THURSDAY, SEPTEMBER 7, 1871

THE IRON AND STEEL INSTITUTE

AFTER having on so many different occasions dwelt upon the importance and advantages to be derived from the cultivation of Science by those engaged in the industrial undertakings of this country, we cannot do otherwise than refer in terms of deep interest to a meeting, which took place during the past week at Dudley, under the presidency of Mr. Bessemer, in the heart of the oldest iron-making district of Great Britain.

About three or four years ago a few gentlemen in Cleveland, the youngest seat of the iron trade in the world, propounded the idea that it would be beneficial to all concerned to organise an association of those interested in the manufacture of iron and steel, to meet and discuss all matters connected with these branches of metallurgical science, but from which all questions of a merely trade character should be carefully excluded.

To dispel any idea of this Iron and Steel Institute, as it is designated, being intended by its original promoters to be confined to their own locality, they solicited and obtained the consent of the Duke of Devonshire to act as their first President. Looking at his Grace's position as one largely interested, but in an entirely different district, in the manufacture this body was intended to foster, and having regard to the literary and scientific attainments of this distinguished nobleman, a more judicious selection could not have been made.

From the day of the first introduction of this association to the public to the present, we find an unflagging interest has been maintained in the papers submitted at the gatherings, and in the discussions which have followed their reading. As a natural consequence we are glad to find that among its 450 members is included almost every name of note in this very important branch of our national industry.

We know of no manufacturing operation requiring for successful enterprise a more extensive acquaintance with scientific truth than that of the iron-smelter and its associated branches. His work is conducted in apparatus of a very costly and gigantic character, and under circumstances which render experimental research very difficult; while, on the other hand, its prosecution upon a commensurate footing is attended with so much expense as to render failure almost ruin.

It unfortunately happens also, that the pursuit of pure scientific inquiry connected with the subject is impeded by obstacles of no ordinary character. A blast furnace containing twenty or thirty thousand cubic feet of space and filled with nearly 1,000 tons of materials, chiefly in a state of intense ignition, is not a field to which the chemical philosopher can, without considerable preparation, transfer his labours. From the crucible of the laboratory to such an enormous and almost inaccessible mass, the focus of very intricate and violent chemical action, is too great a step to be made by the chemist for a few hours with any chance of success; for the very questions in which the iron-master would desire his assistance are the results of anterior circumstances, which themselves must be well known to him who attempts to explain their consequences.

On the Continent—in France, in Belgium, in Germany, in Sweden—there are to be found men of great reputation who have identified themselves with this union of science with art, because in these countries are to be found educational establishments so located as to afford the professors who fill the respective chairs abundant opportunity of making themselves personally acquainted with the action of the iron furnace, and, indeed, with every step in this and in other branches of manufacture.

We can adduce no better proof of the real value of the labours of the Iron and Steel Institute than the estimation in which they are held by some of the Continental professors, two of whom we noticed were present at the meeting to which we have alluded.

In our own country, without saying to whom the blame, if any, belongs, men of science and men of industrial occupation have not been brought sufficiently together. As a rule our schools of science are remote from the scenes where science is practically applied. In consequence our professors are, perhaps, less familiar with and less interested in, pursuits, which, in the eyes of a Leoben or Louvain teacher of metallurgy, possess sufficient attraction to induce him to undertake a long journey to be present at a meeting, or to study the operations of our own iron makers, rarely or never visited by the learned of their own nation.

It is this reflection, perhaps, more than any other, which has induced us to notice so favourably the proposition to found in the centre of a great mining and manufacturing district the proposed College of Physical Science at Newcastle-on-Tyne. We regard it as a desideratum no less important to the philosopher than to those who may seek for instruction within its walls, for it is one which will afford to him who has to instruct ample opportunity of studying the application of those great and important truths which it is his office to teach.

We cannot conclude this brief notice without heartily commending the spirit in which the members of the Iron and Steel Institute, throwing aside all narrow-minded prejudice and jealousy, communicate to each other the result of their own individual research, and make known for the use of all the progress each has effected in his own sphere. It seems to us that everyone is acting under the feeling that, on giving information, he is in reality promoting his own advancement. However this may be, society at large, not the least interested in their progress, cannot fail to profit by assistance thus rendered and received, and therefore we most cordially wish all prosperity to the Iron and Steel Institute.

