seems as if a properly constructed locking apparatus would have fastened the switch, and would have effectually prevented any change in its position. The value and necessity of some such system is unquestionable. It is for American engineers to decide to what extent the one described is applicable upon our railroads.

ELMER P. HOWE.

AGRICULTURAL OBSERVATIONS IN EUROPE, 1873.

BY FRANCIS H. APPLETON, A.M.

Group II.

Part I.—Agriculture.

I left home the 26th of last March, to pass six months travelling in such parts of Europe as my inclination turned me to, but with the previous determination to pass two months in Vienna to carefully examine the Exposition. It was my intention to familiarize myself with the agricultural customs of those foreign countries through which I passed, especially the Austrian Empire, England, and Scotland. As I also remained a couple of months in the two last-named countries, where I kept very constantly on the move, I was enabled to examine not only very many of their most magnificent estates, but also a number of their noted farms, two of their best agriculture shows, the Royal Agricultural College, and to acquaint myself with their modes of operating their estates and farms.

Should I restrict myself to simply reporting the result of my observations at Vienna, I should be confining myself too narrowly, as the results of my observations in a particular case there might have been modified by what I afterwards saw in England, or elsewhere, so that in this article I cannot confine myself to the Exposition at Vienna.

It will not be my object now to restrict myself to opinions I may myself have formed, and present nothing but my own ideas, and thus limit the field for thought. On the contrary, I shall try to picture that part of the agricultural display that seems to me to relate especially to the interests of our agricultural community, advancing my own advice only where I feel it to be what we can adopt beneficially, and what appears to me conclusively proved. That which, however, is good advice now may not always hold good for a long period of time, when improvement and advancement are as rapid as in our own age.

After being in Vienna for a short time, and while one day calling at the office of our Massachusetts Commission, I was for the first time asked to write their report on agriculture, being told that I must concentrate it into about so many pages of a specified size.

Now such a perfect report, as I can conceive might be written on this subject of agriculture which, although a science in itself, is at the same time a combination of almost every other recognized science, cannot possibly be condensed into the necessary space allotted me. I must, therefore, make such selections as I see fit, trusting that each subject will attract the attention of persons who will be benefited thereby.

On my arrival in the Austrian capital I found that the Exposition (May 19) was still in an extremely disordered condition in the parts assigned to almost every nation, and this applied equally well to both agricultural and other departments. Austria herself had then the outward appearance of completeness, and certainly seemed to be in the best order generally, but even here new articles were in a quiet way being daily placed on exhibition.

Going, as I first did, to see what Austria could show, and this being what one would naturally first inquire after, I will speak of what she exhibited agriculturally.

The Agricultural Ministry

(Ackerbau Ministerium) was represented by a building of tasteful exterior, standing at the north-eastern corner of the Industrial Palace (see plan of grounds). It contained collections of a large variety of models, representing a variety of agricultural operations as well as implements, books, charts, the tobacco industry, collections showing the methods of applying chemistry to agriculture, exhibitions of experiments in connection with vine-culture, an historical collection of ploughs used in Austria, with colored illustrations of those implements and the animals attached to them. The books contain chiefly a minute description of the various branches of agriculture practised in Austria, and have been prepared with the view of showing the public the progress and advancement of Austrian agriculture.

We find here descriptive charts, showing how the cultivation of the different crops, including the vine, is distributed over the Austrian Empire, etc.

This, together with a large variety of other objects of interest, made up the display. Most of these were taken from the Agricultural College and School museums, or were made at those institutions especially for the occasion, and at the close of the Exposition were either to be returned to the places whence they were taken, or be added to the collections of the institutions that sent them. In the

Agricultural Halls,

while examining the very extensive displays of implements of all sizes, and for many purposes, I found only a very few that I shall speak of as suggesting novelties or useful ideas for our Commonwealth.

Almost all implements were of English patterns, or similar to them; the English manufacturers having some extensive factories in different parts of Europe. These were universally much heavier than we could use to advantage, but, knowing the unintelligent laborers that are intrusted with the care of implements in Europe, I felt that there was a necessity for their being strong and durable, and such as could only be made of considerably greater weight than our own.

There is certainly, however, a possibility, in some cases, that the usefulness of an implement can be increased only by additions which necessarily increase its weight.

I know of cases where our light American ploughs, which are highly esteemed by us, have been bought by English farmers, but which were thought very little of by them. On the other hand, while the English plough is greatly prized by many Canada farmers, we in the States prefer not to use them. I am sure the true solution of this difference of opinion has not been reached.

Steam-ploughing is much used in England and on the continent, and possesses very great advantages over ploughing with cattle, such as the absence of much constant trampling of the soil by the feet of cattle, the more regular and thorough work accomplished, the shorter time occupied in preparing the land, and other lesser advantages. The obstacles in the way of the adoption of steam-ploughing are chiefly the high cost of the necessary implements and the consideration that no one should be intrusted with the responsibility of superintending the working of these implements who does not know every particular detail of their mechanism, and who cannot instantly detect the cause of any breakage or imperfection in their working.

The sooner the constant trampling of cattle, incident to preparing our soil for crops, can be done away with, and the improved methods of working the land be established, the sooner will a great advancement in agriculture have been made.

Our home-made implements are much better adapted to our needs than foreign ones ; but, while foreign manufacturers may be able to learn and profit by our displays in the Agricultural Halls, at Philadelphia, in 1876, I trust that we shall also be able to learn much from similar displays of foreigners.

A Bohemian Farm.

In order to give an instructive account of some of the most improved systems of farming, as carried on in the Austrian Empire, I cannot do so more truthfully than by giving those extracts from the report of one of her most successful farmers, which relate to my subject and which are thoroughly substantiated, as being the basis of his successful farming, by the financial exhibit which ends his report.

While at Vienna, through the kindness of the Austrian Secretary of the Agricultural Ministry, an invitation to visit the estate of Mr. Franz Horsky, at Kolin, in Bohemia, in company with the Agricultural Jury of the Exposition, was secured for me, and I passed a most interesting day viewing the results of a knowledge acquired by a life devoted to agricultural study and practical work.

The report from which my extracts are taken was prepared by Mr. Horsky, in response to a request from the Directors of the Exposition, and contains a description of the commencement of his study and labors, and his successive steps onward, illustrated by explanatory and statistical tables, also plans and drawings; a description of the domain of Kolin as a swamp, and transformationin to a productive sugar-plantation, with vineyards, trout-breeding ponds, facilities for the transportation of earth by an endless wire-rope and steam (wire-tramways), of methods of planting trees, etc.

Mr. Horsky's report was translated for me by N. L. Derby, A. M., whose excellent knowledge of the German language should be a sufficient guarantee of its correctness. I visited the estate of Kolin in company with Mr. Derby, and not being enough of a German scholar to read the language, I felt sure, from my observations, of finding much instructive matter in the report. Mr. Derby then consented to translate it, and I have found in it a document of much interest.

As to whether and to what extent Mr. Horsky has based his success on correct principles, and has recognized and utilized improvements, can be seen by reference to the results he has achieved.

The more usual varieties of grain and vegetables were exhibited at his estate, showing the richness and length of their roots, and the harmfulness of planting the seed more than half an inch before the surface of the soil, or in too great quantity at one point. This matter was studied by him in the year 1854, and is regarded by him as of great importance.

In his preface, he desires that his readers, in judging of his report, will reflect that its author is no wielder of the pen, but rather a man of action and a practical worker.

Let me here urge, as I have more than once done at a previous time, that our men of action and practical workers, of whom we have a much larger per cent. than any other nation, and who may or may not be able with Mr. Horsky to say that they are not wielders of the pen, will more frequently give their experience to the public in print, either in the form of essays to their county agricultural societies, the news and agricultural papers, or in other ways. Let them realize that to them, as well as to the theorist, we must look to ascertain the true means of success in any undertaking.

Mr. Horsky well says that if he has tried to direct the pen, it has been to impart true and useful information, and not to shine as an author. He excuses himself for repetition by quoting two maxims—" drops of water wear a stone away, not by their weight or size, but by repeated blows," and " the truth can never be repeated enough, for by repetition alone it impresses."

Mr. Horsky was born 29th September, 1801, and his father was without property. The report contains an interesting account of his life, which I shall here very greatly condense, expecting later to place it before the public in full. He was instructed in a private school, passed three years in the office of a large estate of a prince, and at the same time was occupied in practical agriculture, having two farms under his charge; was later a special student in an agricultural college for three years, where he graduated with high honors. From that time he was for a number of years an executive officer of high, and finally of the highest rank, on various estates of the nobility, his services being much sought after.

When, in 1829, he was made director of a princely estate, he first began his experiments on the rotation of crops, which he later said " is an essential part of successful agriculture." He says:—

"The result of my labors for six years on the estate of Kornhaus, as compared with those of the previous period, are thus shown:—

	Whole return in money (gold).
Yield of rye on the average per acre, taking the whole area:	
Average of the years from 1792 to 1798, 14.90 bushels,	$14,630
Average of the years from 1822 to 1828, before my management, 10.38 bushels, ...	7,070
In 1834, the sixth year of my management, 11.80 bush.,	14,140"

This shows us the products of land, when in good condition before it has been exhausted, the products after it has been exhausted, and finally that the application of scientific knowledge to agriculture, can regain much that ignorance has lost, and that, although it is a slow and difficult task to restore to nature what man has taken from it, we are thus constantly doing a most successful and noble work.

As early as 1835, Mr. Horsky adopted the system of " rotation of crops," and to this day adheres to that same practice, thus proving it to be indispensable.

In reclaiming old land, he began by improving it by proper cultivation and draining, so as to thus provide for a larger amount and better quality of fodder, and afterwards turned his attention to the introduction and propagation of improved races of cattle. These improved cattle were yellow and white Austrian and Styrian varieties, and he says that he "invigorated the stock by introducing pure-blooded bulls and heifers, sometimes every year, at other times every other year."

It is part of his system to sell no crops from his estate except in a manufactured condition. To accomplish this, breweries, sugar-factories, oil-factories, etc., were built on the several estates with successful results.

In the ninth year after his directorship of Libêjic, he says, "the productive power of the whole cultivated area, taking the average per acre, had gradually risen, after subtracting the seed value, to the amount of 29.7 bushels estimated in rye, whilst the average per acre for the fifteen years, from 1821–1835 yielded by the three-field system, was only ten bushels, estimated in rye. I was induced by these remarkable results to discourage the three-field system, and above all free-farming, where no rule at all is followed, and to recommend rotation of crops as the very best of all systems."

The accompanying Table A will be found interesting and instructive. The yield and profits resulting from Mr. Horsky's instrumentality, on the several estates named, were remarkably large, we are told, compared with those given by the former system, the average of several years being taken. The table is taken from Mr. Horsky's work, "The General Introduction of the Rotation of Crops."

I hope to be able, at no very distant date, to secure a copy of this work and place it before the public in English.

As regards the manner in which the yield in rye is computed, the computation adopted by Mr. Horsky seems to be the one generally recognized by his country. I have not yet examined it, but as it is contained in his work just referred to, I shall expect to examine it later.

Up to the present year, Mr. Horsky says that he has systematized 225 farms situated in all parts of Bohemia, Moravia, Silesia, Styria, Hungary, etc.

A Proprietor of the Imperial Estate of Kolin, with a description of the former and present condition of the same.

It was only through full confidence in my practical experience gained in agricultural labors continued without pause for fifty years, and especially in the reorganization of many large and small estates, that I was induced at the age of sixty-one years to purchase such a worn-out piece of property as the estate of Kolin. It cost me in the year 1862, $217,000.

The only buildings belonging to the estate at the time, either for farming purposes or for dwellings, were the Castle in the city of Kolin, of which the larger portion was occupied by the imperial and royal district officials, a wing alone remaining for the use of the proprietor, then the brewery close at hand, a large granary and a barn together, five hunters' lodges in Bejchor, Lzowitz, Baczow, Hradisko and Saan, and a saw-mill at Bejchor with a dwelling for the machinist. I had the wing of the Castle fitted for my use and also built the necessary stables and carriage-houses. As the property which I wished to release from the tenants lay on the right or opposite bank of the Elbe, I had the forester's lodge at Bejchor transformed into a dwelling for myself, and added stables and carriage-houses. Here I built later the Castle of Horskyfeld.

About the year 1770, the Raab system had become very popular in Bohemia. This consisted in letting all the buildings and farms on the large estates for a long period and permitting settlements and villages to gradually grow upon them, the proprietor retaining only the forests, ponds and pastures in his own hands. The ponds were set dry by cutting through their dams and then let out with the pastures in small lots of one to two acres without provision for drainage, snow, or spring-water. They were therefore never built upon and generally degenerated into swamp and waste land. They were also entirely robbed of their fertility, since most of the tenants were simply squatters, and on ten, twenty or forty acres of land had only a couple of wretched cows for ploughing and producing manure; nevertheless they continued to sow until little or nothing would grow. In this condition the land was put to grass, but could of course produce but little of this, and of a poor quality. Under the circumstances it was natural that the tenant could not meet his rent, although it was very small, $2.00, $1.00, or as little even as fifty cents per acre. At the time of my purchasing the land they were about $5,600 in arrear, and a year later $2,170 in my own debt.

The question, therefore, was how to raise the yield and profits of these tracts, and to insure them permanently.

This was only to be effected by bringing to a close the leases of the small lots, which were to expire at four different periods, and by taking up their cultivation myself.

Since the fields, meadows and pastures consisted principally of drift sand and were exposed to inundations, while portions were swampy, it was necessary to shelter them from overflow, drain them and improve the soil by the addition of clayey loam or sand. It was also desirable to establish five new farms and put them in running order. The immensity of this task and the great expenses necessarily to be incurred called for the most careful consideration. I had to determine as to whether the gain by the undertaking would probably be sufficient to cover the rent previously paid and the interest on the money expended for improvements, for erecting buildings and for stocking the farms; and whether after this there would be a residue over all.

Consideration showed me the impossibility of this if I made the mistake of constructing the farm buildings according to previous custom;—if I made everything, so to speak, bomb-proof and magnificent, and conducted my cultivation in the same manner. The cost of such buildings, as I know from experience, is often so great that the interest on the sum expended is more than the previous rent of the land or its yield in the hands of the proprietor. This is partly because under the ordinary systems of agriculture neither the present high taxes nor the parish or district dues, nor the pay of artisans or servants can be met. Even where the interest on the capital does not equal the yield it is ever a large part of it.

