taken of the King, and the return journey to India commenced. Returning by Yarkand, the Kara-korum Pass was ascended on June 16, and Stoliczka seems to have suffered from the great height. On the 17th the last record appears in his journal. On the 18th the first symptoms of a new attack of spinal meningitis showed themselves, and, despite all the care of his devoted friends, he breathed his last on the afternoon of the 19th, some eleven marches from Leh, where he was buried beneath a willow-tree. The Government of India placed a suitable inscription over his grave, and other evidences of the esteem and regard in which his memory is held will be found in the Museums of Calcutta and Vienna. And now another, and this not the least, will be found in this too brief, but sympathetic, record of his life and labours, written by one who knew him well, and who was able to appreciate not only the scientific labours of his friend, but his honesty and loyalty. A detailed list of all the scientific papers and published letters of Stoliczka between 1859 and 1874 is appended to this memoir.

THE IRON AND STEEL INSTITUTE

THE summer meeting of this Institute was held on the 6th to the 8th inst., in London, under the presidency of Dr. John Percy, F.R.S. In his introductory remarks, the President made special reference to some of the papers about to be read. He was very pleased to see that the employment of chromium in the manufacture of steel was receiving attention. As far back as 1821 Bertheir, in the *Annales des Mines*, had shown that iron with 1 to 1·5 per cent. of chromium forged well, whilst it took a keen edge when ground, and had a very high tenacity.—Dr. Percy exhibited a portion of a broken ploughshare of American manufacture, which was formed of three metals, and seemed to be produced by casting steel on both sides of malleable iron. He drew attention to mitis metal, but refrained from offering any opinion on the subject, referring simply to the statements put forward that by the use of aluminium in its composition the melting-point was lowered, whilst, as the product was more liquid, it ran better, and sound castings were more easily produced. In speaking of Indian metallurgy, reference was made to the iron column at Delhi, the largest piece of forged iron in the world. The President next drew attention to the development of iron and steel-making in the United States, showing its rapid progress, and how enormously the capacity for production, both in that country and here, was in excess of the demand, as regarded blast-furnaces, Bessemer converters, and open-hearth furnaces. The address concluded with some remarks on diminished cost of production; to what a degree this has been carried, and the influence it has had on the labour market may be inferred from the circumstance that nowadays a single lace-making machine does the work formerly done by 2000 women, that wood-planing, which used to cost 12*s.* per square foot, is now done for 2*d.* or 3*d.*, that the manufacture of gold chains has been reduced from 30*s.* to 3*s.* 6*d.*, and that a gross of steel pens may now be procured for 4*d.* which used to cost 7*l.* Sir Henry Bessemer proposed a vote of thanks to Dr. Percy for his address, which was seconded by Mr. Adamson, the President-Elect.

The first paper read was that of Sir Frederick Abel, F.R.S., and Colonel Maitland, Superintendent of the Royal Gun Factories, Woolwich, on the erosion of gun-barrels by powder-products. This, in the author's opinion is due to a softening, if not fusing, effect exerted upon the surfaces of the metal by the high heat of the explosion, an increase of this softening or fusing effect by the chemical action of the sulphur at the high temperature produced, and the mechanical action of the rush of gases, vapours, and liquid products upon the softened or fused surfaces. There are two kinds of scoring or erosion: muzzle-loading scoring is due to the rush of powder-products over the top of the projectile through the clearance or windage, which has to be allowed for facility of ramming home the shot along the bore in a muzzle-loader; breach-loading scoring is produced by the rush of the powder products behind a shot, acting as a gas-tight plug, during and immediately after its passage through the gun. Evidently erosion will increase with the amount of the powder products, with the pressure in the bore, and with the duration of the time of action, and it is important to ascertain what material best resists erosion by powder products, or what treatment of the material is best calculated to increase its power of resistance to erosion. With this object in view experiments were made on thirteen rifled barrels, of different steels, of 2¼ inch bore, firing 100 rounds each with 10¼ lb. charges of pebble powder and 6 lb shot, fitted with service driving rings; these barrels were screwed into the mouth of the chamber of a 22 cwt. breech-loader. Gutta-percha impressions were taken after each batch of twenty-five rounds. During the preparation of the barrels specimens were cut in prolongation of the bores and tested mechanically, and the proportions of carbon, silicon, and manganese were determined in samples of the metal. The average pressure of the gas was 13 tons to the square inch. The results of the experiments are given in a table, but neither the chemical analysis of the metals nor the testing machine gave any assistance in accounting for the position of the barrels in the mean order of merit in which they were placed by five skilled and independent observers. Thus the worst and the worst but one were respectively the highest and nearly the lowest in carbon, the first, fifth, and tenth were very closely allied both in analysis and as tested by the machine, and it became evident that some agency, hitherto unsought for, dominated the results. Separate and independent investigations were made by the writers of the paper, the one instituting a chemical and the other a mechanical examination of the metals. A chromic solution capable of exerting a very slow solvent action upon the metals brought their structure into relief, and the extent of erosion was found to be more or less referable to the less or greater amount of mechanical treatment the metal had received, and to the consequent extent to which uniform fibrous structure had been developed. Experiments made on the metal as cast, and forged to twice to four times, and to eight times its length proved that the more steel was forged or worked the less it suffered from the eroding effect of powder gas. This was found to be the case both as regarded hard and soft metal. Several members took part in the discussion, notably Mr. Adamson, Sir Frederick Bramwell, Sir Henry Bessemer, and Mr. Frederick Siemens.

