some extent not very good; for the same reason, exposures longer than 70 seconds were not deemed advisable. These temperature variations made the measurements of wave-length a more difficult task than would have been the case had they been absent, but Dr. O. Lohse seems to have taken the greatest pains to overcome this point; the measures were based on the solar spectrum, Rowland's normal lines being adopted; while the spectrum of iron was used as a comparison. It is stated that the measures may be generally taken as accurate up to a tenth of an Angström unit (0·01 $\mu\mu$), and only in the cases of very dim or broad lines is this limit exceeded; the intensities are given on a scale of tenths. The communication concludes with tables of the wave-lengths thus obtained.

THE ROYAL GEOGRAPHICAL SOCIETY.

AT the anniversary meeting of the Royal Geographical Society, on May 17, the President, Sir Clements Markham, F.R.S., in place of the usual annual address, gave a review of the progress of British geography during the sixty years of the Queen's reign. The practice of delivering an anniversary address was commenced in 1837 by the then President, Mr. W. R. Hamilton, in the eighth year of the Society. The first presidential address took the form of a survey of the position of geography at the time, and now forms a suitable landmark by which to estimate the advance that has been made. The Ordnance Survey of the British Islands was fairly under way, and that of India was also in progress. Hydrographic surveys were being pursued by British ships in every sea, and the coasts of Africa had been charted. The whole interior of Africa, most of Australia, and immense territories in Asia and South America were absolutely unexplored. The whole science of oceanography, although created by Rennell, had not yet been recognised.

One of the first pieces of geographical research of the Queen's reign was the memorable voyage of Sir James Clark Ross to the antarctic regions in 1839-41, and this may be held to be the only antarctic expedition ever sent out. Of late years the necessity for an antarctic expedition has become more and more urgent, for many reasons, but chiefly because the science of terrestrial magnetism is at a standstill, owing to the absence of any observations in the far south during the last fifty years. The knowledge which would be acquired by such a magnetic survey will not only be of scientific interest, but will also be of practical importance to navigation. Deep-sea soundings, dredgings, temperatures of the ocean at various depths, meteorology, the distribution of marine organisms, are some of the investigations which would be undertaken by an antarctic expedition with reference to the ocean. Equally important objects would be to determine the extent of the south polar land, to ascertain the nature of its glaciation, to observe the character of the underlying rocks and their fossils, and to take meteorological observations on shore.

Since 1893 the most strenuous efforts have been made to induce the Government to send out another naval antarctic expedition, but without result. We have been told that officers cannot be spared from the ordinary routine of the fleet; that times are much changed from the days of the *Challenger's* commission, and are now much more unsettled. It is forgotten that the naval superiority of Great Britain, in the days of St. Vincent and Trafalgar, "lay not in the number of her ships, but in the wisdom, energy, and tenacity of her officers and seamen," and that these qualities are now to be acquired by such special service as is involved in an antarctic expedition. It is forgotten that in the good old times neither war nor the fear of war were any check to the despatch of naval expeditions of discovery. Captain Cook was sent on his third voyage at a time when France, Spain, Holland, and the American insurgents were all vainly banded together for our destruction. In the midst of the French revolutionary war, Captain Vancouver was calmly surveying the intricate straits and sounds of New Albion, and Captain Flinders was exploring the shores of Australia.

The duty which will not be undertaken by the Government, will now receive the special attention of the Society, which will not appeal in vain for co-operation to the patriotism and energy of private individuals in Great Britain, or to the Governments in Australasia.

In the arctic regions Englishmen have discovered the whole of the American side from Bering Strait to the north coast of Greenland, and have explored the intricate system of channels and straits which separate the numerous islands. They have thus thrown open to the knowledge of the world a vast amount of information in all branches of science, and have especially taken the largest share in preparing for the solution of the polar problem. Dr. Nansen, by his memorable drift of the *Fram*, has supplied what was needed to complete the means of comprehending what had previously been a mystery. For this great service to geography Nansen has received a special gold medal from the Society; and he has rendered ever memorable, in arctic history, the sixtieth year of the Queen's reign. It saw the solution of the north polar problem.

The main points in the history of the exploration of each continent were touched upon, and the part taken by the Society in the work made plain, the President summing up the results as follows.

"When we contemplate these immediate consequences of our geographical work, it will, I am sure, be felt by all who are connected with this great Society, that it occupies a position of national importance, a position which entails most serious duties and heavy responsibilities. It is our privilege to render frequent services to several departments of the Queen's Government; to take the lead in numerous enterprises, many of which are eventually recognised, in their results, as involving considerable benefits to the nation; and to prepare the means, by our great collections of books and maps, and by the facilities we can give for instruction, for others, including the authorities under Imperial guidance, to follow in our footsteps."

As regards the new departures in the work of the Royal Geographical Society, the President mentioned the institution of a diploma for proficiency in practical astronomy and surveying, and the according of a large measure of support to Mr. Mackinder's scheme of a London School of Geography.