To excuse the great expense of such buildings it is customary to speak of their permanency, of the small outlay required for repairs, and on the other hand of the constant renovation called for by lighter and cheaper buildings.

However, this should mislead no one nor frighten him from his undertaking; for the difference between the cost of a massive and of a lighter structure is very apparent, and the saving in the latter great and important.

The saving invested at five per cent. doubles at compound interest once in fourteen years. If we can, therefore, spare only a third or a half of the building expenses, and invest them, we have in fourteen years its double and in twenty-eight years its quadruple. With this great sum repairs can certainly be made, and in fact the whole building be reconstructed every fourteen years without touching the sum originally invested. At the rate of six per cent., which is now usual, the advantages of this method are still greater.

Any one, therefore, who is under the necessity that I was at this time of erecting new farm buildings, is recommended most strongly to select some simple and cheap, yet durable form of construction.

I have always striven on my five farms for the greatest saving of building capital possible, but at the same time for the erection of practical and convenient structures. I have constructed buildings varying from the greatest solidity to the utmost lightness, as their location itself varied. The difference of their cost was very important.

The costs of my cattle-sheds per square foot of surface were, for instance:

On the farm of Franzenshof, where the walls to the roof were entirely of stone, having in some cases an attic story, while the ground story is vaulted with brick in spans of thirty-five feet without supporting pillars, the roof being covered with tarred paper, $1.12.

On the farm of Carolinenhof: Here the floor and walls rest on a foundation of stone, the walls in the ground-floor and attic are of bricks, made on the spot, the ceiling over the ground-floor is vaulted in Belgian manner with bricks rising from horizontal and parallel joints supported by posts. The roof is covered with tarred paper, ninety-one cents.

On the farm of Hajka: Here the foundations and base are of stone, the remaining walls to the roof are of air-dried bricks, the ceiling over the ground-floor is made of birch trunks, and the roof is of straw, eighty-four cents.

On the Eleanorenhof farm: The foundations and base are of stone. The rest of the walls to the roof are of pisé (rammed earth). There is no attic story. The ceiling over the ground-floor is of birch trunks and the roof of straw. The building expenses were per foot only forty-five cents.

The fifth farm is in the suburb of Kolin called Keisersdorf, and contains the great grain-magazine, with adjoining sheds, which were turned into cattle-sheds, and a small collection of farm-buildings which I purchased.

The internal arrangement of the stables with straw roofs is in all cases the same, their ventilation is in all cases carefully provided for, the mangers and water-troughs are made vertically movable and the floor of the stalls is made eighteen inches deeper than that of the remainder of the building, to allow the accumulation of the manure. The floors are of beton and are impervious to moisture.

Forty-five cents per square foot seemed to me still too much to pay for buildings on the Eleanorenhof farm, and I made an attempt to reduce the cost yet further. The light straw-huts built on the farm of Carolinenhof merely for the purpose of brick-drying, had been used in winter merely through the lack of other room, as shelter for oxen. This suggested to me the idea of building an ox-shed in the same manner. This was done in January, 1868, but to provide against decay the roof was not brought into direct contact with the ground. The frame of the roof, some forty feet in width, is supported by wall-plates, and in the interior by posts resting on flat stones laid upon the ground without any underground masonry. A ditch, one and one-half to two feet in depth, is dug around the building to lead off the snow-water and rain.

The earth dug out from this was heaped against the opening under the eaves, and against the wall-plates, to keep out draughts of air; planks being previously placed before the wall-plates to prevent direct contact of the earth, as, in the case of decay, these planks are much easier to replace than the framework.

The cattle stand along the middle in two rows, and between them and the walls two wide passages are left. At the ends of the building are located the rooms for preparing the fodder, and for the use of the laborers.

This shed, like the others, is arranged for the accumulation of manure in the stalls; the floor is therefore made impervious to moisture by a layer of clay; the mangers move at will, up and down; at the ridge of the roof are openings with valves for ventilation.

The ends of the building are covered with double boarding, filled out with moss; they are provided with sliding doors, and over them windows. It is thus possible, as in a sheep-pen, to drive through and load the dung directly into the wagons. The straw thatch must be at least twelve inches thick. This style of shed is as convenient as any other, and cost originally seventeen cents per square foot. Including the boarding afterwards added for greater warmth, the whole cost reached about twenty-three cents.

This, as well as the facility with which this building can be transported, renders it very valuable. A shed built in the same manner, with a clear width of only sixteen or seventeen feet internally, without supporting posts, and with a light roof, would be well adapted for laborers who have come from a distance to the grain, potato, and beet harvests, and cannot be elsewhere accommodated. I saved also a great deal in building expenses by extending the roofs of the sheds on both sides on the Eleanorenhof farm; in fact, on all four as far as their slope would allow. Thus I procured space cheaply for my sowers, machines, and the smaller farm-tools, as well as for the storage and preparation of artificial manure. The roofs thus extended were supported on posts; the doors were made to slide, thus saving room and wear. On the Eleanorenhof farm the corn-sheds were made entirely of wood and partitioned off, whilst a portion of the cattle-sheds were left without partitions, for the laborers to sleep and eat in, and for the construction of tools. In this way the cattle could be constantly and easily cared for.

The greatest saving, however, in the expenses of building and keeping a costly inventory of stock, was made by the application of my principle of "No more dung-heaps, no more reservoirs or pumps for urine." This I applied as early as the year 1844, in the common cattle-sheds then existing on various estates under my care. My own sheds were expressly built for the collection of the manure in the stalls, and these expensive contrivances, as well as the pipes for leading away the urine, were avoided. From the external appearance of my farms no one would know that cattle were present there.

In addition to this my method offers still greater advantage. Only half as much live-stock, and consequently half as much shed room, is required as by the old process.

The manure remains under the cattle as long as the space at hand admits, or until it is required for use. It often reaches a height of five feet in fifteen weeks. The fluid excrement, which contains as much fertilizing matter as the solid, soaks into the latter, and the whole is then trampled by the cattle and preserved from the contact of the air and from decay. The gases which are developed by decay are thus retained until the manure is spread on the fields. By the usual treatment in dung-hills, fermentation sets in in four to six weeks, and the urine collected in reservoirs becomes putrid in warm weather at the end of twenty-four hours, thus losing the greater part of its value.

In the way described, manure is produced containing one hundred per cent. more fertilizing matter than by the ordinary process; and since thus from half the quantity of live-stock the same amount is obtained as previously, only half the amount of shed room is required, and this again reduces the building expenses to a very great extent.

There is the same saving, of course, on the capital expended for live-stock, for fodder and for labor, these being also reduced by one-half. This applies also to the amount of straw required.

The latter is cut into lengths of five or six inches to allow of its easily mixing with the manure and absorbing the fluids. This also assists in removing the mass from the stalls, and in spreading it, and in working it into the soil. The collection of the manure in the sheds causes no bad smell, and is not at all injurious to the health of the cattle. This was clearly shown in 1854, when my process was introduced on the estates then under my care, so that it soon after became customary even in the military stables. Its convenience and value can be considered as practically proved by the fact that I have made use of it in all the cattle-sheds and stables on my five farms for eight years, and with the best results. This would seem sufficient to remove all doubt and disbelief.

All the buildings on my farms are capable of extension to double their present size if desired.

The farms are fenced in entirely by heaps of brush. Hawthorn has been set out along these and will eventually take their place. On the farm of Franzenshof, the barns, storehouses for fodder and supplies, and the walls around the poultry-yard, were constructed of pisé, or rammed earth, previous to the year 1865. Also a green-house was built near the Castle of Horskyfeld, at the same time, with the assistance of this material; then, in 1866, a cattle-shed on the farm of Eleanorenhof; in 1867, a cattle-shed at Franzenshof; in 1868, a stable for fifteen horses, adjacent to the Castle of Horskyfeld, and, in 1872, a dwelling-house for the laborers from a distance, near the village of Freudenck, on the farm of Carolinenhof.

This rammed earth dries and settles very slowly, and on this account it is well to postpone plastering it for a year. Otherwise, the plaster dries first and becomes blistered as the earth settles. It has then to be removed and renewed.

The rammed earthwork can be prevented from settling and cracking to a great extent by avoiding the use of clay in its construction, and employing only earthy matter just moist enough to admit of thorough ramming. If this can be found in a natural condition, it is much better than such earth as requires artificial moistening before using. The latter can never give such uniform and satisfactory results.

With practised laborers, the expense of a cubic yard of wall made of this rammed earth, without plastering, should not exceed thirty-two cents. My experience has shown that, for raising one klafter of earth (8.86 cubic yards), loading it into wheelbarrows and transporting it a distance of two hundred feet, it is necessary to employ four laborers per day; for transporting it to the staging, two laborers per day; for ramming it between boards in layers of six inches, five laborers per day; *i. e.*, in all, for 8.86 English cubic yards, eleven laborers per day; or, per one English yard, 1.2 laborers per day; these being paid fourteen to nineteen cents per day each, the cost is eighteen to twenty-three cents.

The employment of more laborers is utterly unnecessary, and shows either shiftlessness and laziness on their part, or neglect on that of their overseer.

Walls of rammed earth are very durable, and, besides their cheapness, offer the advantage of remaining dry, when built on a good masonry foundation. They also, from their non-conducting power, keep out the heat in summer and the cold in winter. They are, however, by no means new, but only unusual in Bohemia. In other countries they have been used for a long time.

Their introduction is to be especially recommended in those districts in which stone and bricks are dear, or where their transport involves too great expense, or where it is wished to save as much as possible in building expenses. In these cases the cheap roofing with tarred paper is advisable, when straw cannot be used, which is by all means the best material for farm-buildings.

The last of my farm-buildings was the grain-magazine erected in American style near Franzenshof in 1868.

There is a mill also in this magazine for grinding small quantities of grain for my own use and that of the cattle. This was built to do away with the necessity of hauling to and from the existing mill, and of the inspection attending grinding. It is driven by a fixed engine.

The brewery at Kolin was provided in the year 1863 with the apparatus necessary for the production of 780,000 gallons. This consisted of boilers, coolers and an English malt-kiln. Cellars were also made for fermentation for beer, ice and storing. In the year 1872 it was adapted to working by machinery.

It was not until I had completed all the farm-buildings and the brewery that I resolved to make my dwelling in the former forester's house at Bejchor more convenient and agreeable. By successive additions the Castle of Horskyfeld arose upon the spot, with stables, carriage-houses and buildings for employés; and finally the governmental telegraphic station was erected at my own expense.

The beautiful location of this place, its healthfulness and its proximity to a forest of nearly one thousand acres, containing many varieties of trees, determined my choice in its favor. In this forest there are many sorts of singing-birds, and above all a large number of nightingales, which are also to be found in all the groves of the vicinity. There are also several large springs, furnishing water enough to drive a saw-mill six hours each day. The situation of this mill is very beautiful, and in its vicinity I established my ponds for trout-raising. In addition to the large mill-pond I laid out six smaller nurse-ponds and five nurse-boxes, also a hatching-house, each of these being supplied by a separate spring. At the end of last January I had on hand: 9,986 fish of this year, 2,981 one-year fish, 2,691 two-year, 373 three-year, 130 four year fish,—in all, 16,161 salmon-trout and others. Those of one year are three to four inches; those of two years six to eight inches; those of three years eleven to fourteen inches; and those of four years nineteen to twenty-five inches.

The three-year fish weigh nine to ten ounces; those of four years two pounds and more, and some as much as two and three-quarters pounds. They are doing excellently.

For the protection of the trout a portion of the wood, comprising about one hundred and eighty acres, is fenced off and used at the same time as a deer-park. This is traversed by paths and possesses great natural beauty.

Near the saw-mill is a shed to shelter a stock of wild ducks for the winter; it is connected with running water. The wild ducks breed on the mill-pond and two other ponds newly constructed for the purpose. Forty to fifty breeding ducks and twenty drakes are to be found here.

In two reservoirs, fed by springs, fresh-water crabs are kept,

The Castle is surrounded by a park, adjoining which are a kitchen and fruit-garden of six and one-half acres area, and a green-house of pisé, in which the earliest and latest varieties of fruit and berries are cultivated.

A deer-park of nearly seven hundred acres has been laid out near Bacov, including meadow and field. At present this contains one hundred and seventy-five fallow deer and thirty-two of the larger sort; also hares, pheasants and partridges in large numbers.

On account of the close proximity of land belonging to other parties, this park is fenced off so as to be inaccessible to hares. The game is all very fat—a buck of the larger sort weighs generally three hundred and ten to three hundred and fifty odd pounds; a fallow buck a hundred and sixty-five to two hundred pounds.

Before commencing the erection of my buildings and the improvement of my land, it was necessary to get this latter out of the hands of my tenants, and to provide for the immediate shelter of my draught cattle, servants and overseers. For this purpose I bought and hired various buildings in the villages of Freudenck, Bejchor and Ovcar.

On account of its low position the land was exposed to inundations, as before mentioned, and was therefore swampy and uncultivable. In addition, its nature was very diverse, some portions consisting of drift sand and others of the purest clay. Its powers were also exhausted to such an extent that it was considered at first utterly valueless, and my outlay for its improvement was looked upon with astonishment.

It was necessary, first of all, to increase its extent by the additional purchase of 370 acres containing many varieties of soil. Thus the estate Kolin contains to-day 5,000 acres, of which 29 acres are vineyard; 17 acres are building area; 9 acres are hop-gardens; 1,915 acres are tilled land; 201 acres are meadow; 23 acres are gardens; 10 acres are ponds; 386 acres are rivers, roads, ditches and unproductive area; 39 acres are pasturage; 2,370 acres are wood. In all, 5,000 acres; of which 139 acres are held by the tenants; 208 acres have been hired to extend the area of the hunting preserves. These are mostly sandy pasturage, and have been ploughed over.

The necessary stock of draught cattle has been procured, together with sowers and other implements, and a regular rotation of crops introduced,

Inundations are guarded against by dams, and the water collecting is led away by a system of ditches. The water accumulating on the inside of the dams is carried off by wooden pipes passing through the latter, and having valves opening outwards only. These are closed by the inundating water, and on the disappearance of the latter are opened by the water within, which then flows off.

