THURSDAY, SEPTEMBER 20, 1877

THE WORK OF THE IRON AND STEEL INSTITUTE

IT cannot be denied that of late years the component parts of that great aggregation of the contributions of workers in a thousand different fields, and which is known by the name of Science, have arrived at their common destination as much through the paths opened up by the development of the applied sciences as through those of original research or the seeking after scientific truth for the truth's sake.

In this country the institutions set apart for the furtherance of the applications of science to the use and convenience of man form collectively a very powerful body. Their influence upon the greatest industries of the country renders them indispensable to trade and finance, and that connection places at their disposal large means, both monetary and influential, without which many of the most important scientific researches could never have been attempted. The mere mention of the names of the Institution of Civil Engineers, the Institution of Mechanical Engineers, the Institute of Naval Architects, the Society of Telegraph Engineers, and the Iron and Steel Institute, suggests at once to the mind wealth, and influence, and scientific progress; and it is not too much to say that the wealth and influence of all those institutions has been brought to bear upon the advancement of applied science with remarkable success.

The Iron and Steel Institute ranks second to none for the importance of its objects to the welfare of the country, for the scientific value of its papers and discussions, and for the influence of its members. It was founded rather more than eight years ago for the purpose of advancing the knowledge of the manufacture of iron and steel, by bringing before its members the latest inventions and methods of working adopted in different establishments, for the encouragement of scientific research bearing upon the manufacture of iron and steel; whether in the domains of geology, metallurgy, chemistry, mechanics, or physics, and for the improvement of the operations of mining, smelting, and working the ferruginous ores of the country so as to obtain the highest perfection of the products at the smallest expenditure of capital and labour.

The field which the Iron and Steel Institute set itself to cultivate was partly covered by the domains of the institutions devoted to the advancement of the above sciences respectively, but a very large portion of it was never reached by any of them; and even the knowledge derived from discussions in other societies was too general to be of much practical value to the iron and steel manufacturer. No greater proof could be given of the need of such an institution in such an iron-working country as this than the very rapid rise and progress which it has made. It includes in its list of members, we believe without exception, all the leaders in the iron and steel trade of this country, as well as many of the eminent workers on the continent of Europe and in the United States of America; and among its most active members are the leading metallurgists and several of the first chemists, physicists, and engineers.

There cannot be any doubt that with so influential a body of members, with such varied and important objects, bound up as they are with the largest commercial interests of this great country, and with so many exceptional advantages, the Iron and Steel Institute has many and great responsibilities. Its only connection with trade is a scientific one (for the commercial interests of the iron and steel industries are represented by the British Iron Trade Association), and commercial matters have no right to be introduced into its discussions except in so far as accurate scientific knowledge, sound technical experience, and correct mechanical manipulation, by producing perfection in the products, and economy and certainty in the various processes employed, enable a manufacturer possessing these advantages to outdo those who do not, and by the guidance of scientific truth to command the market for his productions.

The iron and steel trade, represented in its scientific aspect by the Iron and Steel Institute, owes to pure science a deep debt of gratitude; but through that valuable institution it is year by year repaying that debt, at one time advancing the science of metallurgy, at another that of mechanics, at another adding to chemical knowledge, and so on. And we have little doubt, judging of its future by its past, that it will make still greater additions to scientific knowledge, in consequence of its increasing scientific organisation and the habit of scientific thought which it engenders among manufacturers and others by its meetings and published transactions.

The work of the Iron and Steel Institute is necessarily very varied. First and foremost it should promote, by every means in its power, the technical education required to make its various processes and operations understood by those who are entering the profession, and who in a few years will be its representatives. The importance of this can hardly be over-estimated. And it should be given in no grudging or half-and-half spirit; the days of the monopoly of knowledge, more especially of such as is based upon philosophical research, are long past, and though there must necessarily be some trade secrets, the results of knowledge and experience, still the knowledge which led to them is patent to all; and a technical society which has the best interests of its members at heart must be foremost in encouraging the dissemination of the scientific and technical knowledge required for advancing the interests which it represents. Another point for the consideration of such an institution is economy in fuel, and in the various processes employed in the making of iron and steel. In these days of close competition, when not only individuals but whole countries are doing their utmost to undersell one another, and a saving of a few shillings here and a few pence there may mean the difference between a profitable or a losing adventure, it becomes of the utmost importance to be working in a direction which is guided by scientific knowledge and proved by experiment and practical experience.

Then again the encouragement of the investigation of the physical and chemical laws which come into play within the smelting, puddling, and converting furnaces is a most important duty for the Institute to discharge, for if the amount of fuel consumed in proportion to the amount of metal produced can be reduced by only one per cent. an important step is gained and in large works

a large addition to the returns is insured. The knowledge, however, necessary for such improvements can only be obtained through long experience, patient investigation, and the collection of data and information furnished by many workers towards the same end but in different paths.

The questions of the proper application of the hot blast and of the utilisation of waste heat are of the utmost importance, and with regard to the former the knowledge of the laws of radiant and specific heat has taught the engineer that economy in blowing and other engines can only be obtained by high piston speed, and that far greater advantages are to be had from small engines working at a high velocity than from engines of larger capacity working slowly.