INSTRUCTION TO SCIENCE TEACHERS AT SOUTH KENSINGTON

DURING the months of June and July, a number of science teachers from various parts of England, Scotland, and Ireland, were assembled in London, for the purpose of attending special classes, arranged for their instruction under the auspices of the Science and Art Department. We propose to give some account of the course of instruction in the principles of Biology, which was directed by Prof. Huxley, to whose suggestion, we believe, liberally accepted by Mr. Forster and acted upon by the Government, this important scheme for raising the character of science teaching in the various schools and classes at present in relation with South Kensington is due. It had long been felt by those who annually examined teachers and pupils for certificates in various branches of science, under the Science and Art Department, that the candidates displayed a sad want of practical acquaintance with the subjects in which they presented themselves for examination; many showed considerable ability and great book knowledge, but a knowledge of the things themselves with which science deals, a proof of personal intercourse with Nature, which after all is the only foundation of scientific knowledge, and without which all the 'ologies are so much bookwormery, was to a very great extent wanting. Under the existing state of things it seemed almost impossible to get out of this vicious condition, for the scholars who were in their turn destined to become teachers were for the most part taught by men who were deficient in practical knowledge; and with the increasing demand for science teaching there appeared to be a probability of the evil being increased by the rapid accession of these book-taught students to the position of instructors. The only way to meet this difficulty was to find teachers who had the requisite familiarity with "the solid ground of Nature," and set them to work to leaven the mass. The readiest means of doing this was undoubtedly that adopted by the authorities—namely, to summon to a central class the ablest of the teachers at present distributed throughout the kingdom, and to impart to them as much practical acquaintance and personal familiarity with the *things* of which they had read in books, as was possible in a given time. By annual repetition of this plan there can be little doubt that the body of science teachers throughout the country would be materially affected. Being already acquainted with the outlines and much of the detail of their subjects by hearsay, they would readily understand and appreciate the facts and methods of investigating facts placed before them, and after passing through such a course of instruction would be prepared to proceed further in the same direction by their own individual efforts, and what is more important, to teach, not at second-hand, but from experience, not as fluent repeating machines, but as thoughtful students of phenomena.

Thirty-nine students, of whom one was a lady, attended the course of instruction in the principles of Biology, their expenses (involved in coming to London) being defrayed by the Government. The course occupied six weeks; the students attended every day, with the exception of Sundays, from ten in the morning until half-past four in the afternoon (Saturdays until two). Each morning at ten o'clock a lecture, occupying from an hour to an hour and a half, was given by Prof. Huxley, and the remainder of the day was employed in dissection, microscopic work, and demonstrations, in carrying out which Prof. Huxley was assisted by Prof. Michael Foster, Prof. Rutherford, and Mr. Ray Lankester. The students were placed in pairs at large working tables, and each table was provided with a microscope (with inch and one-eighth inch objectives, and two eye-pieces furnished with micrometric square-ruling), with four scalpels, two pairs of scissors, two pairs of forceps, pins, thread, dissecting needles, watch-glasses, beakers, pie-dishes, glass tubing, and camel's-hair brush.

The practical instruction proceeded *pari passu* with the lectures, the students at once taking their places at the tables after the lecture, and setting to work at materials provided for them to dissect or examine with the microscope in illustration of, or rather as the sequel to, the lecture which they had just heard. Each student was required to send in full reports and drawings as the result of his day's work, many of which proved very excellent; an abstract of the lecture was also given in by each student, with the report of his practical work, and the lot were returned at the end of the course (after due examination by the lecturers) to the students for their future reference. Two prizes—which were two microscopes similar to those used by the members of the class, and provided like them with inch and one-eighth inch objectives—were offered to the students who should be considered to have done best during the course, especial weight being given to excellence in the practical work, as judged both by observation of the student when at work, and by the reports sent in. The names of the students were placed in two classes of merit at the termination of the course, arranged in alphabetical order.