The soil is kept in a proper condition of dryness in part by drains and in part by open ditches, some of which soak up the water, while others carry it off. These have various dimensions, and a length in all of 216,400 feet, or forty-one miles. The water in them should never rise beyond a foot's distance from the surface of the soil. The snow and rain-water is conducted to these ditches by the furrows left in ploughing, and in part also by others made at right angles to the latter, which should be as numerous as possible.

The number of the ditches depends on the width of the field, for the cross-furrows cannot be made very long without danger of being filled and washed away by the water.

This is the only way of keeping ploughed land dry in winter, and of avoiding the injurious effects on the winter-seed of moisture, accompanied by alternate thawing and freezing. Frost increases the volume of moist earth, and, at the same time, raises the plants and tears up their roots. These then become sickly and die, or are even drawn entirely out of the earth.

It is easily understood that in such an extensive system of ditches as exists on these farms, the width and depth of each must be correctly proportioned in order to prevent an overflow. I have known cases, however, where this apparently simple precaution has unfortunately not been taken. The ditches should be enlarged at each point where they receive a new supply of water, and sufficiently enlarged to take this up. Thus the main ditches must have a capacity equal to that of all the smaller ones emptying into them.

The spring-water is used for supplying the farms and the pond for the game in the deer-park. The inundating water is dammed up for irrigation of the meadows.

I have adopted a simple means for crossing the large number of ditches on my farms. These must always remain open for draining the swampy land, and bridges are expensive, and liable, if of wood, to be stolen. On the regular wagon-roads the approaches to the ditches are made with a slope, and even where they are six feet deep it is customary to drive through them. In other cases bundles of branches or fascines are laid temporarily across, and afterwards carried back to the sheds, where they are stored.

The soil has been improved by transporting clay to the sandy parts and sand to the clayey parts. Happily the estate of Kolin itself furnished the material for this purpose in abundance and conveniently accessible.

Two hundred and fifty to three hunded loads of clay per acre have been transported to the sandy patches occurring on most of the fields, and also to a cultivated tract of two hundred and sixty acres.

To facilitate this labor, I procured a wire-tramway, which was also of assistance in laying out my vineyards and in bringing down large quantities of soil from the hills.

To prevent loss of time in the employment of my draught cattle and laborers, the farm-buildings are placed in the middle of my farms, and the roads made to radiate from them. The latter have a convex surface and side ditches, and the main roads are macadamized. The length of roads thus laid out is more than fifty miles.

All boundary lines, roads and ditches are planted with fruit-trees of the same sorts, and six orchards have also been established.

The land near the Elbe and belonging to the farm of the Kaiserzdorf, is the only tract bordered by apple and pear-trees, planted alternately. I have set out 544 apple-trees, 445 pear-trees, 20,046 plum-trees, 6,442 wild and cultivated cherry-trees, 810 chestnut-trees; making in all 28,287.

The method introduced by me in 1836, of setting out fruit-trees in hills above the surface of the ground, has proved very good. The trees grow very luxuriantly, and their trunks are entirely free from moss. Those, on the contrary, planted in the old way, six to twelve inches below the surface, are weak; their trunks and branches are covered with moss and their roots decayed.

To prevent the gardeners from setting out these trees in pits, as was formerly the custom, I issued directions in 1868 to dig holes only six to eight inches deep in the meadows, pastures or other tracts devoted to grass, where they were to be set out, and to refill these previous to planting. The trees are then to be placed on these spots, and their roots spread out and covered with earth to a distance of four feet from the trunks.

This great number of fruit-trees will eventually give the estate the appearance of a garden, and even now the farm-buildings, rising picturesquely from amongst the foliage and the lines of road extending in all directions, present an appearance incomparably superior to the former wild and barren look of the region.

Thus the estate has gained, not only in agricultural value, but in natural beauty, and this to a remarkable extent.

Hop-gardens were laid out in 1867 according to my method, introduced in the year 1830, on the estate of Kornhaus in Srbetsch, Bdin, Prerubnitz and Kownowa, two and a half miles from Saaz. This consists in planting the slips in rows four feet apart and distant two feet from one another in the rows.

The hop-poles are set out four feet apart, as usual, one being given to every two plants, and serve for only two vines each, one from each plant.

The latter are not at all weakened by training only one of their runners on the pole. The principal advantage of my method is that, by doubling the number of slips set out, there are no gaps in the fields at harvest-time, and the yield is made larger and more certain. If particular slips die, their places are supplied by the vines of the neighboring one until others set out in their stead reach maturity.

The old system has such inherent defects that its results can never be as great nor as regular as my own; its disadvantages are the following:—

1. Three to five slips are set out at one point, and crowd and rob one another of the necessary nourishment, thus preventing their proper development.

2. The plants are separated from one another by intervals of four feet. Thus, if one set dies, a bare spot eight feet long and wide is left.

3. Many such spots must occur, because usually one-twelfth of all slips set out die each year, and those planted in their stead require three years to reach maturity; many of these also die from the shade occasioned by the matured vines. Under the most favorable circumstances three-twelfths or one-fourth of all the plants come to nothing.

In order to dry the hops quickly, thoroughly and cheaply, I have made use of a contrivance first applied by me on the estate of Meschau, which I had leased in the year 1858. Here it was attended with the best results. The hops are dried on flakes in the magazines, just as malt in the kilns. Narrow boards are placed perpendicularly between the floor and ceiling, holes two and a half to three inches in diameter are cut in them at intervals of about one foot, and hop-poles passed through from board to board horizontally. The flakes are then covered with hops to the depth of one to two inches and laid upon these poles. They consist of a wooden frame or coarse sackcloth.

The hops thus exposed are stirred up and turned by tapping slightly upon the lower side of the net with a light rod.

This simple and convenient method of hop-drying has proved invariably successful, and has been widely imitated.

In order to try how grapes would grow on my estate, and what quality of wine they would produce, I set out a few vines in 1865 in the Elbe suburb of Kolin, and also in my kitchen garden at the Castle of Horskyfeld. The grapes yielded were pressed, and gave a wine of good quality.

Dr. Schmidt, imperial and royal counsellor for the section, now deceased, and celebrated as the reformer of grape-culture in Bohemia, had produced such excellent results by his methods of treating the grape-vine and wine at *Unter-berkowitz*, that I was led to introduce grape-culture on my estate at Kolin, on a much larger scale and conformably to his principles.

To carry out my project I selected the wooded territory situated in the parish of Lzowitz, near Elbe-Teinitz, lying between the lines eleven and four, and having a southerly and south-westerly slope. It is thoroughly sheltered from the cold east winds and constant west winds prevalent. The formation of the mountain is in layers, with an inclination of forty-five degrees. The upper portion of the tract was covered with sand to the depth of nineteen feet, and abounds in springs. Not far from the foot of the slope flows the Elbe.

The whole territory was woody; above was pine; below, on the portions constantly covered by inundations, was a growth of brush springing from the roots of fallen trees of enormous size. Some of their trunks had a diameter of from four to five feet, and were, in several cases, buried under three feet of soil.

The first thing to be attended to was the drainage. On the eighth of January, 1871, work was commenced, by the aid of five hundred to six hundred laborers, and at the end of June, 14.2 acres were trenched, cleared and planted. Up to the present summer 23.4 acres have been completed in all, and there now remain 5.88 acres to be reclaimed.

The severest task was to transport sand to the lower loam soil, then utterly unfit for the vine; to transport loam to the upper sandy tracts, and to fill in the many gaps and gorges on the slopes. In addition to the human and animal labor employed, the wire-tramway was of great assistance in these operations.

On the warm southerly slopes I planted "Johannisberger Riessler"; on the heights less exposed to the sun, white Burgundy "Chablis." The middle portion, which has a rich subsoil, is planted principally with blue Burgundy "St. Laurent"; and the sunniest portions of this tract, to the west, with "Trollinger." The middle stretches of the east side were planted with "Gewürz Traminer"; and the lower land with "Krachgutedel."

The whole vineyard is provided with the necessary roads. One of these winds up to the highest point in zigzags 2,480 feet long, and is supported by solid walls, in some cases twenty-four feet in height. These face the south and are used for training the vines upon.

From any point in the vineyard a fine view is obtained of the plains of Elbe-Teinitz, Cáslau, Kuttenberg and Kolin.

I have employed both artificial and animal manures for the vines, and for the further production of the latter shall build a shed this year for twenty head of cattle. This will be constructed in the simple manner already described, by merely resting a straw roof upon the ground. Here cows will be kept to furnish milk for the wine-pressers and regular vineyard laborers; also relay oxen for fattening and hauling. A house for the accommodation of the laborers will also be built in the same manner.

The preparation of the land for this vineyard has been a great piece of labor, but Dr. Schmidt has conducted it most judiciously and artistically, as he previously did that of the large vineyards at Unterberkowitz. He afterwards laid out similar tracts at Liboch, Beraun, and Chrudim, and thus erected to himself an imperishable monument, while he infused new life into the Bohemian grape-culture.

Immediately on purchasing my estate, I paid particular attention to the care of the woods. The trees were judiciously thinned out, and the litter which formerly sold for $1,400 to $1,600 per year, was no longer removed.

The mulberry bushes planted between the rows of fruit-trees, in the hopes of some day introducing the silk-worm and serving at the time as a hedge, had to be removed, as they were destroyed by hares and rabbits.

The meadows lying near the Elbe are provided with facilities for irrigation. A movable engine, with a centrifugal pump, draws 2,700 cubic feet of water per hour from the Elbe. It is also used to fill the pond of Mnekovina formerly existing in the Elbe suburb. This pond is furnished with a sluice and is filled immediately before the setting in of the frost, in order to get ice for the brewery before it forms on the running water of the Elbe.

The banks of the Elbe are protected from injury through the water, by heaps of stones, fascines, and interlaced willow-work.

The swampy meadows and fields are sown with coarse grass, also the wider ditches. I have, further, two threshing-machines, driven by movable engines of ten to fourteen horse-power, which are also employed for cutting up straw. The field-hands have as much grain as they can thresh by hand.

After the North-western Railway had become a certainty, and the transportation of beets from a distance rendered a possibility, I determined, in the year 1869, to complete the sugar-factory commenced in the Elbe suburb of Kolin, and on which labor had been suspended for several years, for I felt that, without factories, farming can never give the highest returns possible otherwise to be reached.

It is through the influence of this feeling that so many sugar and alcohol-factories and distilleries have just come into existence. *It is only to be wished that the government* *would regard their establishment as means to an end, which end is the furtherance of farming, and would therefore assist them as far as possible, and sustain them in a condition of prosperity.* The more such sources of revenue are encouraged, the greater will be the tax returns, although they be set at the lowest rate. Also the tax-paying power of landed property will be raised, and this is the mightiest source of revenue.

I am unable to conceal the fear that has long oppressed me, that as the cultivation of the beet increases, even beyond the needs of the sugar-factories now coming into being, while the production of grain is at the same time urged to its highest amount, the threatened exhaustion of the soil will be all the sooner brought about. This is already showing itself in the frequent bad harvests, which are, however, never attributed to their real cause, but always to unfavorable weather.

With such a method of cultivation as unfortunately now generally exists, without system, without judicious rotation of crops and proper application of manure, nothing less can be looked for than the utter decay of agriculture. This I have called attention to several times since the year 1861, in my pamphlets and lectures (field sermons), and now take the opportunity to refer to it again, with the expression of the opinion that, without THE INTRODUCTION OF SYSTEM IN FARMING, and PRACTICAL INSTRUCTION, GAINED BY STUDYING THE OPERATIONS CONDUCTED ON MODEL FARMS, IN ACCORDANCE WITH MY METHODS, the reform so thoroughly needed cannot be brought about, at least within the time at our disposal.

A great amount of hauling had been necessary on my estates, in order to transport 19,000 to 22,500 bushels of grain annually from the farm of Carolinenhoff to Kolin, as well as the 110,000 to 120,000 hundred-weight of beets that can be raised there. In addition to this, 6,000 to 7,000 hundred-weight of artificial manure, and 47,000 to 60,000 hundred-weight of beet-cuttings, had to be hauled back from Kolin to Carolinenhoff each year. To do away somewhat with this necessity, a horse-railroad was built between the sugar-factory and the station, Gross-Wossek, on the Northwestern Railway, having a length of 9,733 feet, and a branch line of this road further constructed, connecting the station of Kolin with the farm of Carolinenhoff. The large cost of this connection is more than made up for by the great facilitation of farming operations, by which the yield is increased and insured.

To facilitate hauling at other points, a movable wooden tramway, 1,200 feet long, and provided with six tip-cars, is being made.

I pass now to the consideration of the results which I have brought about on the estate of Kolin, by my great outlays for improvements and farming generally.

As before mentioned, I had raised the yield on the seventeen estates under my control, taking an average of several years, 62 to 110 per cent., and their net returns in money, 84 to 236 per cent. Yet this very favorable result did not fully satisfy. I had applied the three mainsprings of agriculture,—labor, manure, and rotation of crops, especially the latter, in its strictest form. Yet the average return per acre, taking the whole area cultivated, was only 25¾ bushels of rye, after subtracting the seed, while the soil seemed capable of a much larger yield.

The cause, as it seemed to me, lay in the fact that there can never be enough manure produced on a farm to keep the whole cultivated area in full vigor, and thus to attain the greatest possible yield and profits. It was impossible, upon these estates, to supply the lacking amount by an artificial substitute, and thus increase the results produced by the rotation of crops. It was not until I became proprietor of the estate of Kolin, that I cared for the proper application of all three of the mainsprings of agriculture, being here first able to make thorough use of artificial manure.

In order to avoid the adulteration of the latter, which is frequent in trade, I resolved to erect an artificial manure-factory for my own use. After its completion, I made it, to some extent, a joint-stock enterprise, retaining for myself, however, a large proportion of the stock, and gave the small farmers an opportunity to procure the manure pure and cheap.

This factory was soon looked on with general favor, for I delivered its products on a year's credit, thus giving the farmers an opportunity of convincing themselves of its value. They soon found its use indispensable.

Although not a member of the board of directors of this enterprise, having declined election to this position, the stockholders expressed their thanks to me by giving me a vote at the meetings, according to statute. I had also caused the bat-guano found in the grottos at Altogradena, near Orszowa, to be collected. This reached the amount of 4,900 hundred-weight.

At the same time, I made experiments on a small and large scale with various manures, wishing to discover what amount and kinds, whether alone or mixed together, would produce the greatest yield.