The next paper, which was taken as read, was an elaborate report of 137 pages in length by Messrs. P. C. Gilchrist and E Riley, "On the Iron-making Resources of the British Colonies and India, as illustrated at the Colonial and Indian Exhibition." It would appear the reporters are of opinion that, so far as the exhibits are concerned, the iron and coal-producing power of the Empire is rather undershown, as with a proper application of the materials at the disposal of our colonies and India, they should at all events be able to supply their own requirements.

The next papers read were: "On some Early Forms of Bessemer Converters," by Sir Henry Bessemer, F.R.S., and "On Modifications of Bessemer Converters for Small Charges," by John Hardisty. The first of these contains descriptions of the different forms of converters selected by the author as typical of the whole, and which embrace the main features of ten several forms of apparatus which he has from time to time designed for the conversion of crude iron into steel. It was written with the double object of letting those who are seeking to improve the

process know what has already been done; while the general public ought not to remain ignorant of what legitimately belongs to them, and which, after the ample reward he has received for his inventions, the author desires they should enjoy without any restrictions. The author of the second paper holds that the making of steel in small quantities is a step in the wrong direction, because the steel cannot be made so cheaply; but, as he points out, it is to the interest of owners of small blast plant to possess the means of converting their product into steel, and of ironworkers who cannot find work for their puddling furnaces to make steel enough to keep their machinery at work rather than be dependent on larger firms for a supply of ingots. An American steel-maker in the discussion drew attention to the circumstance that in the United States, when the rail trade was brisk, it was impossible for the smaller works to obtain Bessemer ingots at all, and that they had to introduce small plant for self-preservation. From the statement of opinion it was evident that there was necessity for the original Bessemer converters and the smaller modified forms.

Mr. Frederick Siemens's paper on combustion with special reference to practical requirements draws attention to the means necessary for adoption to insure perfect combustion. The gases must be supplied in the exact chemical proportion in which they are required for combustion; they must be brought together in such a manner that the different molecules which have to enter into combination may readily do so, whilst every thing must be avoided which interferes with the motion of the gases while combustion is proceeding.