No one has done more to advance the science of the iron and steel manufacture than the distinguished president of the Iron and Steel Institute, Dr. C. W. Siemens, F.R.S. His regenerative gas furnace, which is now made use of in so many industries in this country, in America, and on the Continent, is at the same time one of the most beautiful applications of science to industry that has been made in this or any other age, and one of the most, perfect economisers of fuel that has ever been invented. Then again the process of steel manufacture worked out by Dr. Siemens, and which bears his name, is the only equal competitor with the Bessemer process over which it possesses one great advantage, and that is that the progress of the operation may be watched and tested from commencement to conclusion, and may be arrested at any moment.

It is, of course, needless to point out the vital importance to the steel manfacturer of a knowledge of the chemistry of the blast, converting, and heating furnaces, and of the chemical properties of various qualities of iron, of various fuels, of spiegeleisen and ferro-manganese, and of various "*fettlings*," or furnace-linings. In connection with this subject the Iron and Steel Institute has done and is doing most valuable work, and the names of Mr. Edward Riley, of Mr. Isaac Lowthian Bell, M.P., F.R.S., of Dr. Percy, F.R.S., of Dr. Siemens, F.R.S., of Mr. Mushet, of M. Gautier, of Mr. A. L. Holley, and others, who have given to the Institute valuable communications both in papers and in discussion, will always stand foremost in this branch of scientific labour.

Again the construction of furnaces and the various mechanical systems of puddling, manipulating, rolling, and working the product in its various stages of manufacture, all call for the aid of science, and the Iron and Steel Institute is in no way deficient in recognising the importance of science to this branch of the profession, many interesting papers having been read and valuable discussions held in connection with this subject.

One great result brought about by the Institute is the establishment in nearly all the principal works of the country of experimental work and laboratory practice. It has, ever since its establishment eight years ago, been dispelling the clouds of darkness and of the "rule of thumb," and by allowing the light of science to illuminate the road has spread far and wide a desire for accurate scientific knowledge based upon practical experiment. But there is much yet to be done. There are still many manufacturing firms turning out many tons of metal in the course of the year who have exceptional advantages for the promotion of scientific knowledge, but who make no use of it; the advantages, however, which such an institution as the Iron and Steel Institute brings to all manufacturers must in time be recognised by all, and we cannot but believe that with all the national resources and with the advance of knowledge promoted by such institutions, this country will still be able to hold her own against foreign competition.

Much has yet to be learnt about the behaviour of many of the elements during the various processes of the iron manufacture, whether in the form of alloys or merely as substances present in the converter or puddling furnace. It would be well if the Iron and Steel Institute were to appoint a committee composed of practical analytical chemists and influential manufacturers of iron and steel, for the purpose of investigating the effect of various metallic alloys upon iron and steel as regards their tensile or compression strength, malleability, brittleness, &c. We feel sure that very interesting results would be obtained, and that the reports of this "Alloy Committee" would be found of great practical value to manufacturers, and would well repay the expenses incurred. It is well known that the metals chromium and tungsten form alloys with iron possessing valuable physical and mechanical properties; and the influence of carbon, silicon, boron, phosphorous, sulphur, arsenic, aluminium, and antimony, have been more or less examined; but there is very much yet to be learnt with regard to this subject.

The value of spectroscopic research in connection with the investigation of this subject can hardly be overestimated. It is, without exception, at once the most infallible and the most delicate test that has ever been placed in the hands of the chemist, and, when employed in conjunction with quantitative chemical analyses and with mechanical tests, cannot fail to clear away many of the mists with which that most mysterious substance, or compound of elements, which we know generally by the name *Iron*, is enveloped. Spectroscopic research presents several collateral advantages to the iron and steel manufacturer. There are many instances in which much valuable information may be obtained by its means without the progress of the various processes being disturbed. Nearly all other systems of testing require the taking of samples, and necessitate either the stopping of an operation at a critical time or the waiting until the process is perhaps too far advanced for the information gained to be of practical utility. The spectroscope, on the contrary, peering through the smallest crack, can detect all that is going on which concerns itself, and makes a report in unmistakable language, and before it is too late to be taken advantage of.

There is no better way of obtaining reliable results than by the systematic investigation by a committee which should certainly include in its list of members the names of Dr. Siemens, Mr. Riley, Dr. Percy, and Mr. Lowthian Bell.

There are so many important branches, both scientific and technical, of the iron and steel manufacture which come under the legitimate cognisance of the Iron and Steel Institute, the importance of which is every day increasing, that we cannot help thinking that such subjects as mining, mine ventilation, pumping and winding

machinery may safely be left to the Institutions of Civil and Mechanical Engineers, as well as the consideration of the *applications* of iron and steel. The subject of corrosion is one, however, which, though rather appertaining to the finished product than to its manufacture, is one which should not be altogether overlooked, for if, by any variation in the process of production, the effects of corrosion may be diminished or modified, a new value will be given to the finished product.