In the following table B, I have collected the results which have proved most satisfactory from 138 experiments made in the year 1871, in connection with beet-culture. Here are to be seen per acre the kind, quantity and cost of the manure; also the amount, value and richness in sugar of the beets.

Experiments conducted on a large scale with various artificial manures in the cultivation of all other products, although applied in very different quantities, and at different times, were, in general, attended with the most satisfactory results.

They settled the following points:

Stable-manure, produced with farm or purchased straw and fodder, is twice as dear as its equivalent in artificial manure. Further, good manures are more efficient when properly mixed together than when used alone; manuring should be conducted rather frequently, and in small quantities, than seldom, and in large quantities; finally, as with animals a certain quantity of fodder is necessary to sustain life, and only the amount given over and above this serves to produce strength, flesh and fat, so to sustain the productive power of land a certain quantity of manure is absolutely necessary, and only what is added beyond this produces an increased and profitable yield.

This I have proved in the following manner. I selected from my estate at Kolin two superior pieces of land, of equal quality, from those portions which had been held by small tenants for over one hundred years, and had thus become exhausted. They had come into my hands between the years 1863 and 1869, one after another. These I sowed with winter-grain for the harvest of 1868, having given them 5.2

TABLE B.—*Collection and Comparison of those twelve experiments, with artificial manuring substances, which proved the most productive and profitable from among 138 manure tests made in the year 1871, near the farm of Franzenshof, belonging to the estate of Kolin.*

Number of the Trial* on the List of all Made.	PER ACRE = 43,560 FEET.																Saccharometer.	Polarization.	Difference.
	OF MANURE WAS EMPLOYED—										CROP HARVESTED.		MONEY VALUE OF THE CROP.						
	Animal Manure, 6 cts. per cwt.	Sulphate of Ammonia, $5.10 per cwt.	Bonedust Superphosphate, $2.55 per cwt.	Stassfurt Potash, $1.70 per cwt.	Gypsum, $1.92 per cwt.	Ground Rape-seed Cake, $1.67 per cwt.	Fish Guano, $3.63 per cwt.	Sombrero Superphosphate, $2.34 per cwt.	Phosphorite dust, $0.90 per cwt.	Money Expended for Manure.	Beets.	Beet Leaves.	From the Beets at 30 4-10 cts. per cwt.	From the Beet Leaves at 5 7-10 cts. per cwt.	In all.	Remaining after deducting cost of the Manure from the value of the whole Beet crop.			
											cwt.	cwt.					deg.	per ct.	
6	–	–	–	–	–	–	2.6	–	5.2	$14 31	333.06	92.22	$102 48	$5 31	$107 80	$93 48	16	14.90	1.10
63	–	5.2	–	–	–	–	–	–	10.4	36 38	387.84	121.34	119 33	6 99	126 33	89 95	18.20	16.74	1.46
4	–	–	26	–	–	–	–	–	–	6 72	284.26	106.78	87 46	6 15	93 62	86 90	15.80	11.95	3.85
1	–	2.6	–	–	–	–	–	–	–	13 44	296.06	117.86	91 09	6 79	97 89	84 45	17.50	16.65	0.85
62	–	2.6	–	–	–	–	–	–	5.2	18 19	312.70	89.02	96 21	5 13	101 34	83 15	19.20	17.78	1.42
22	–	–	–	–	2.6	–	–	–	–	5 04	269.69	81.40	82 98	4 69	87 68	82 64	16.00	14.90	1.10
88	156	–	–	–	–	–	–	2.6	–	15 16	301.60	86.66	92 79	4 99	97 79	82 63	17.50	16.11	1.39
27	–	–	–	–	–	5.2	–	–	–	8 80	279.68	77.66	86 05	4 47	90 53	81 73	14.40	12.85	1.55
82	156	1.3	–	–	–	–	–	–	–	15 72	298.14	86.24	91 73	4 97	96 70	80 98	17.90	16.13	1.77
94	156	–	–	2.6	–	2.6	–	–	–	13 48	287.04	93.60	88 31	5 39	93 71	80 23	17.90	16.13	1.77
26	–	–	–	–	–	2.6	–	–	–	4 40	257.22	74.18	79 14	4 27	83 42	79 02	17.50	16.11	1.39
5	–	–	5.2	–	–	–	–	–	–	13 44	279.42	110.94	85 97	6 39	92 37	78 93	15.00	11.67	3.33
138	–	–	–	–	–	–	–	–	–	–	187.20	45.34	57 59	2 61	60 21	60 21	16.00	13.67	2.33
137	156	–	–	–	–	–	–	–	–	9 00	250.98	56.16	77 22	3 23	80 46	71 46	15.00	12.90	2.10

* The ground devoted to these trials was ploughed twice in the fall after the harvesting of the summer wheat, and once more in the spring. Thereupon the manure was spread upon it and harrowed in. The beet-seed was planted at intervals of fifteen inches in lines across the furrows. The preparations were completed on the 18th of April, 1871.

NOTE.—All the trials here shown took place on separate tracts of 1,506 square feet each, and the result was afterwards reckoned per acre. Between every two such tracts a third tract of similar size was left unmanured. The only mistake made in conducting these experiments was that of drawing the harrow across the tracts and thus spreading a little of the manure on the unmanured portions to the loss of those manured.

KOLIN, November, 1871.

FRANZ TASCHEK, *Farm Director.*

hundred-weight of superphosphate per acre. I then selected a third piece of the same field, but of inferior soil, and gave it 7.8 hundred-weight of the same substance per acre. The yield from the first averaged 253 sheaves per acre, from the second 506. The use of 2.6 hundred-weight addition superphosphate per acre thus doubled the yield. After subtracting $4.97 as the cost of this additional manure, from the value of the increase in yield of 253 sheaves, we have a remainder which can be considered as net profit, since there were no other expenses connected with its use. Judging from the appearance of the grain, still more manure might have been employed, and the yield thus still further increased. Less than 5.2 hundred-weight of superphosphate per acre would have paid no better than an insufficient supply of stable-manure.

Basing my system upon these trials, I commenced manuring the fields every second year from 1872 on, but each year only with small quantities, so that they only gradually reached their full productive power and a condition in which more manure would have been injurious. It is not always easy to determine beforehand how much manure should be spread, as changes in the weather cause great difference in the quantity required. In fact, the manuring begun in 1872 for all summer crops caused me great uneasiness on account of the warmth and wetness of the spring, for after every heavy fall of rain, accompanied generally by violent winds, the grain was beaten down as if by a roller. It was only through the strength of the stalks arising from the use of the superphosphate that the grain arose after being six times prostrated, and at this moment is almost all in good condition.

In the year 1872 the condition of the crops had become so luxurious through the application of manure, that they surpassed in appearance anything I had ever before seen.

As mentioned, however, there is great danger attending the use of manure each year, since the effects of the weather cannot be calculated upon in advance.

The gradual increase in the quantity of manure employed each year is as follows :—

1864–65	4,952 cwt.,	costing	$5,754	(gold).
1865–66	5,839 "	"	9,031	"
1866–67	4,627 "	"	6,523	"
1867–68	6,207 "	"	11,571	"
1868–69	7,026 "	"	12,834	"
1869–70	8,698 "	"	16,041	"
1870–71	11,633 "	"	18,758	"
1871–72	10,066 "	"	21,851	"
1872–73	9,848 "	"	24,335	"

Therefore in nine years, in all, 68,896 cwt., costing $126,698 (gold).

Besides these artificial manures I had employed up to December, 1872 :—

Of wood-ashes, ...	37,283 bushels.
Of compost consisting of the refuse of the sugar-works and of the butchers' stalls, also horn-parings and wool-refuse, ...	59,020 cwt.
Of bat-guano from the grottos at Altogradena, .	4,940 cwt.
Of clay containing lime, ...	71,024 loads.

The conviction of the advantage and necessity of helping the land with artificial manure has become established in the minds of the small proprietors in this vicinity to a most encouraging extent. Herr Prokupek, in Kutlirsch, employs, beyond all, large quantities of artificial manure every year and gets the best results. This gentleman proves himself an intelligent farmer, and sets a most judicious example by putting his land into systematized working order by following the rules of a strict rotation of crops or otherwise pursuing the most rational course.

On the occasion of deep ploughing after my method for the first time at the estate of Kolin, upon the different tracts which had been let out, we brought a quantity of fertilizing substances to the surface, among them original matter not yet exhausted, and the various manures which had been occasionally applied by the tenants, washed into the subsoil by rain and snow-water.

By thus employing many varieties of manure in the larger amounts, the third mainspring of production is made to play its part.

I have also, as one might say, carried the rotation of crops to its furthest limits. I have divided the whole cultivated land into two portions, and on one of these planted potatoes, beets and other vegetables, on the other grain; each year alternating. I have referred to this system in my "Field Sermons," as the most efficient of all in use and capable of yielding the greatest returns.

This is clearly shown by the farm of Franzenshof. Here I introduced this double rotation immediately after the close of the leases in 1866–67, and obtained a greater yield than on any of the other farms, which were going through a rotation with ten or twelve changes of cultivation, being also left fallow and then sown with clover cut for two years in succession.

Clover had not flourished well at first, but only during the last three years. On this account, and since, the sugar-works at Kolin, now built three years, required a larger supply of beets, and afforded a large amount of residue as food for the cattle. I selected the better fields from the other four farms in the year 1872, and cultivated them on my system of rotation, while the remaining inferior fields went through ten and twelve changes, with one year of clover only and lying the same time fallow. I was led to make these changes also through the fact that Franzenshof had not only produced the most beets of all the farms, but had given the greatest return in money, and felt confident also of retaining the soil in its full vigor by artificial manuring.

Sowing with clover-seed for only a single year was introduced on the estate of Kolin, as an exception and contrary to my principles of agriculture, for the reason that the mild climate there prevalent allows of a double crop, and also of fully preparing the land for winter-seed, while the use of the clover-land in the second year for beets renders an extensive culture of the latter possible, and they are my most profitable crop, now that the sugar-works are established.

This latter method of cultivation places but a slight strain on the soil, and will be continued until the other sandy stretches are strengthened with clay, and the clayey tracts receive their proper supply of sand.

On account of the dissimilarity of the methods of cultivation practised, and in the fertility of the various fields, arising from the different periods at which they were taken from the tenants, or were secured by exchange and purchase, the yield is also very dissimilar. For instance the land in my hands, from 1865 on, produced on an average per acre, 390 to 494 cwt. of beets, 884 to 1,170* sheaves of rye, 758 to 1,012 sheaves of summer wheat with one bushel of waste per twenty sheaves, 316 to 411 sheaves of oats with one bushel of waste per seven sheaves; while the land only three years under my care produced proportionately hardly a third as many beets and a half to two-thirds as much grain.

When the yield of the last-mentioned land reaches that of the first, the whole money returns of the estate will be necessarily largely increased, because the previous expense will remain the same, and the gain will be entirely net.

The farm of Carolinenhof stands behind the others in the average yield per acre, because a plain of 208 acres of a very sandy nature, and consisting entirely of pasturage, has there been hired to extend the game preserves. This is ploughed but not improved by the addition of clay, and can, therefore, be planted with grain only on half of its area, while the other half lies fallow, as the owner will not lengthen the lease.

It should also be known that on the farm of Eleanorenof the land is very bad, and has been extended by later purchases. I propose, however, to render it profitable, and have already transported a large amount of clay and spread it over a portion. On the farm of Haika the soil is in part wet and clayey, and in part gravelly and woody. On the latter portions, before my purchase, the trees were cut away, and the ground leased to parties who were to remove the stumps, but I have it now entirely in my own hands.

I have drained the wet and clayey parts, and intend to cart sand and clay into the portions requiring them.

These two farms stand behindhand in culture and, of course, in yield, and thus lower the average for the whole. The land rented at the Carolinenhof farm is also bad.

If we consider, as I have before mentioned, that the fields had received little or no manure for a long period of years, that they had been badly tilled, had been sown every year and thus become utterly useless, and been left as such; it is really extraordinary to see what the three mainsprings, work, rotation of crops, and manuring, have been able to accomplish. During the earlier period of my operations, on account of this wretched treatment, the ploughed land and also the meadows and pasturages, which were finally broken up, could produce nothing at all without manure, since all their vitality had been drawn from them. At present I have brought the woodland under cultivation with good results, and am confident that what I have thus far achieved, though very remarkable, will be surpassed in the future.

The average per acre for the whole land under cultivation, including all five farms, after deducting the seed, was—

	A yield equivalent in rye to	A net profit in money of
For the first four years, 1865–69, . .	23.92 bushs.	
Here was a loss of $4\frac{1}{2}$ cents.		
And for the last 4 years, 1869–74 (for the last of these judging from appearances), .	41.15 bushs.	$12 $23\frac{1}{8}$
Therefore in the last 4 years there is a gain per acre of	17.23 bushs.	$12 $27\frac{5}{8}$

The average of the net profit for the last four years is lowered at least $5 per acre of cultivated land, by a rise in the cost of labor to double its previous figure. This was occasioned by a demand for laborers to aid in building the various structures of the North-western Railway, also the depot and three factories at Kolin.

It is also to be noted that the farm of Franzenshof is included in the calculations. Here a double rotation of crops was introduced, as before mentioned, immediately after calling in the leases, and in spite of two bad seasons, it has already yielded—

In the farm year 1869–70, . . .	63.36	bushels.	$36 68
" " 1870–71, . . .	53.23	"	14 18
" " 1871–72, . . .	49.23	"	13 95
" " 1872–73, . . .	56.41	"	25 17
(1872–73 according to estimate.)			
Therefore, averaging these 4 years, .	55.56	bushels.	$22 49

In the amounts contributed by each article per acre to the average sum of all, it is to be seen that beets stand far ahead.

On the Franzenshof farm:—

In the year 1869–70 the total yield per acre was 63.36 bushels,—

Of the beet alone, . . .	43.30	bushels in rye equivalents.
Of the grain, ...	15.47	" "
Of the other products, . .	4.59	" "
In all, ...	63.36	" "

In the year 1872–73 the total yield per acre was 56.41 bushels,—

Of the beet alone, . . .	36.09	bushels in rye equivalents.
Of the grain, ...	13.30	" "
Of the damage by hail, . .	3.54	" "
Of the other products, . .	3.58	" "
In all, ...	56.41	" "

Thus the beets alone formed in 1869–70 . .	68.11	per cent.
in 1872–73 . .	63.90	"

That is, over two-thirds of the value of the whole yield.