The author enters in detail on the way in which gases should be brought together, he explains that the Bunsen burner, though theoretically perfect, cannot be advantageously carried out in furnaces, as the flame of a Bunsen burner being almost non-luminous owing to free carbon not being liberated during combustion, has but little radiating power, and must in consequence transmit its heat by direct contact only. As the gases cannot generally be mixed before combustion, it is a matter of great importance how they are brought together when combustion commences, a mean being necessary between a too intimate mixture, producing a short flame having great heating but little radiating power, and an imperfect mixture, which does not allow of combination properly taking place. The third means necessary is the one to which the author has frequently drawn special attention, because neither the employment of gases in proper proportion, nor their proper mixture is sufficient to insure perfect combustion *if the disturbing influences of surfaces is allowed to interfere to prevent combustion, or to dissociate particles of gas already combined.* In the author's view the dissociation caused by hot surfaces is of various kinds, and takes place at different temperatures. At a comparatively low temperature, dissociation of hydrocarbons takes place, the carbon being liberated in the solid form as soot. At a moderately high temperature carbonic oxide is dissociated into solid carbon and carbonic acid gas; at a higher temperature the products of combustion begin to dissociate, steam splitting up into hydrogen and oxygen, and lastly, at a still higher temperature, depending upon the kind of surface with which the products of combustion come into contact, carbonic acid splits up into solid carbon and oxygen. From this it will be seen that dissociation has the effect of setting carbon free, and to its influence the formation of smoke is largely due.

The author then proceeded to show that smoke within a furnace chamber is caused by flame in the first instance touching surfaces which then become enveloped in a dense cloud of dissociated carbon, which prevents the heat rays from reaching them. The author illustrated his remarks by means of a gas-burner proposed to be used instead of the English fire-place, by the use of which it is stated that heat is much more uniformly distributed throughout a room. The flame was intensely bright and hot, due as explained to its being fed with hot air, and working with free development of flame that is entirely out of contact with any surfaces. The gas stove afforded considerable interest to the members, and the author by special request explained its mode of action.

The papers read on the last day of the meeting were two by Mr. F. Gautier, of Paris, on the casting of chains in solid steel, and on silicon in foundry iron. Hitherto chains have been made of wrought iron, the difficulty in the various processes of manufacture being the difficulty of securing a good weld; this, according to the author, is now overcome by a process of Messrs. Joubert and Leger, of Lyons, which combines chilled casting and instantaneous removal from the moulds. In the second paper the writer refers to the advantage of silicon in producing homogeneous steel and pig iron castings and improving foundry pig; he also drew attention to the introduction of ferrosilicon in French foundry practice. The author's views were in general supported by the members in discussion. Mr. F. W. Harbord's paper, "On the Elimination of Silicon, Phosphorus, &c., in the Basic Open-hearth Process," gave evidence that soft steel of the very finest quality could be produced from inferior material by this process, whilst the conditions of working in the Siemens furnace are peculiarly favourable to its production. Surgeon-Major Hendley's paper, "On the Process employed in Casting Brass Chains at Jeypore, Rajputana," was contributed by Mr. C. Purdon Clarke, and illustrated by samples. The papers on "Chrome Steel," by Mr. Brustlem, and on "American Blast Furnace Practice," by Mr. F. W. Gordon, Philadelphia, were put off to the next meeting.

NOTES

WE regret to learn that Baron von Müller retires from the directorship of the Melbourne Botanic Gardens in June next.

THE death is announced of M. Dubosc, a Paris optician, who assisted M. Léon Foucault in all his constructions, and especially in the organisation of his automatic electric lamp.

THE Laboratoire d'Électricité created with the surplus of the Electrical Exhibition of 1881, held in the Palais de l'Industrie, will be erected on the site of the old Collège Rollin, on ground granted by the City of Paris. It will be open to electricians of every nation, and governed by the International Society of Electricians.

AN ordinary General Meeting of the Institution of Mechanical Engineers will be held in the Yorkshire College, Leeds, on Monday, October 18, by invitation of the College authorities, in celebration of the opening of the Engineering Department of the College. The following papers will be read and discussed, as far as time permits:—"On Triple-Expansion Marine Engines," by the late Mr. Robert Wyllie, of Hartlepool; "Notes on the Pumping Engines at the Lincoln Water-Works," by Mr. Henry Teague, of Lincoln; "Description of a Portable Hydraulic Drilling Machine," by M. Marc Berrier-Fontaine, of Toulon.

THE Commission of the French Budget having adopted without reduction all the proposals of the Government for the Algerian provinces, the construction of the large instruments for Bouzareah Observatory will be continued, and inspection of the heavens will be conducted on a large scale at Algiers. An observer connected with the Trocadero Observatory has been appointed to assist M. Trépied, and left Paris last week for his destination.

THE photographic method has been established at the Algiers Observatory for the sun. Nine times out of ten the operation has been successful.