The Royal medal awarded to Dr. G. M. Dawson was handed to Sir Donald Smith, the High Commissioner for Canada; that awarded to M. P. P. Semenoff was given to M. Lessar, of the Russian Embassy. The Danish Minister received the awards given to Dr. Thoroddsen and Commander Ryder, while Lieutenant Seymour Vandeleur received the Murchison grant in person.

THE IRON AND STEEL INSTITUTE.

THE annual spring meeting of the Iron and Steel Institute was held on Tuesday and Wednesday of last week, in the theatre of the Institution of Civil Engineers. There were twelve papers down on the list, as follows:—"On the Permeability of Steel-making Crucibles," by Prof. J. O. Arnold and F. K. Knowles; "On the Practice of the Combined Open-Hearth Process of Bertrand and Thiel," by E. Bertrand; "On the Agricultural Value of Sulphate of Ammonia from Blast-Furnaces," by F. J. R. Carulla; "On the Specific Heat of Iron," by Prof. W. N. Hartley, F.R.S.; "On Charging Open-Hearth Furnaces by Machinery," by Jeremiah Head; "On the 'Weardale' Reheating Furnace," by H. W. Hollis; "On the Effect of Phosphorus on Cold Shortness," by Baron Hanns Juptner von Jonstorff; "On the Determination of Hardening and Carbide Carbon," by Baron Hanns Juptner von Jonstorff; "On Malleable Cast Iron," by G. P. Royston; "On Carbon Changes connected with Malleable Cast Iron," by G. P. Royston; "On Microscope Accessories for Metallographers," by J. E. Stead, Member of Council; "On Central Blast Cupolas," by T. D. West.

Of these six were read and four discussed. Six papers were taken as read, and not discussed. The latter consisted of the papers of Messrs. Carulla, Hartley, Stead, and West, and the two papers of Baron Juptner von Jonstorff. Mr. Royston's papers were those read and not discussed.

The formal proceedings having been got through, and the report of the Council having been read, the past-President, Sir David Dale, introduced the new President, Mr. E. P. Martin, who, as is well known, is the manager of the Dowlais Iron Company of South Wales. Sir Frederick Abel was next presented with a Bessemer medal; and then the President proceeded to read his inaugural address. This was of an eminently practical nature, and gave a most interesting description of the growth of the iron and steel industry at Dowlais almost from the earliest times, these historic works having been established for over a hundred years. It is interesting to notice that in the year 1791 the quantity of coal consumed in making a ton of iron in

the South Wales district was no less than 8 tons 1 hundredweight; while the average make of pig iron per furnace per week was 20 tons. Last year the maximum output of blast furnaces at Dowlais was 1600 tons per week, the consumption of fuel (coke) being equal to about 1½ tons of coal per ton of pig. The description of the manner in which the steel industry was introduced at Dowlais and its subsequent increase was commented upon by the President; one of the first works to take up the Bessemer process being the Dowlais Ironworks. Sir Henry Bessemer himself has stated that the first ingots were made from grey Blaenavon, which was converted into soft iron or steel without spiegel or manganese, the converter being lined with Stourbridge bricks. Menelaus, Edward Williams, and Edward Riley made successful tests at Dowlais immediately after Bessemer read his historic paper at the Cheltenham meeting of the British Association; the latter only of the three gentlemen named survives, he being present at the meeting and taking part in the discussion. When Mr. Bessemer came to Dowlais to continue the experiments a convenient refinery happened to exist opposite the furnace making cinder pig, and the iron from this furnace was by a singular and most unfortunate mischance employed for Mr. Bessemer's trials. The result, naturally, was very disappointing; and it is characteristic of the troubles inventors have to meet, that it was then contended such accidents were inherent to the process. Mr. Martin states that some time ago he came across one of these Bessemer ingots, which he analysed. As might be imagined, the phosphorus was extremely high—in fact, ridiculously so, being nearly 2 per cent. Unfortunately, the mistake in regard to the pig iron was not ascertained until some time after, so that, though the Dowlais Iron Company was one of the first to take up a licence to make Bessemer steel, they did not begin to roll steel rails till 1864. It will surprise a good many people to learn that large quantities of iron rails were rolled at Dowlais as late as the year 1882. The substitution of Bessemer and Siemens steel for wrought iron has reduced the number of puddling furnaces at Dowlais from 255 to 15.

The statistical part of the address was extremely interesting, especially that relating to American competition. American iron and steel makers exceed those of this country enormously by the output they obtain from their appliances. The Carnegie Steel Works have, the President stated, again surprised the world by the tremendous strides they have made. The Duquesne furnaces hold the world's record. Their best month's work has been 17,182 tons, or 572 tons per day, the actual best day's output being 690 tons, with a consumption of coke, as an average of a month, of 1700 lbs. per ton of pig iron. That is with a 57 to 60 per cent. ore, but in our country with a 48 to 50 per cent. ore we look on a make of a little over 1600 tons per week with satisfaction. "When this is compared with the gigantic outputs obtained from the Duquesne furnaces," the President said, "during the same period, it must be admitted that the results achieved here leave much to be desired." It may be added that still larger furnaces are being erected in America, and it is confidently expected that these will produce 1000 tons of pig iron per furnace per day. The Bessemer Steel Works at Duquesne are on the same huge scale as the blast furnaces, and other American works mentioned by the President are on a similarly imposing plan. In spite of the high wages paid in America, it has been possible by working in this wholesale manner to bring the cost of production to a very low ebb, until, as has been recently stated, it is a question now not how much steel we should send to America, but how far we can meet American competition within our own boundaries. The details as to freights, iron ore supply, by-products, wages and labour cost, railway rates, and other matters of a like nature were also discussed in the address.