Now as to the subjects which were gone over in the time, which, though limited to six weeks, yet, by dint of hard work, was made to take in more than many a six months' course. The yeast plant occupied the first lecture, and each student was provided with some yeast, which was carefully examined and drawn under the microscope. Each student sowed some in Pasteur's solution which he had himself prepared, and on the following day studied its germination. In like manner the Penicillium mould was studied, sections being cut through the crusts, and careful drawings made of mycelium, hyphæ, conidia, &c. The latter were sown, and their development accurately observed and drawn by each student. A solution of hay was given to each, and the formation of a Bacterium film was studied, the form and movements of Bacteria were compared with the Brownian movements of gamboge rubbed up in water. The structure of the higher Fungi was then studied in specimens of a common toad-stool, and thus a general notion of the morphology and life-history of the Fungi was obtained. Protococcus in its various stages, Palmella, and Volvox next formed the subjects of lectures and practical work, and from these simpler forms the students passed on to Spirogyra and Chara. In Chara the advance in cellular differentiation was noted by each student on specimens supplied to him, and the male and female reproductive bodies examined in detail, and the Antherozooids were obtained in active movement. The phenomenon of cyclosis was also very carefully gone over, each student comparing that of Chara with that seen in Valisneria, and in the hair of the nettle and of Tradescantia; drawings and descriptions being made and the specimens prepared by every student for himself. During this time a certain amount of familiarity had been obtained by all with the use of the microscope—not half a dozen of the class, be it remembered, having previously ever used the instrument at all, still fewer one of adequate power—and as well as the instrument itself, the use of various reagents had been learnt, such as iodine-solution for demonstrating starch, and for delineating protoplasm, acetic acid, magenta-solution, &c. From Chara the class proceeded to the study of the Fern—the sori and sporangia were examined in the first place, and the general form of the fern-frond; then each student was provided with spores which had been previously allowed to germinate, of two stages of development, the one set with the quite young pro-embryo-like prothallium, the other more advanced exhibiting numerous archegonia and pistillidia, the structure of all of which were examined and drawn; and in many cases active antherozooids were obtained. The structure of the fern stem followed, exhibiting typical scalariform, dotted and spiral ducts, and other forms of tissue; also the leaf of sphagnum; the methods of recognising starch and cellulose being here again used. From the fern the class passed on to the study of a bean plant as typical of a phanerogam. Its general morphology, the microscopic structure of its tissues, the minute structure of the flower and the histology of the essential reproductive organs were examined during three consecutive days, and finally the development of the seed and the growth of the young bean plant were studied.

In this work each student used a razor for making sections of the parts to be studied, and portions of turnip were made use of for embedding delicate pieces of tissue, such as leaves, in order to facilitate the cutting of thin sections. A few typical flowers (*e.g.*, Campanula, Rosa, Viola, various Orchids) were next studied as examples of the kind of modification of parts exhibited by phanerogamous plants, and also the female flowers of a small Conifer. Before proceeding to the animal kingdom, a lecture was devoted to a retrospect of the steps through which the class had passed from the simple to the more complex forms, a comparison of the various methods of reproduction, and an outline of the physiology of vegetable life.

Amœbæ, the colourless corpuscles of the Triton's blood, and the amœboid particles of Spongilla, were the first examples of animal life studied, each member of the class making drawings of the various forms due to protoplasmic movement presented by an individual example of each of these cases of simple organism whilst in the field of his microscope. The Gregarinæ of the earthworm next occupied a day, and every student was able to observe and draw the actively moving nucleated Gregarina, its simple encysted condition, and its various stages of breaking up into pseudonaviculæ.

The structure of Infusoria was next examined, as exemplified in Vorticella and Vaginicola, the nucleus, contractile vacuole, mouth, &c., being fairly observed and drawn by all the students. Specimens of Hydra were provided on the following day, and the endoderm and ectoderm, thread-cells and reproductive organs studied. To this followed a copious supply of *Cordylophora lacustris* (from the Victoria Docks), in which the class were able to study a typical compound Cœlenterate, and to recognise not only the male and female gonophors, but the larval "planula-form" as it escaped from the reproductive capsules. Plumatella as a typical Bryozoon succeeded this, and then two days were given to the dissection and histology of Anodon, of which each student was provided with two or three specimens. The lobster as a typical Arthropod was then examined, a fresh specimen being supplied to each table; the heart and vessels were first studied, then the alimentary canal, liver, reproductive organs, and green glands. A large piece of mill-board covered with paper was used by each pair of students for placing out in order, numbering, naming, and comparing the twenty somites and their appendages, an instructive preparation being thus made. The corresponding parts were again examined, and the microscopic structure of the muscular tissue, blood, liver, and gills, in specimens of the river cray-fish. The careful dissection of the frog next occupied some days, and to this succeeded the rabbit.

Simultaneously with the dissection of these vertebrata, the study of the microscopic structure of the various tissues and organs was commenced, so that whilst one student was using the microscope, his companion at the table was dissecting, and *vice versâ*. The blood of the frog and of man, the movements of the colourless corpuscles in both cases, and the action of acids on them, the varieties of epithelium, the various forms of connective tissue and its corpuscles, cartilage, bone, muscular tissue smooth and striped, nerve fibres and cells, the termination of nerve in muscle, and the structure of the more important organs, were examined by the class, *not* in already prepared and mounted "slides," but in specimens which each student took for himself, usually from the animal under dissection, and treated with various reagents, the methods of cutting thin sections and embedding tissues in wax or paraffin being learnt at the same time.