There is one thing, however, which, as we hinted at the beginning of this article, has no place in the deliberations of a body holding a scientific position such as the Iron and Steel Institute, and that is the consideration of commercial questions as such and apart from the influence of science upon the cheapening of the cost of production or the lessening of labour. There must be, no doubt, in a society composed to so great an extent of men largely interested in the commercial aspect of the manufacture of iron and steel, a great temptation and tendency for the discussions occasionally to diverge into commercial questions; but it will be the duty of the president for the time being to check such digressions and to keep the discussions within legitimate channels; and it will be one of the objects of the council to allow no paper to come on for reading or discussion which is not calculated to advance the technical and scientific interests of the Institution over which it has been called to preside.

With the present council, and under the presidency of so distinguished a worker in science as Dr. Siemens, there is every prospect of the Iron and Steel Institute keeping up its high scientific character, and we cordially wish it every possible success. C. W. C.

COHN'S BIOLOGY OF PLANTS

Beiträge zur Biologie der Pflanzen. Herausgegeben von Dr. Ferdinand Cohn. Zweiter Band. Erstes Heft. (Breslau, 1876: J. N. Kern.)

THE first part of the second volume of Cohn's Beiträge contains five papers, two of them being illustrated with three plates each. The first paper is by Dr. Leopold Auerbach, "Cell and Nucleus," remarks on Strasburger's work, "Ueber Zellbildung und Zelltheilung." It is a critical paper, and hardly admits of any condensation. He tries to controvert the statements of Strasburger, and sums up thus:—1. The longitudinally striated body in the interior of the cell is not the "nucleus," but the middle part of the so-called "karyolitic figure," and therefore a product of the mixing of the special substance of the nucleus with the surrounding protoplasm; and 2, That the young nuclei do not develop by the fission of the mother nucleus.

The second paper is one of great importance, dealing as it does with one of the carnivorous plants. It is by Dr. A. Fraustadt. "Anatomy of the Vegetative Organs of Dionæa muscipula, Ellis," with three plates. As Dr. Fraustadt gives a very useful summary of results, we may here quote them. Each half of the lamina is slightly bent in a sigmoid manner, and forms a cavity to retain an insect, while the petiole is broadly winged and flattened. The cells of the epidermis, as well as those of the ground tissue, are elongated in the direction of the long axis of the leaf, in the petiole and midrib of the lamina, but in the transverse direction in the rest of the lamina. The cells forming the epidermis contain chlorophyll grains. The epidermis forms numerous stomata and stellate hairs on the upper and lower surface of the petiole, and under-surface of the lamina, but glandular hairs only on the upper surface of the lamina. The glands are placed in depressions in the epidermis, and are formed of a two-celled basal portion, a two-celled short stalk, and a round secreting part of two layers of cells convex on the upper side. The stellate cells are similarly constructed, except that the cells of the top layer grow out in radiating straight arms, giving the whole a star-like appearance. The stellate hairs appear early and are completely developed before the glands begin to form. The stellate hairs and glands are homologous structures. The lamina bears on its margin numerous (from fifteen to twenty) teeth or marginal setæ, and usually six spiny hairs (central setæ) on the upper surface. The marginal setæ are slender, triangular, pyramidal, and have stellate hairs and stomata on all sides. A fibro-vascular bundle is present running nearer the upper than the under side of the structure. Between each of the marginal setæ a single stellate hair is placed sometimes elevated on the top of a small projection, which, however, receives no fibro-vascular bundle. The central setæ consist of two parts, the lower forming a joint, and receiving an axile cellular string; the upper part is conical, contracted below, and has no cellular string. The cells of the central setæ show aggregation of the protoplasm (as described by Darwin in Drosera), as well as those of the glands. In the green parts of the petiole (above ground), and in the midrib of the lamina, the cells of the ground-tissue increase in length and in size of cavity from without inwards, the superficial cells, and those near the fibro-vascular bundles are green, the others colourless. In the lamina, with the exception of the midrib, the inner cells of the ground tissue are colourless, very broad, with sinuous walls and small intercellular spaces. The epidermal cells of the upper side of the lamina and the ground-tissue cells below it, are larger than those of the under side. The chlorophyll grains contain abundance of starch before the leaf has obtained any organic (animal) nourishment. The starch diminished after the reception of organic (animal) matter by the leaves, and lastly disappears entirely from the parts of the plant above ground. The bases of the petioles are dilated into colourless sheath-like portions developed underground and together forming a kind of bulb. The ground tissue consists entirely of equally broad and long cells completely filled with starch, as well before as after the reception and absorption of organic (animal) matter. The starch grains in the part above ground of the petiole and lamina are oval; in the basal sheathing part of the petiole, on the other hand, the grains are cylindrical or rod-like.

The living cells of the lamina and petiole contain a colourless substance dissolved in the cell-sap, precipitated by bases in the form of dark grains which are redissolved by acids. The glands contain no starch. The red colouring matter of the glands becomes converted into green by the action of strong bases as ammonia and potash, but is again restored by the action of acids. The colour seems, therefore, to be identical with the red colouring matter of plants so fully described by Prof. A. H. Church in a recent number of the *Journal* of the Chemical