The beet brings in ready money, as well by its sale as by supplying the sugar-works connected with the farms, and leaves also in this case refuse for the use of the cattle. It seems, therefore, to have great value and to be worthy of cultivation. It can be produced with the greatest economy only by the system of double rotation,

My practice, introduced in 1872, of manuring all my land each year, including that sown with summer grain, can, if the weather is unfavorable, weaken the stalks and thus cause much damage. The beet, however, stands a large quantity of manure, and leaves some of its value for the grain of the following year. If we consider the results shown by the figures above given, and in addition, that the beet leaves a residue of sixty per cent. for the cattle, after being worked, also that the beet crop, judging by separate instances, can be raised fifty to a hundred per cent. in amount, no one can take exception to my present intention, which is, from this year on, to use for the beets the manure that has been previously saved for the summer grain. Thus these get all the more fertilizing matter, and the ground remains in good condition for the next year's grain, while there is no danger of injury to the latter, as often occurs in direct manuring.

The beet yield can be increased and rendered more certain by planting the seed in ridges.

The advantages of sowing in drills and on ridges are great and have an important influence on the yield.

They are the following: —

1. The upper layer of superior soil and the manure are all collected in the ridges.

2. The application of artificial manure can be conducted together with the sowing, if the machines are arranged for this purpose, and thus all the manure be concentrated in the drills.

3. The seed is preserved from the injurious effects of moisture by means of deep furrows on each side.

4. The water is led away from the seed in the furrows, and thus little or no crust can form over it.

5. What little crust may form can be broken up by the cultivating implements as soon as it appears; since these, if made according to my principles, are prevented from disturbing the seed by adjusting their blades to the required positions.

6. In the same manner weeds can be destroyed as soon as their roots are formed, and even before their appearance above the ground; and this too without awaiting the sprouting of the seed sown.

7. My method of working the soil with implements which pass over the ridges and break up the earth on both sides of them, gives certainly the most perfect results, since the distance between the knives is always the same. By the old method, which cultivated only between the rows, large clods were left untouched, and the weeds undisturbed.

Amongst the various instruments for extracting the beetroot I find those of my own invention the best, and shall show their excellence at the trials. They draw the root from the soil without injury, and at the same time loosen the earth to a great depth. This is of especial value when it is impossible to plough over all the beet-fields before winter; which, unfortunately, often happens.

In such cases I have been obliged to renounce the great advantages of cultivating in ridges, since the necessary labor of preparation could not be performed, and have had to sow on an even surface, which sowing can take place in four rows at once with the use of my machines, and be treated afterwards with my cultivator also on all four rows at once. Ridge sowing and cultivating have thus far been carried on only on one or two rows at once, but I have constructed sowing and manuring machines, for ridge-drills, that work on four rows. These will be shown at the Vienna Universal Exhibition, and will render it possible to introduce ridge drill-sowing again.

My cultivator breaks up the soil on each side of the four rows, and, after turning it, throws it back to its first position. Thus all weeds are rooted up and destroyed, while the soil is thoroughly loosened. This operation can take place both before and immediately after the sprouting of the seed if the soil happens to be crusted over or hardened. It does not cover the seed and sprouts with earth, clods, stones, or manure, nor does it tear them up with the crust, as all this is prevented by movable screens.

The implements for sowing and cultivating the beet which I send to the Vienna Exhibition, are the results of my efforts constantly directed from the commencement of my agricultural labors to working the soil as thoroughly as possible. I I have paid most especial attention to cultivation in drills during the whole of this period, and consider my own implements the most effective of all.

In this manner alone can the greatest yield of beets be secured on a given area, while this is by no means to be accomplished by extending the amount of space devoted to them, say to half the whole cultivated surface of the farm.

It is to be regretted that on the farm Franzenshof, in order to reach a four years' average of fifty-five and one-half bushels in rye equivalents, per acre for the whole cultivated area, and a net return of $22.49, it was necessary to expend the sum of $47.28 per acre. Those who are unable or unwilling to employ so much working capital will find no profit in the ordinary yield of 18.4 to 27.75 bushels in rye equivalents, but meet with actual loss, since the high rate of taxation, labor, and artisans' pay, as well as the farmer's own wants, call for a far greater yield.

These average results of the various harvests show what a height the yield of cultivated land can reach in a short period by the judicious application of labor, manuring, and the proper rotation of crops. They impress us, also, with the belief that this productive power is capable of still greater development if all the fields are thoroughly manured, and labor is applied in the most advantageous manner.

The cultivation of my land has by no means reached perfection. I had supposed that under my supervision it was as thorough as possible; yet many deficiencies are apparent, which I have not yet been able to meet. Although my directions are that the earth is to be ploughed to a depth of twelve to fifteen inches, this is not always a possibility, partly since the supervision of such a large number of ploughs, often fifty to eighty working at once, is very difficult, and in case of dry or wet weather is utterly impossible, with the present weak labor of boys mostly from thirteen to sixteen years of age.

It would be possible, of course, to work the soil still deeper and more evenly by means of steam-ploughs; but here arises the unavoidable difficulty, which also occurs in ploughing with cattle, of preventing the soil broken to such a depth, especially when it is still moist, from being trodden hard again by the first harrowing, rolling, sowing, and after-harrowing, etc. My endeavor is now to overcome this difficulty, and to secure the advantages of subsoil ploughing to the depth of twelve and fifteen inches, as I have been in the habit of conducting it.

For this purpose I have ordered, as before mentioned, a steam-plough with two locomotives, to be used also for road-hauling, and two transportable gins, from the renowned English machine-works of John Fowler, & Co., in Leeds.

My object is especially to apply my system of ploughing, according to which a double operation is carried on at the same time. The upper layer of soil of the depth of three to four inches is turned over, and also the subsoil is ploughed up to a great depth without being mixed with the upper layer. This is accomplished with my Ruchadlo, with two subsoil shares constructed for the purpose. The English firm spoken of has expressed its willingness to fulfil my order, and has received from me a specimen of my Ruchadlo.

By means of the two gins the remaining labor of working and sowing is to be accomplished, with the assistance of a wire rope stretched over the field, and thus the treading down of the soil by draught cattle prevented.

Thus the steam-plough would accomplish its real mission, and, at the same time, a new process of culture would be developed, and the greatest perfection in the working of the soil reached.

This method must, in connection with the great advances made by manuring and rotation of crops, reach and assure the largest yield and profits possible.

Just as every mechanic and manufacturer endangers his very existence if he does not keep up with the march of improvement and experience, and as it is impossible for him to compete without progress, so the agriculturist also is subject to their laws, as I have already shown. By the ordinary processes the yield per acre can rarely rise above 25.75 bushels in rye for the whole cultivated ground after deducting the seed. The expenses of all varieties of agricultural labor, and the rate of taxes for the parish, district and state, are more than double what they were formerly; and can only be met by a larger yield if one's own wants are to be satisfied also.

This state of things renders it unavoidably necessary to bring the three mainsprings together into full working power, if actual profits are to be looked for. The large amount of capital required should not terrify; it must be employed and is sure to repay.

The net profits of my whole estate arising from all sources, at the time that it was let out in parcels and previous to my purchase, was, on the average, $8,490 to $9,434 yearly. In order to introduce my own methods it was necessary to call in these parcels. At this time there were no farm buildings, no agricultural implements, no cattle, no fodder, and no straw, although wood litter was on hand, it is true. Also, in the years when the leases were called in, no rent was received, as this had always been paid in advance; further, the swampy tracts had at no time been cultivated, and were then all the worse for a rainy season. On the sandy stretches the roots of the sprouting seed were often laid bare by the drifting of the sand, and on other fields the seed was in the same manner covered to the depth of eight to ten inches, and almost utterly destroyed. Finally, the cattle and laborers could be accommodated only with difficulty in the villages and various scattered buildings which I had purchased. In view of all these difficulties the commencement of my agricultural labors was most arduous. It was only after I had prevented inundations by ditches, had improved the soil by canals, and, in part, by drainage, and had added a large quantity of clay to the tracts covered with drift sand, and sand to those containing strong loam, that, in the year 1869–70, after the cultivation of beets had been introduced, I found it possible to reach the profitable yield.

The estate of Kolin, exclusive of the sugar-works, yielded a return, in the year 1869–70, of $41,091; in the year 1870–71, of $42,288; in the year 1871–72, of $33,392; and for the year 1872–73, as estimated, $43,232; for the average of these four years, $40,000. In two years from the present time, at the longest, the yield is expected to be $47,000. This represents, at five per cent. interest, a capital for the average yield of the last four years, of $800,000; for the yield of the present year, 1872–73, of $864,640; and on reaching the return $47,000, to be expected in the course of two years, $940,000.

Such very satisfactory results can only be arrived at by large previous outlays for improvements, preparations, manures and labor, which are, of course, continuous, but through them the yield is made also continuous and certain.

The improvements for practical and ornamental purposes had consumed by the end of December, 1872, $323,580. Besides this, at the end of the farm year 1871–72, the stock of cattle, supplies of grain, straw, fodder, malt beer, and other products and material, with the seed already planted, were valued at $91,073; the additional tracts purchased cost $49,132; finally, the sum paid for the estate of Kolin was $217,000; the whole reaches the sum of $680,785, on which the estate is to pay the interest by its yield.

One hundred and twenty-six thousand seven hundred dollars, which have been expended for artificial manure, are not included in this estimate, as they form a part of the running expenses.

In the same way the \$230,058, required for building the sugar-works in the Elbe suburb of Kolin, are also omitted.

The sum above estimated, without reckoning the profits of the sugar-works, pays by the returns of the estate of Kolin, for the average of the four years from 1869–70 to 1872–73, namely \$40,000, and an interest already of $5\frac{88}{100}$ per. cent.; and by the yield of the present year, 1872–73, of \$43,232, $6\frac{35}{100}$ per cent. If, as is expected, the yield reaches \$47,000 in value, the percentage will be $6\frac{92}{100}$, say 7 per cent.

It is certain that few agriculturists can boast of such a high rate, from a large estate purchased such a short time since.

That a tract of land in a so thoroughly demoralized condition has been thus organized, laid out, cultivated and conducted, that such large sums have been expended and such large returns have been secured and made certain, has caused the estate of Kolin to become a model, in many respects, for large and small proprietors.

It has been visited by men scientifically and practically eminent, by large and small proprietors, and by agricultural societies and institutions, who have all wished to become thoroughly acquainted with its arrangements.

When I now reflect upon what I have accomplished, I feel assured, then, I can do no greater service to my native land, to the progress of agriculture, and to the general good, while I at the same time insure the interests of my heirs and bring my own labors to a close, than by holding to my purpose of making the estate of Kolin, with the sugar-works in the Elbe suburb, a family and model farm, and devoting the remainder of my property to the accomplishment of this object. I shall fix the necessary conditions, the management of the whole fund, its use and continuance. Of course I shall provide for its general improvement, and especially for that of agriculture and the industries.

By means of clear provisions for the continuance and management of the foundation fund, it will be possible to do away with those drawbacks which unfortunately exist to the detriment of most foundations. Thus the present returns and value of the foundational property would be insured, while under common farm management it would sink to the common yield and value of the capital, to the loss of the national revenue.

In addition to this, immediately after my death, six practical learners will be received and supported, and after three years supplanted by others.

In case of the death of my heirs and issue, the whole foundation fund will fall to the nation for the establishment of an Agricultural College, where, also, the industries connected with agriculture would be taught according to principles determined by myself.

For this I have no doubt of the royal assent, since the purpose is entirely directed towards the general good.

Part II. — Forestry.

At the north-western extremity of the grounds, there was an interesting display of the results of the cultivation of forest trees. Here, huge trees, stripped of all branches, were lying side by side, and trees of smaller sizes were also exhibited; these had been cut in such lengths as would allow of transportation, and were so placed as to show the full size of the original tree. A great variety of wood was here represented, which was remarkable for its perfection of growth and clearness of grain. Collections of manufactured articles, both useful and ornamental, made from the various woods, were exhibited in neighboring sheds and houses, the latter being entirely constructed of wood.

The whole system of preparing the wood for market was also represented by models displaying the successive operations from the time it was felled in the forests. One plan, by which the logs are sometimes conveyed, in the absence of water-courses, and where neither wagons nor sleds are employed, seems worthy of explanation. A wire-rope tramway is suspended on firmly fixed supporters, in such a manner that the wire-rope forms a single track, upon which trucks run, and from the trucks are suspended, by blocks and ropes, the logs to be conveyed. When the logs go down hill, their weight furnishes the power for returning the empty trucks, by the aid of a rope attached to each set, and passing over a wheel at the upper end of the tramway. The speed can be regulated by a "brake" at the end of the tramway, and when the weight of the logs cannot be used for power, a steam-engine, stationed at one extremity, can be used to effect the same purpose. It is evident that two tracks must be used, in the first case, one to carry the logs, and the other the empty trucks, and with steam-power this plan would also seem to be more economical.

Much of the wood exhibited was the result of plantations, while much was also from natural forests that had been systematically treated under the superintendence of educated foresters. Nurseries of young trees of different varieties were also exhibited, showing how these were treated from the time of planting the seed until they could be separately set out.

It has been frequently and most truly said, by many writers who have had the welfare of our country at heart, that there is much poor land in Massachusetts that is either in pasturage or under cultivation, which would be much more profitably employed if judiciously planted with forest trees; and this fact has been greatly ignored by farmers, to their own loss.

You may say that the planter of the trees will derive no profit from them, and this may, or may not, be true, according to circumstances. But many, perhaps most, of our farmers would be better off if they would cultivate, at least, half as much land as at present, plant the remainder judiciously with trees, and apply yearly the same amount of manure to one-half the amount of land, thereby doubling the amount applied per acre. In some cases I would advise a still greater increase of the amount of manure, when possible. I believe, by adopting such a system, their increased profits would allow them to increase the manure. Trees could also be so planted as to afford protection from winds to cultivated fields, and thus prevent the drying of the soil and injury to crops that exist on bleak and exposed land.

In this way the real value of the farms would be increasing every year from the growth of wood, and higher cultivation of the remainder would increase the yearly profits considerably.