A simple injecting apparatus (formed by two Wolff's bottles and a large vessel of water) was put up, and the method of injecting a frog shown to each student. The best part of a day was spent in a thorough dissection of a sheep's heart, and another in the dissection of the sheep's larynx. Vertical antero-posterior sections of the sheep's head were supplied to the various tables, and in these the parts of the brain and cranial nerves (already made out in the rabbit), the tongue, the relations of the cavities of the mouth, nose, and ear, the ducts of the salivary glands, and the muscles of the eye, were studied. The structure of the eye was again examined by each student, in specimens of those of the bullock, supplied in quantity, and the internal ear and auditory ossicles were demonstrated in rough preparations of the sheep and rabbit.

But little time could be afforded to Physiology; and, indeed, it was hardly possible that each member of the class should perform many physiological experiments for himself. The movements of the heart in the frog after excision, and the localisation of the nerve-centre, was made out by each student for himself; also the phenomena of reflex action in the frog after the destruction of the cranial portion of the cerebro-spinal nervous system. Again, each table was supplied with simple galvanic forceps, and the irritation of nerve and of muscle examined, also the action of chemical and mechanical stimuli on the nerve. The action of curare poison on the frog (Bernard's experiment) was examined by every student, and the condition of the poisoned and the unpoisoned leg compared. Every member of the class was made familiar with the simplest way of demonstrating the circulation in the frog's foot, tongue, and mesentery, under the microscope, and repeatedly examined the phenomenon for himself. Rigor mortis and the artificial rigor produced by warm water were examined. The conversion of starch into sugar by the saliva, and the methods of proving the presence of starch and grape sugar, were made the subject of experiment by every individual of the class. The peristaltic movements of the intestine and the absorption of the chyle by the lacteals were exhibited and closely examined. A model of the circulation, consisting of india-rubber tubes and pump, was used for demonstrating the nature of the pulse, the pressure (by means of manometers placed in connection) in the arteries and veins, and the effect of dilatation and contraction of the capillaries and of rate of pulsation on this pressure. Finally, the thorax was opened in a narcotised rabbit, and the heart exposed, and each student satisfactorily witnessed the pulsations of that organ and the inhibitory effect of irritation of the vagus nerve; the blood-pressure was exhibited to each member of the class in a similarly narcotised dog by means of the hæmodynamometer, a tube being placed in the animal's carotid artery; and as a concluding demonstration the important fact of the influence of nerves upon gland secretion was demonstrated by the beautiful experiment of Bernard, the chorda-tympani being irritated, whilst a canula was placed in the duct of the submaxillary gland. Great care was taken that none of the experiments exhibited to or performed by the members of the class should be open to the charge of cruelty, the animals used being either completely narcotised, or (as in the case of the frogs) having the cerebral portion of the nervous system destroyed in the proper manner.

Throughout the course the morning's lecture was made preparatory to or an extension of what was afterwards brought under actual observation. The concluding lecture was devoted to a retrospect of the work which had been gone through, and an exposition of the idea which had guided the scheme of study pursued, the object having been not to make botanists, nor zoologists, nor anatomists, of the members of the class, but to give them a practical insight into the structure and activities of living things, in such a way as to enable them to observe for themselves the relations and connections of the various forms of life, and to follow from actual examples the characteristics and increasing complexity of different plans of structure.

The reports of work and lectures daily sent in by the members of the class were entirely satisfactory, and the spirit and enthusiasm displayed throughout proved how greatly the value of the course was appreciated. When it is remembered that, with scarcely an exception, these teachers had hitherto never used the microscope, never dissected a single organ or organism for themselves, nor seen one properly dissected, the advantage gained by the experience they have now obtained, even if only a portion of what was condensed into six weeks' work remains with them, is something very considerable, for it is something of a *new kind*, a form of knowledge which they had entirely failed to obtain before.

It is exceedingly interesting to find that no difficulty was experienced in going over all these matters in a class which was not confined to men alone, and most heartily do we hope to see in the future a larger proportion of women engaged in this and other branches of scientific study. Those who imagine that women have some innate incapacity, and assert that if admitted to classes now limited to men they would be unable to profit by them, or would hinder the progress of the class by the greater attention they would require in order to keep them to the level of male students, may take this fact to heart—one of the microscopes offered as a prize for the best work done, and the best record of the lectures and the day's work, was adjudged simply upon the merits of her reports and work to the one lady among the thirty-nine students who formed the class. On the other hand, this fact will probably stimulate that unavowed feeling, akin to the trades-unions' hostility to competition, which is the cause of the arbitrary exclusion of one half of the community from our greatest educational institutions. E. R. L.

MAGNUS'S BONES OF THE HEAD OF BIRDS

Untersuchungen über den Bau des Knöchernen Vogelkopfes. Von Dr. Hugo Magnus, Assistentarzt an der Klinik des Herren Prof. Dr. Förster, zu Breslau. Mit sechs Tafeln. (Leipzig: Engelmann, 1870; pp. 108. London: Williams and Norgate.)

THIS work is a systematic description of the form, structure, and relations of the various bones of the head of birds. Each bone is taken separately, and the chief varieties it presents in the several sub-classes are described, and are illustrated by carefully drawn plates. In here giving a brief notice of the work, we need scarcely say that the details of the several bones in the adult state are very well and clearly given, and the author has had opportunities, of which he appears to have thoroughly availed himself, of studying and comparing the skulls of a large number of birds. The mode in which the variations from typical structure are given is instructive and accurate. We will give an extract to show the mode in which he deals with the subject, and select a part of his account of the squama of the Temporal:—

"The squama of the Temporal Bone (Squama, Sheitelbein, Geoffroy) closely resembles that of Mammals in its form and position. It is an elongated, scale-like bone situated upon the lateral wall of the skull above the tympanic cavity, and is posteriorly in contact with the occipital, above with the parietal or temporal, and anteriorly with the great wing of the sphenoid, with which, as we have already seen, it frequently unites to form the posterior orbital process. The external convex surface of the squama for the most part enters into the formation, sometimes more and sometimes less, of the temporal fossa, especially in the long-billed marsh and aquatic birds. From the processus orbitalis posterior a semicircular line runs upon or around the squama, separating it with its striæ or ribs from the planum temporale. Near the anterior border of the squama, and usually below the posterior orbital process, a process shoots forth from its surface, which is the Processus Zygomaticus of Carus and the temporal process of Köstlin. This in some birds, as in the Larks, Parrots, and Fowls, is tolerably well marked, and fuses with the processus orbitalis posterior. In the singing birds, this process is very variable in size; in Thrushes, Sylviadæ, Motacillidæ, and Hirundinidæ, it is rather feebly developed, resembling a small blunt head. In the Fringillidæ it is developed into a slender rod, as it is also in Edolius, and (though to a less degree) in Lanius. In the Paridæ it forms a broad lamina. In the Corvini, it is considerably developed; while in the Falcons it appears to be entirely absent. In Owls it is slender and acicular. In the Woodpeckers it is very large, and occupies a special groove of the Quadrate bone. In the marsh and aquatic birds it approximates very closely to the articular surface of the os quadratum, and is for the most part of very small size." He then proceeds to describe the internal surface of the squama, and its junction with other bones to form the tympanic cavity.

The principal defects of the book are obviously that the author has little acquaintance with the history of the embryological development of the class of birds generally, and does not appear to have studied the serial homologies of the several bones in other classes.

As an instance of the former defect, we may note that Herr Magnus maintains with Nitzsch that the os dentale, or median portion of the lower jaw, is developed from a single point of ossification. "I have never," he says, "been able to discover the presence of two nuclei, even in the youngest animals I have examined, nor any trace of a suture." We would refer to Mr. Parker's paper on the head of the fowl, as clearly showing the double nature of this bone, though no doubt the two parts early coalesce. Taking the ethmoid bone again, we find Dr. Magnus describing it rightly as a cranial bone, or rather as one belonging to his animal sphere. He notices the singular modification in form it undergoes throughout the whole class, and observes that it is a thin bony plate lying between and in front of the globes of the eye. The anterior portion, he goes on to say, situated in front of the eyes, and provided with lateral processes that shut off the nasal from the orbital cavities, may be regarded as the labyrinth of the ethmoid. And then comes the remarkable statement that "the plate extending backwards from this and separating the two orbital plates from each other is the *crista galli*, whilst the short plate extending forwards into the cavum narium represents the lamina perpendicularis." This scarcely appears to us to be an accurate representation. The crista galli is to all intents and purposes an intracranial projection of bone, we might even consider it to be a portion of the falx cerebri which has undergone ossification, and such result must be above the plane of the canals for the nasal branch of the fifth; in point of fact, it may be seen in all birds in a rudimentary form between the two passages for the olfactory nerves. (See note to Mr. Parker's paper "On the Structure of the Skull of the Common Fowl," Phil. Trans. 1869, p. 762.) The septum between the two orbits is chiefly and not to a small extent only, formed by the os perpen-