To ascertain the best varieties to plant, and the methods of planting, I would refer the reader to the valuable and instructive work of George B. Emerson, Esq., and other kindred works. Mr. Emerson's work is now out of print, but can be seen in our most prominent libraries. It is a book that ought to be always for sale, and a republication should be urged, especially when the planting of trees is so generally recommended as a source of great benefit to our State.

Agricultural and Forestry Congress.

I take the following extracts from the Discussions and Lecture, at the Meetings of the Agricultural and Forestry Congress, held at Vienna during last September, which received high commendation there, and which, in general, seem to also apply to our needs in Massachusetts. These were also translated for me by Mr. N. L. Derby.

During the discussion of the subject "What measures are to be taken for the protection of those birds, useful in cultivation?" Dr. Brehm, of Berlin, said:—

"That we ourselves are really to blame for the great increase in harmful birds and animals, since we, for instance, plant the same sort of tree over miles of territory, and thus give the woods over to the ravages of a single variety of these. We exterminate, further, every tree, hedge and bush on our fields, when every grove and hedge is a dwelling for our most industrious assistants, whom we now simply turn out of doors and deprive of their breeding-places. (Bravo! from the Congress.) We should therefore try to preserve every strip of wood on our fields; especially should we protect the starling as fully as possible, *i. e.*, we should place bird-houses for them in all woods, trees and gardens." * * * * "The most efficacious means of protecting birds consists in teaching the people; by the publication of a good book, treating of the matter, it could be shown that it is for the general advantage." (Supported.)

Dr. Blomeyer, of Leipzig, said:—

"It is certainly not our object to propose laws which the various governments are requested to accept. We can only establish general principles; culture, morals and education will be of more service than any laws." He asks "the Congress to declare that every form of advanced civilization demands the protection of birds." (Supported.)

Those gentlemen, who took part in the discussion on this subject, were constituted a committee to present a proposal the following day, and, after long discussion, they united on the following:—

"The International Congress of Proprietors of Land and Forest, resolves: that the Imperial and Royal Austrian Government shall be requested to provide for the protection of birds useful to the farmer, by means of international treaties with all the European States, in accordance with the following provisions: 1. The capture and destruction of birds living upon insects are unconditionally forbidden. 2. It is desirable that a special catalogue of birds to be protected should be prepared by an international commission of experts. 2. The capture of those birds living principally on grain is allowed, except in the closed time, lasting from the first of March to the fifteenth of September. 4. The capture of birds with snares and traps, of whatever sort, as also by the use of bird-lime, is entirely forbidden. 5. The removal of the eggs and young, or the destruction of the nests of all birds, except those of harmful varieties, is forbidden; the preparation of a catalogue of these harmful birds shall also be conducted by the commission mentioned above. 6. The sale of live or dead insect-eating birds is forbidden at all times, as also the sale of all varieties of birds during the close time; this prohibition includes also the sale of the nests of the birds mentioned. 7. Exceptions to the above mentioned provisions can be permitted at all times for purely scientific purposes."

These proposals were accepted by a large majority.

Upon the discussion of the subject of the second day, "In what way is it best for nationalities to unite in methods of collecting agricultural and forestry statistics, and what particular branches of statistics should be collected in common, for the purpose of comparison," the ministerial counsellor, Dr. J. R. Lorenz, made an exhaustive and concise address, which was received with general favor. Among other things, he strongly advised, in general, "in all cases, the use of the metrical system of weights and measures."

In Europe, the basis of successful farming is a careful system of keeping farm statistics and accounts, and it would be impossible for our agriculturists to over-value such systems.

On this subject, Dr. Meitzen, private governmental counsellor, of Berlin, advanced certain proposals, differing in part, but not essentially, from those of Dr. Lorenz (but being shorter, I give them preference here), and having thoroughly discussed them, offered the following resolution :—

"The International Congress of Cultivators of Land and Forest is of the opinion that land and forest cultivation cannot, without disadvantage, dispense with exact and statistical comparable data of its condition and progress in the different civilized states, that the previous exertions on the part of the International Statistical Bureaus have proved insufficient for the purpose of collecting the same; that the necessary comparable results are rather to be expected from investigations whose field, although limited, is clearly and fixedly determined by the separate governments unitedly and internationally, and whose reciprocal interchange and communication is insured by the same."

Therefore, the International Congress of Cultivators of Land and Forest requests the Imperial and Royal Austrian Government, "to take measures to bring about international unity of action in advancing the statistics of land and forest."

While recognizing the points of assistance in bringing about such unity in the memorial laid before the congress on this question, the speaker recommends "an investigation about once in ten years, and to be undertaken at the same time by all states, if possible." This should determine the areas, at least approximately, and determined separately for as small districts as possible, of land devoted to the general varieties of productions of land and forest, to the cultivation of the most important sorts of produce, and the yield of an average harvest of these sorts. Further, it should ascertain the areas of the different varieties of forest and the amount of timber contained therein, the amount of stock, the number of cattle slaughtered, and finally, the approximate number of farms and of farming population.

He further thinks it well to recommend that this international unity of action should extend to the early intercommunication of the following facts, which should be comparatively and concisely given, at least once a year. These are the results of the harvests; the market and exchange rates of the productions of land and forest, the cost of transportation per hundred-weight and mile on railroads, highways and by water; the daily wages of the laborers; the discount on credit; the movement of purchases and leases. These should be officially ascertained or determined with proper accuracy, in the manner usual in the special countries. The proposals of the speaker were warmly seconded.

Prof. Dr. F. X. Neumann, of Vienna, governmental counsellor, speaking in praise of what had been said, also remarked that "the introduction of common agraria-statistical investigations, with the present organization of the cultivation of land and traffic in the produce of the soil, is no longer a theoretical matter, but one of practical signification. The knowledge or ignorance of these conditions affects the prosperity and misery of many millions of beings." The speaker proves most minutely, by the example of grain traffic and the prices of rye, the results upon national economy which good or bad statistical investigations can produce.

In a lecture delivered by Dr. A. E. Brehm before the International Congress, on "Our treatment of the soil and the birds," he says :—

"It is not to be wondered at that, with a coincidence of favoring conditions, an increase of vermin can ensue which calls to mind the Egyptian plagues. On the other hand, we drive away, in many cases, utterly, the enemies of the vermin, and this too by our methods of cultivation, since we deprive them, if not of life, yet of dwellings, *i. e.*, of places for building their nests and breeding. It is seldom that we occupy ourselves directly with the nurture of the injurious sorts, and the destruction of the useful ones ; but indirectly we protect the former and destroy the latter, without, however, giving the world the right to call us thoughtless or malicious. We keep one end and aim, to the exclusion of all others, before our eyes. This arises from lacking perception of what is right, not from intentional neglect of the existing conditions, and deserves to be excused, if not defended. Friendly and earnest instruction is therefore more appropriate than the reproaches which Gloger addresses to all cultivators of land and forest."

He also says :—

"I must assert, that the direct persecution of our destroyers of vermin, resulting from the failure to recognize their activity and usefulness, is far less injurious to them than the removal of their resting and breeding-places, which is most intimately connected with the methods of cultivation common with us. The eye follows miles of the most luxurious soil turned into fertile fields, without meeting a tree or a bush, not to speak of hedges or groves. Every foot of land is ploughed over, and even the shade of the single trees along the roadways is regarded with jealousy. In our cultivated woods, especially in those upon which the forester looks with satisfaction, it is not much better. No old tree disturbs the regularity of the growing thickets; no knotty, half-decayed veteran, rich in hollows and hiding-places, is tolerated in the midst of the young wood, and that ready for felling. We calculate also here, and miss our mark as before. The old orchard tree does not bear enough fruit, it is true, to compensate for the loss of grain occasioned by its shade; the hedge, tolerated formerly as the home of the partridge, does not yield fuel or brush sufficient to show a profit; the grove in the midst of the fields disturbs the cultivation of the adjacent land; the half-rotten veteran in the forest is a loss to the woodman; but the tree and the hedge or thicket served various birds as dwelling and shelter, as breeding and setting-places, and amply repaid their maintenance, yielding a much larger profit than many cultivators of forest and land seem to think possible. All birds attach themselves to their breeding-places in especial, and to their roosts with great tenacity, and, driven from them only with difficulty, when they are no longer disturbed, are sure to return in a short time; but if these resorts are destroyed, they leave the unfriendly land and emigrate. To this fact, proven by frequent observation, I lay the decrease of our useful birds. Our forests and fields are each year deprived of more and more appropriate breeding-places for birds, and thus the latter diminish constantly in number."

"What measures," he says, "are now to be taken for the protection of those birds useful to the cultivator of the soil? The answer is certainly: Only those which promise actual results. The first of all practical measures I consider to be the general instruction of the people in regard to the nature and habits of our own animals, and especially of our birds; the improvement and development of instruction in the natural sciences; the introduction of a more or less extended course of natural history and botany in all our primary and other schools, dealing particularly with the usefulness of plants and animals; the assistance and incitement of all rational exertions on the part of societies for the prevention of cruelty to animals; the diffusion of general information on this subject by presentation of good works by the governments and by all associations for the general good, especially the distribution of a concise text-book with good illustrations representing animals and plants indigenous to our country, to all employés connected with forestry, village school teachers, country parsons, head selectmen or judges, and other proper personages; and finally, the establishment of small collections in schools for the use of the pupils. . . . . Without a sufficient acquaintance with the animals, their nature and habits, their working for or against our interests, we are not benefited by any exhortation to the protection of those which aid us, for man is much more inclined to destroy than to protect. As knowledge increases, so increases also our interest for the animals, and with the latter arise the inclination and effort to protect where we should protect, and to destroy where destruction is necessary to insure the safety of the useful animals. A mere acquaintance with the external appearance of a bird is insufficient; we must be instructed also in regard to his relation to other (birds and) animals, in order to be able to appreciate his working and activity; we should also study his dependence upon the vegetable kingdom. . . . . The best thing will ever remain the safeguard of universal intelligence. He who has become really acquainted with their life, nature, habits and works will be in a condition to do what is proper for their protection in a given case; he who does not know them will perhaps display friendly feeling, but only exceptionally give them the proper aid. I therefore place the diffusion of ornithological information before every other measure."

Experimenal forestry stations are at present in existence in different parts of Austria, Germany and elsewhere in Europe, where carefully prepared plans for investigation in this branch are constantly being followed, with a view to increase, as much as possible, knowledge, as to the proper treatment of forests which will make them yield the greatest benefit. In conversation with some of the most prominent men connected with forestry in Austria, I was told that the effects of forestry on climate, although it has been long studied in Germany with the greatest possible care, was yet unsettled. Strenuous efforts are being made to improve the means of investigating this subject throughout Europe, by international action in the matter.

On the fourth day of the congress, upon the subject, "What points in the conduction of experimental forestry call for the establishment of an international system of observation?" Dr. Seckendorff addressed the following proposals to the congress: —

"1. The governments of the different countries shall be recommended to advance experimental forestry with all the means standing at their command.

"2. Valuable results are only to be expected when the highest chiefs of experimental bureaus can put into proper form, for the necessities of forestry science, the material accumulating so rapidly in a short period. It is therefore desirable that only such experts shall be appointed as chiefs who, if necessary, can devote their entire power and time to this important subject.

"3. As soon as experimental forestry has come into existence in a given land, it is for the interests of the matter that the experimental directors or chiefs be caused by the government to enter into relations with the directors of previously existing experimental institutions, in order to determine the objects to be investigated which call for international treatment, and to consider in common the methods of investigation.

"4. An international system of investigation and observation is called for by those questions in experimental forestry which pertain to the influence which the forest has on climate, rain, spring formation, inundations, etc."

The immediate international investigation of these matters seems all the more necessary, as only after the full settlement of the same, the so-called question of forestry preservation can be properly answered.

The subject of the fifth day's sitting was, "What international unity of action seems necessary in order to put an end to the increasing devastation of forests?" Dr. A. Bernhardt, of Neustadt Eberswalde, offered the following proposals, to which, besides introductory remarks, he added suggestions as to the preliminary arrangements for the assembling of future congresses at regular intervals of time:—

"1. It is acknowledged that international unity of action is necessary in order to take successful steps towards the prevention of the increasing devastation of woods, especially towards preserving and properly cultivating those woods which lie in the regions of springs and on the banks of large streams. For by their destruction at will, commerce and the industries can be greatly affected through injurious variations in the height of the waters, changes in the beds of streams, falling in of the banks, and inundations of the territories devoted to agriculture, all of which can extend beyond the limits of the particular country in which they originate.

"2. It is further recognized that that branch of cultivation which deals with the preservation and proper treatment of other woods important in cultivation, such as lie upon drift-land, summits, ridges and steep mountain-slopes, on the sea-coast and other exposed positions, is an important subject of consideration for all civilized nations, and that universal principles must be agreed upon which can be applied to protect the cultivation of all countries from the injuries caused by the proprietors of such protective woods.

"3. It is finally recognized that, at present, a thorough acquaintance with those disturbances of cultivation which are, and can be, produced by destruction of woods, is not at hand, and that therefore a sufficient foundation is lacking upon which we can build up the desirable legislatory measures."

Dr. Judeich, of Tharaud, in furtherance of Dr. Bernhardt's proposals, said:—

"Laws for the protection of woods will never have the desired effect. The state should be the only proprietor of protective woods, and should also care for them itself. The most important task for the congress is to attempt a collection of statistical data."

He moved that the following be incorporated in Dr. Bernhardt's proposals:—

"In order to secure this foundation (of congresses), and to assist further international treatment of the question of the protection of woods, the Imperial and Royal Austrian Government is requested to enter into correspondence with the governments concerned, to collect statistical data of the position, extent and nature of the existing protective woods, and to consider this as its most important and nearest aim."

These remarks were supported, after being accepted by Dr. Bernhardt, and finally a part of them were accepted by a unanimous vote, and the remainder by a large majority of the congress.

Immediately afterwards the proposals in regard to the question of experimental agriculture were voted upon in the following form, and accepted by a unanimous vote:—

"I. There are numerous questions in experimental agriculture which can only be solved by an international system of observation, or whose solution can be made by such a system in the best manner and that most compatible with the interests of agriculture. As such questions for united investigation are to be recommended:—

"1. Analysis of atmospheric deposits, to ascertain their proportion of ammonia and nitric acid, in which connection the meteorological and local conditions and time of making the experiment are to be observed as far as practicable. (Solution of the nitrogen question.)

"2. Determination of the power of absorption possessed by cultivated soils, with regard paid to their chemical and physical nature (mechanical and chemical analysis of soils), as well as the influence of manure upon absorption.

"3. Attempts to settle the question of agricultural hydrotechnics (laying out of hydrotechnical gardens for study).

"4. Analysis of the agriculturally important seed and grain of different countries and localities, for the purpose of determining their nutritious and commercial value.

"5. Settling the influence which food and race exert upon the quantity and constituents of milk produced, as well as on the fattening of stock.

"6. Estimate of the fæces, seed, and eggs of the silk-worm.

"7. Attempts to produce different varieties of plants from the same seeds under different conditions of cultivation (acclimatization).

"II. For the purpose of investigating these matters, the governments are to be requested to complete the number of agricultural experimenting stations and to supply them with the necessary material.

"III. The chiefs of the agricultural experimenting stations, assisted by the delegates of the respective governments, are to meet in periodical international assemblage in order to deliberate together upon the investigations to be conducted in common, the appropriate methods of research and the united publication of data.

"IV. The request is to be addressed to the Imperial and Royal Austrian Agricultural Ministry, that it will be pleased to undertake the steps which seem to it proper in order to effect the execution of the proposals under I. and II."

The representative of France, M. Boitel, at the close of the session offered a proposition, "that an international congress of cultivators of land and forest be called together at London, in 1875; this congress should consist of the delegates of government and of the more important societies of land and forest cultivators." A sketch of a proposed programme was then given, which refers to the most prominent matters that must necessarily come up before such a meeting. This proposition was accepted unanimously, after a few unimportant modifications.

In European schools we find that natural history holds a much more prominent part in education than in the United States. The works of nature are made more the basis of knowledge, and, after children have become acquainted with them, then the other important studies are made more prominent.

Beet-Root.

When the results of careful study and research have been well expressed, it is better to collect and repeat the words of others rather than to attempt to convey the same idea by new forms.

Mr. William Crookes, F.R.S., in his book on the "Manufacture of Beet-Root Sugar," published at London, 1870, says in the preface:—

"It is calculated that a proportion of 8.5 (per cent.) of crystallizable sugar will pay, and in some instances comprised within the range of the experiments there was a yield of 10.91 and 8.94 (per cent.). That the magnitude of the industry is sufficient to warrant operations on the largest scale is shown by the fact that last year France alone produced no less than 300,000 tons of beet sugar, which at £25* ($125) per ton would be worth £7,500,000 ($37,500,000), the molasses (100,000 tons at £5) bringing up the value to £8,000,000 ($40,000,000)."

In referring to climate he says:—

"Few of our cultivated plants thrive under more varied conditions of climate than the beet. The relative season for sowing, for it to be harvested at the right time, can be so regulated by the intelligent cultivator, according to the degree of latitude, as to suit the exigencies of the manufacturer.

"Heat and moisture being needed in considerable quantities for its perfect development, very cold or very dry localities will alone

* For the above calculations I have allowed $5 to the English pound.

prove antagonistic to its profitable production as a sugar plant; but beet does not need a brilliant sky, or much light and heat. Light has comparatively little to do with producing its saccharine matter, for this is formed, not in the portion above ground (where the saline particles gather), but in that beneath. A moist climate with moderate sun is what it requires.

"The seed germinates at a temperature of 44° F.; the root rots on thawing if exposed to a cold much below the freezing point."

Dr. Voelcker, chemist for the Royal Agricultural Society of England says:—

"The cultivation of the beet-root sugar in the north of Germany has tended more than anything else to raise the general agriculture of large districts of country, and it would produce a similar effect in England.

"The tendency of the sugar-beet is to go into the soil, but only when the latter is properly prepared. It is sometimes said that if beet grows out of the soil the seed cannot be of the right sort; but this is a mistake, for if the soil and the subsoil are badly worked, the root will come out even if the right kind of seed is grown.

"In making an analysis of beet-root grown in England, Dr. Voelcker found that while the percentage of sugar in a portion of the root covered by the soil was 8½ per cent., in a portion which grew above the soil the percentage was only 4 per cent., or about one-half.

"The best soil must be loose, fresh, and free from stones."

Respecting the most suitable soil, Mr. Baruchson, in his work on "Beet-Root Sugar," published at London, 1868, says:—

"The land most suitable for growing beet is that on which the soil is free from peat and salt, but is rich, light and loamy. Clay land is too cold; the roots do not easily penetrate it, and they would be deficient in saccharine matter. On moorland and heavy marsh land, the result is the same; nor does dry, sandy soil, or soil with a hard, rocky bottom, yield a satisfactory crop. Stony ground also is to be avoided, as it cannot be thoroughly worked, while ground newly cleared contains matter detrimental to the sugar-producing power of the beet. . . . As this root takes up 3 to 4 per cent. of mineral salts, lime, potash, and soda, and as the bases of these may interchange with one another, all attempts to make good sugar from the products of salt lands, soil too much manured, or ground recently cleared of timber, are certain to be entirely futile. Sloping land, of moderate elevation, will give the best result. The most suitable soil for the purpose would be that which should contain four parts mould, fifty-six argil, thirty-six silex, and four carbonate of lime."

Dr. Voelcker, in his paper "On the Chemistry of the Sugar-Beet," remarks:—

"Like other grown crops the sugar-beet, although not equally well adapted for every kind of soil, is nevertheless grown on land varying greatly as regards depth, texture, and general physical and chemical properties. It may, however, be observed at once, that all soils incapable of being cultivated to a depth of at least sixteen inches, are unsuited for the growth of sugar-beet, which, unlike the ordinary yellow globe mangel, grows almost entirely under ground, and therefore cannot be cultivated with advantage on very shallow soils. Peaty soils, and, more or less, all soils, in a bad state of cultivation, are unsuitable for its cultivation. The chief requisites in soil upon which this crop is intended to be raised, are a sufficient depth and ready penetrability by the plant. . . . A moderate or even large amount of clay, far from being an undesirable element, is very useful for this crop, provided the land is well worked and the clay has become friable by exposure to the air, and by general good management."

Under the head of "Manures and Fertilizers," Dr. Belcker is quoted as saying: "There is no soil so well suited for beets as a good, well-worked, deeply-cultivated, and thoroughly-drained clay-loam; or, in other words, a soil containing a good deal of clay, with a fair proportion of sand. Most good clay-loams contain sufficient lime to meet the requirements of the beet-root crop." "On land deficient in lime the sugar-beet is apt to get fingered and toed, and hence care should be taken before taking the land in hand for the cultivation of this crop to ascertain whether it contains a fair proportion of lime."

Sour-Fodder.

This is a kind of "sour-hay," which is used in Hungary, and consists of our ordinary fodder-corn, cut green and placed immediately in large pits, where it remains, covered with earth, until it is wanted for use. It was very highly prized by those who used it, and was much relished by the cattle. At my suggestion it was described by an Austrian agriculturist in the November number of the "American Agriculturist," and was also copied in the "Essex Agricultural Society's Transactions," for 1873, and is well worthy of examination and criticism.

My Austrian friend has also recently written to me that another sour-fodder, probably also unknown in America, was cured by them (on the Archduke Albrecht's estate) in the autumn of 1873, when about 5,000 cwt. of sugar-beets were made into sour-fodder in the following manner: "We hauled in the sugar-beets from the fields, washed and cut them, then we mixed the cut beets with some chaff in the proportion of one cwt. chaff to ten cwt. cut beets; viz., we put into the pits (the same as above referred to for sour-hay) a layer of ten cwt. cut sugar-beets; then we placed upon the beets a layer of one cwt. chaff and mixed the two layers well with a fork; then came again a layer of beets, and upon this layer came again a layer of chaff, and was again properly mixed, and so on. This manipulation was continued until a height of six feet over the level of the ground. On the top of the fodder-heap we put rye-straw bundles, which had been opened, and covered the heap with earth, as in the sour-hay making."

I shall deposit with the Secretary of the State Board of Agriculture a few circulars of foreign implement-makers, which may be worth the perusal of interested parties.

FRANCIS H. APPLETON.

BROADFIELDS FARM, WEST PEABODY, ESSEX COUNTY.

THE USE OF WINE AND BEER AT VIENNA:

WITH SOME ACCOUNT OF THE DRINKING PLACES.

BY FRED. W. RUSSELL, M. D.

The city of Vienna and its environs have a population, according to the last census, of 932,000 souls. Most of the elements, so diverse in blood and language, which go to make up the Austrian Empire, are fully represented. Indeed, the leading newspaper of the city claims that seven languages are habitually spoken within her gates. One constantly sees on the streets evidences of this diversity, in the dress and social habits of the people, yet so far as the subject of this paper is concerned, they all seem to be members of one common brotherhood.

There are several pretty strongly marked social grades among the citizens. The nobility and upper classes are intelligent and cultivated, enjoying all the creature comforts of good housing and good feeding, which their wealth brings them. Another class, made up of wealthy bankers, merchants and manufacturers, lives well and is not exposed to the wear and tear of life more than the same class elsewhere. The next, or middle class, consists of traders, agents, professional gentlemen, teachers, etc., whose incomes allow of some degree of comfort; owing, however, to the excessive rents within the city they do not live so well as a similar class here. They are restricted to a very small amount of house room; a fact which has much to do with some of the outdoor habits of the people. Still another class is made up of workmen, commissaires, conductors, drivers, etc., whose wages range from eighty cents to $1.50 per day. Lastly, there is a great throng of poor laborers (men and women) who work on the streets, pump water, lay brick, carry mortar, and do the lowest drudgery of the city. Wages among these last two classes are much lower than with us. The women engaged in sweeping the streets earn forty cents per day; the men about eighty cents. Good workmen get from $1 to $1 50, with higher wages where special artistic training is required. Policemen in the city receive $1; those at the "Exposition" (a picked body of men) receive $2. The extravagantly high rents in Vienna eat up the earnings of the lower classes, and leave them very little surplus money. They do not have adequate incentives to thrift and frugality, while a large proportion of them are restricted to black bread and beer.

Among the people of wealth, of course, food is varied and abundant. Beer is drank by all. But wine, of the finer qualities, is more commonly found on their tables, and partaken of by the whole family. Among the more dissipated young men of this class brandy and strong liquors are somewhat used; but society frowns upon excess, and intoxication is rare.

In the middle class the use of brandy, rum and spirit is not common. Light wines and beer are the staple drinks. At dinner a bottle of light wine, containing a very small per cent. of alcohol, is usually taken, while at lunch and often during the day, a glass of beer is relied upon to cool and comfort the partaker.

Among the third rank of people beer is the common beverage. At all hours of the day men turn aside from their work for a glass. Women pass you on the streets with mugs or pitchers of the foaming drink. With a glass or two of beer, and a piece of bread, the appetite is satisfied and business resumed.

With the very lowest classes the use of wine and beer is restricted. Wages are so small that even the cheap food and clothing exhaust nearly all they can earn. Consequently the very poor are wont to use whiskey and rum in small quantities.

The most striking feature of Vienna life is the open and universal use of wine and beer, and the almost total absence of intoxication on the streets and in public places. The drinking habits of the Viennese are very closely related to the manner of life, the wages for work, and the food of the various classes. I shall endeavor to give an outline of their habits, and especially describe some of their methods of amusement. Perhaps the latter may be found worthy of introduction into our own country.

For the gratification of this appetite lavish provision is made throughout the city. There are no saloons with a green blind just within the door, and concealed drunkenness beyond. No secrecy is thrown about the habit; no taboo of society rests upon it. Gardens and cafés abound on every hand. Ladies and gentlemen sit at the tables, with the customary deference to the social rank of each saloon, and lunch in merry company. Every one is quiet and sober, and during the day-time there is no intoxication whatever. Beer is not guzzled, to use a coarse word for a coarser fact, but is enjoyed for its own sake. A habit of continued drinking, one glass after another, exhibited by certain wild Americans attending the "Exposition," was a source of constant wonder to the "beer-boys." Wine is not so commonly called for. Indeed it is rather rarely used in the gardens, but is more common in the restaurants.

I. Rum, Brandy, and Spirit Shops.

These are found scattered here and there about the streets, but attracting no attention by their elegance or obtrusiveness. The most popular one is situated opposite the Vienna Exchange. Usually they are small, dirty affairs, with rows of casks on shelves along the wall, and a few large bottles on the counter. By law the number is limited, and they are required to open at 4 A. M., and close at 10 P. M. As a rule, only the very poorest classes visit them, the street laborers and those who do the lowest labor of the city. Commonly in the morning, before starting out for the labor of the day, these people purchase a few cents' worth of liquor to use during the hours of work. When evening comes you see numbers within the shops, calling for and drinking very small portions at a time. A sum of three or four cents is all these poor people can afford to spend. Should one get drunk or be noisy he is at once put out and quickly appropriated by the police. If any disturbance arises the place is peremptorily closed. I entered very many of these establishments, early and late, and seldom saw any signs of intoxication. However, by dint of many questions, I found that there is a proportion of these people who become so infatuated with the pleasures of the cup, as to forego almost everything to obtain the wished-for enjoyment. When a country youth visits the city for a "lark," he very quickly falls into the clutches of the law, and is sent back to his rural home. Every morning the visitor at Vienna sees several huge arks, without windows, only a narrow door at the end, filled by a policeman, lumbering through the gates toward the country. In one of these the unfortunate youth makes his triumphal entry into his home. Among the denizens of the city, it is a common thing for the wife to be present when the husband is paid off on Saturday night, and to reserve from his wages whatever sum she thinks necessary for household expenses. The rest is so small an amount that it does not admit of an extended debauch; it lasts until work begins. (In England, with the increase of wages during the last few years, has come increase of drunkenness, among many trades the men not getting at work until Tuesday afternoon, where previously the debauch was over by Monday morning.)

II. The Bar-rooms

Come next, of various degrees of elegance and popularity. There are more than two hundred of them about the city, all outside the ramparts, obliged to close at 12 P. M. In these, one can obtain wine and beer with a limited variety of food. Many are simply furnished with coarse tables and chairs, while some are quite noted for their sumptuous appearance. Dreher, who has carried the manufacture of beer to a high state of perfection, has a famous saloon in the old city. On Saturday and Sunday evenings, particularly if the weather is a little unpleasant, these saloons are crowded. The visitor notices that most of the patrons are of the middle and working classes, who come to smoke and talk while they enjoy a mug or two of beer. There is a peculiar sociability among the men, most of whom are smoking big brier-wood pipes. If the evening is a merry one, a song is given occasionally, or a street musician comes in to play for awhile. Here and there in the corners you notice a reader asleep over his paper, and occasionally parties engaged in a game of cards. But no one is on the floor, no one trying to create a fuss. In certain parts of the city there are a number of mongrel establishments, half bar-room, half garden, where the most abandoned of both sexes congregate. I mention them now only because the strange absence of visible intoxication is noticeable, even among the frequenters of these low and miserable dance-halls. In each a policeman is on duty, whose orders are to prevent disturbance at all hazards.

III. Cafés.

At these establishments, which exceed two hundred in number, one obtains tea and coffee, with eggs, bread and ices. Sometimes a more liberal larder is supplied, but in theory they are limited to these few articles. Wine and beer can be had, but are not very generally called for. The larger places are fitted up with considerable elegance, billiard-tables, pictures, and statues being quite common. These places remain open until 2 and 3 A. M.

IV. Beer-gardens.

These are the most prominent feature of Vienna life. Everywhere throughout the city and among the suburbs, these gardens are found, varying in size, completeness, and social rank. In one place a garden may consist of a handsome glass pagoda, brilliantly lighted at night, furnished with chairs, tables, surrounded by gravel-walks and a few trees. Again, one may consist of a hanging-garden, which, filled with trees, bright lights, and a merry company, is a very pleasant sight on a crowded thoroughfare at night. Often a bit of open land, where several streets intersect, gives room for a tent with a few tables and chairs. But the beer-garden *par excellence* consists of a grove of trees filled with round tables and chairs, and the ground covered several inches deep with pebbles, sifted from the bed of the Danube, an admirable preventive of dampness. Along the edge of the grounds buildings are erected, often of fanciful designs, open galleries, out of door dancing floors, and very commonly a band-stand in the centre of all. The covered buildings are in use during wet weather. Among certain grades of society it is quite common to give the wedding-supper in one of these halls. These gardens are always very brilliantly lighted at night, and are usually provided with a good band, often both stringed and brass, which performs with a deal of fire and precision. The greatest aggregation of these establishments is at the Prater, so-called, the large park of the city, in which the Exposition was held. Here are gathered together beer-gardens without number, restaurants, theatres, menageries, shooting-galleries, a grand aquarium, concert-halls, velocipede-rinks, "Punch and Judys," and all manner of things to attract and amuse. A uniform appearance of neatness and good taste pervades everything. Every variety of amusement is provided in a legitimate and respectable way, and every place is thronged by respectable and orderly people.

In the development of the plan which is to make of Vienna one of the most magnificent cities of the continent, a tract of land was reserved for a city park. This has been laid out in the charming style of landscape-gardening so universal in Europe, and is a very favorite place of resort, especially with children. At one end of the park a large and handsome building has been erected, called the Cure Saloon, and the open space in front is filled with the inevitable paraphernalia for eating and drinking. Here one always finds a throng of well-dressed people with their children. The peculiar feature of the place, however, is the fact, that the various mineral waters of the country are on sale, and their genuineness is provided for by a government inspector.

Another favorite place of resort is the People's Garden, nearly in front of the palace of the emperor. In summer the grounds are filled with the most exquisite beds of flowers, arranged with fine taste. But what gives it a peculiar character, is the fact that on certain evenings in the week, Strauss, either Johann or Edward, gives a concert here. A portion of the garden is railed off at night by a light rope-netting, and within the reserved space stands a permanent semi-circular building and two orchestral stands. Very numerous gas-jets are distributed among the trees where the chairs and tables are crowded thickly together. On evenings of great days a military band occupies one stand, and Strauss, with his strings, the other. During the Exposition season an admission fee of seventy-five cents was charged, but the concerts were always thronged with a nicely-dressed and well-behaved company, promenading about the walks, or sitting at the tables quaffing beer and eating ices, while the passionate music rose and fell on the evening air. Outside in the garden, often, thousands of people were quietly listening, with no sign of disorder, rowdyism or drunkenness.

Near Schönbrunn, a village a few miles from the city, where the emperor has a summer-palace, is the largest and most popular beer-garden of all. Its proprietor, Mr. Schwender, is commonly spoken off as a public benefactor, for having established so beautiful a palace of amusement. He calls it the New World. It embraces a large amount of space, filled with walks and beds of flowers, with buildings for various uses, a theatre, shooting-galleries, and a semi-circular band-stand, which can accommodate singers or musicians by the thousand. In honor of great fête-days he provides enlarged entertainment. One evening he massed twelve of the best military bands stationed about the city, making a total of over 700 performers, and also provided an extra dramatic entertainment, the whole closing with fireworks. By 7 P. M. the grounds were flooded with light from the gas-jets, arranged in cones, wreaths, and festoons, and were crowded with merry people. The neat, unostentatious dress of the Austrian officers appeared on every hand. Tall orderlies, with spur and clanking sword, stalked about the walks. Whole families were here, all eating, drinking, chatting, and listening to the music which the monster band rendered most charmingly. Here were several thousand people, but not a noisy word nor an ungracious action during the evening. As the crowd hurried for the cars and omnibuses, it certainly was unexampled for order and good nature.

During the day the gardens are not very numerously visited. But as the late summer afternoon comes on the citizens begin to wend their way toward the suburbs, where the gardens do most abound. On Sundays, for instance, after attending church in the forenoon, the people fairly load down every means of conveyance toward their favorite resorts. After 4 P. M. of that day the theatres, circuses, and similar places of amusement are allowed to open. The German of the middle class and the well-to-do laborer take wife and family and go out to some cool, shady retreat. Every garden is filled with family groups, sitting at the tables, with merry children running about from place to place. Here, listening to good music splendidly played, they laugh and chat with neighbors and friends, while they leisurely sip from the tall glasses of white-capped beer. Later they wend their way homeward, having passed an eveniug of simple, hearty enjoyment, finding at the same time relaxation and fresh air. On some evenings of the last summer 150,000 people were among the gardens at the Prater.

Wandering here and there for months, visiting every garden and place of amusement, I saw not one intoxicated person. The wonder continually grew. It was impossible to believe the fact, yet such was the actual case in my experience.

V.—Esterhazy's Wine-cellar.

It may be worth while to mention one of the peculiar institutions of the city, known as Esterhazy's Wine-cellar.

Turning off from the Graben, a leading street of the old city, a few steps bring one to a narrow door, down a little alley. Entering, you find yourself at the head of a flight of narrow stone steps leading down into the darkness. Once safely arrived at the foot, you are in a range of small, arched cellars, irregularly connected together, with rows of plank benches and plain chairs along the sides, and a ledge just above to support the glasses. In one small nook a woman retails sausages and cheese, behind a dirty candle and pile of black bread. A few flaring lamps give an uncertain light through the gloom. Every bench is occupied, the air is thick with smoke pouring from the tobacco-pipes. At one end an extemporaneous bar is established, over which active boys dispense the liquors called for, and behind which an interminable and mysterious range of cellars seem to stretch off into the darkness. A clerk records each order in a huge ledger before him. In these subterranean cellars are gathered a strange aggregation of tongues and nationalities. The noise is a perfect babel of sounds, yet you rarely find any person intoxicated. Many are singing, but not noisily. Girls and boys come in constantly with bottles and pitchers for the liquor. A placard on the wall announces the names and prices of the wines : Weisser ruster Wein, 23 k. ; Weisser badacsdner, 17 k. ; rother sexander 12 to 13 k. (A kreutzer may be considered a half cent.) These are Hungarian wines, of a stronger character than those in common use among the Viennese.

VI.—Höchster Henriger.

It would be pleasant to say that nothing worse than the previous showing in relation to this subject existed in Vienna, but it is too true that intoxication can be found if one seeks in the right place for it. A place of this character is called a "Höchster Henriger," and is marked by a bunch of grape-vine leaves or a pine-branch over the door. Entering the largest one of the city, consisting of a series of large halls around a garden, with planks laid down for out-door dancing, with dancing-halls, music-rooms, and banquet-rooms, here and there, you come at once into a very large room, exceedingly brilliant with gas, and filled with the noise of two bands and the clinking of innumerable glasses. Here you find a great company gathered, often numbering four hundred,—babes in arms, children, men and women. Every table is crowded, everybody drinking, smoking, singing, beating out the time on their glasses, and having the wildest time imaginable. In one group I saw once three couples, and on their table were sixteen empty wine and beer-bottles. It is needless to say that all in that party were intoxicated. Here sit young men and girls in very close proximity, mostly coarse in dress and features. They are the servant girls, the diensters, the commissaires, the wild and reckless of the city. Moravian girls, with curious black turbans on their heads, serve the guests with wine and beer. The wine is that of the last making, not yet done fermenting. It is pleasant to the taste, but quickly mounts to the brain. One notices in these companies many women with babes in their arms. They are one of the curious features of Vienna life, which may be appreciated when I say that the illegitimate births of the city are sometimes thirty-three per cent. of the whole. These people find their highest relaxation in the "Höchster Henriger." What must be the morals of children habituated to such scenes! Again, an unexpected fact attracts attention. You see no one drunk upon the floor. Nobody is wrangling with his companions. Uproarious hilarity pervades all the people present. As the clocks strike twelve a policeman puts his head in and announces that the festivities of the evening are over. Such extravagant hugging and kissing as then goes on is a sight to see; but each gets hold of his or her companion, and they wander off, all quite unsteady, but yet well able to proceed.

Such are some of the places where the Viennese obtain their liquors, and their customary ways of drinking.

Some Effects upon the People.

The constant and free use of beer and wine must have some influence upon the physical well-being of the Vienna people. You notice, as men and women sit drinking in the gardens in company, that their eyes become red and full of tears; the face flushes and often gets purple, and a certain stupidity or sleepiness comes over all. Often one is irresistibly inclined to sleep after two or three glasses. Everywhere throughout the city are evidences of this sleepiness. Hackmen drop off to sleep on their coaches, and commissaires are curled up on the door-steps of churches. Examining photographs of Vienna people there is easily recognized a universal thick look about the eyes, as if the brain was doing its work under a clog. Not that all cases display such strong effects.

Taking the mass of the people together, one seems safe in saying that the mental acumen and celerity of action among these beer-drinkers does not equal our own. Yet the beer satisfies a want of the system. The water is unfit to drink, and the cooking full of grease and onions. The pleasant bitter of the beer corrects this unpleasant feature of their food. Where the beer is made an article of food more than the means for the gratification of an appetite, it has scarcely any unfavorable effects. Many classes of the city do not taste of meat by the month together. To them a few cents worth of beer is a positive addition to their food.

It is well known that German women are often large and stout. Many influences conduce to bring about this result.

Many of the men are portly and dignified. Hackmen are gross. They are the hardest drinkers of the city. Medical men claim a great exemption from dyspepsia among the beer-takers. Certainly the pale face of the dyspeptic was not common on the streets. Rotund ruddy faces predominated. Among the young soldiers, of whom there were above twenty-five thousand about the city, there was a bronzed healthy look quite refreshing to see. They were allowed remarkable freedom about the city, but, among the hundreds on the street daily, I never saw one intoxicated. This liberal use of beer throws increased labor on the kidneys, which accounts for certain unpleasant features of life in continental cities.

The use of wine is far more common than that of brandy, rum, and whiskey. At the restaurants a large variety of brands is offered to the visitor. The best Austrian wines are considered to be the Gumpoldskirchen, Bisamberg, and Vöslau, and these are drank in immense quantities. They are not unlike a Hock wine, and contain a very small per cent. of alcohol (Hock wines contain from 11.93 per cent. to 14.37 per cent. of alcohol). They are furnished, too, at a very low price.

The Hungarian wines, which have been mentioned in connection with the Esterhazy wine-cellar, are much stronger. I find a curious statement in a Vienna publication, that these wines are too strong for the climate of the city, though wholesome in Hungary ; as if the people did not care for the intoxicating properties of their drink.

The beer is of two kinds ; the Vienna a coarser quality, and the Pillsner, so-called, originated, I believe, in Bohemia. This Vienna beer is about the same in quality as the Bavarian or Munich beer, but is claimed to be superior. Immense quantities of it are now manufactured for export, Dreher being the most prominent manufacturer. The Pillsner beer is comparatively a new article, being an attempt to make a lighter, less intoxicating beverage. It is slightly more costly, of a lighter color, and more limpid, and does not wear so well in its use as Vienna beer. The latter seems to contain just the elements needed with the peculiar food of the people, supplied in a cheap, non-intoxicating form. This brand costs about four cents a seitl or glass, and Pillsner five cents.

A very wide field is open in the discussion of the medical bearings of the question. I made attempts to obtain statistics concerning the crimes committed in the city as the result of intoxication, but I could obtain no real information. I tried, also, to obtain the death records, to see what proportion of deaths resulted from causes depending in any degree upon the use of wine and beer. But to obtain valuable records will require a vast amount of long-continued and accurate research. I had interviews with a number of the leading physicians of Vienna, and found, in reply to questions, that, in their opinion, no effect upon the mortuary statistics is produced by the drinking habits of the people.

Dr. Sigmund, the eminent syphilologist and alienist, said there was no predominance of diseases of the liver and kidneys; that there was a very small proportion of patients in the insane asylum from the effects of alcohol. Dr. Grunfeld, assistant in the syphilitic wards of Dr. Sigmund, said there was not an unusual amount of Bright's disease, but that occasional cases of delirium tremens were received into hospital. Dr. Neumann, author of a well-known work on skin diseases, agreed substantially with the above statements. He had studied in the hospitals of Paris and other continental cities, and was of the decided opinion that there was less of liver and kidney disease in Vienna than in those cities. Mr. Holmes, an American engineer and contractor, and well known through England and on the continent, informs me that he had never seen so much drunkenness anywhere as in some districts in Scotland. He remarked again and again upon the marked sobriety of Vienna.

There seems to be in Vienna unrestrained use of wine and beer, with almost complete absence of public intoxication. Law is rigidly enforced, and some of the unpleasant results of this freedom are perhaps thereby restrained. The people, however, seem to use these liquors as food, more than as means for dissipation.

FRED. W. RUSSELL, M. D.

WINCHENDON MASS., April 2, 1874.