Mr. Hollis' contribution was the first paper to be read. The Weardale furnace is of the re-heating type—that is to say, it is used for heating slabs, &c. It would be difficult to give a description of the design without the drawings by which the paper was accompanied. The author's object was to obtain continuous working without reversing, and yet to dispense with the regenerating chambers altogether, on account of their cost. It was also a point kept in view to introduce the flame in such a way as to obtain equal heating over the whole floor of the heating chamber. The broad principle upon which these ends was effected was by constructing the furnace so that the gas-flame would be introduced through, and surrounded by, a stratum of highly-heated air in the roof of the furnace. The flame would pour down on the slabs or piles to be heated, and would pass along the floor of the working chamber to an outlet port at each end. Judging by the details given by the author in his paper, and from the testimony of many competent judges during the discussion, the Weardale furnace seems to give satisfactory results.

The next paper read was the contribution of Messrs. Arnold and Knowles. The authors stated that in passing pure carbonic oxide over white-hot aluminium the metal became coated with a grey mixture of aluminal and carbon. Also, on blowing forty gallons of carbonic oxide through molten mild steel, containing about 4 per cent. of aluminium, the percentage of carbon was raised; this power of aluminium, to reduce carbonic oxides at high temperatures, has since been used to measure the permeability to furnace gases of clay steel melting crucibles. The experiments were carried out by melting ingots of Swedish iron, containing 99·85 of iron, with calculated quantities of aluminium. The ingots were broken up and re-melted, and it was found that in each case the greater part of the aluminium had been oxidised, and that the carbon liberated had converted the iron into hard steel; in one case remarkably high in silicon, doubtless reduced from the clay of the crucible during the prolonged time the steel was maintained in a molten state. The most important practical feature of the experiment was the fact shown that the walls of a crucible form little protection against the absorption of sulphur by the metal inside it. A good discussion took place on the reading of this paper, it being opened by Prof. Roberts-Austen, who gave what was a valuable supplement to the paper, consisting of details of work of a similar nature carried out by previous investigators. This question of the porosity of crucibles was, Prof. Roberts-Austen said, the dominant problem in the minds of metallurgists early in the century. The reading and discussion of these two papers, and of the President's address, occupied the first sitting of the meeting.

The first paper taken on the Wednesday was that of Mr. Jeremiah Head, in which he described an apparatus worked by electrical power, which has been introduced in America for charging Siemens furnaces. In this country hand labour is universally adopted for the purpose, although mechanical means are about to be introduced in some works. It is by such appliances as those described by Mr. Head that the American steel-makers are enabled to obtain the enormous output to which reference has already been made. It would be difficult to describe the machine without the diagrams which Mr. Head had shown upon the wall, or the very beautiful working model which Mr. Archibald Head exhibited at the conclusion of the reading of the paper. It must suffice to say that a powerful frame or gantry is run up in front of the furnace; by means of an electric motor a massive arm is projected from this. The arm is provided with what might aptly be called a hand, which grasps the boxes containing the furnace materials entirely by automatic means. The furnace door is then opened and the arm carries the iron box, with its charge of pig iron, ore or scrap, into the furnace; by another electric motor the arm is rotated, depositing the materials into the glowing bath of the furnace. The box is then withdrawn by the arm, the operation being continued until the whole charge is in position on the hearth; the apparatus is then moved on to the next furnace. The speakers during the discussion who had seen the apparatus at work gave testimony as to its efficiency.

The last paper read and discussed at the meeting was that of Mr. Bertrand. The combined process, to which reference is made in the title, consists of two open-hearth furnaces. The operations are divided into two stages, the metal being run, when half-treated, through a header from the primary to the secondary furnace, the latter being of the nature of a finery furnace. The perfect elimination of the phosphorus is not intended in the upper furnace, and therefore less lime may be added than would be otherwise necessary, and the quantity of slag to be melted is materially diminished. The plan of working adopted consisted in charging nearly all the siliceous and phosphoric pig iron into the primary furnace, and nearly all the scrap into the finishing furnace, adding in each such quantities of ore, lime, &c., as they were demanded. The advantage claimed is an increased output and a material reduction in the consumption of lime and basic material for lining the furnace hearths; a saving of fuel also takes place, it is thought. A long discussion followed on the reading of this paper.

The summer meeting this year will be held at Cardiff.

The annual dinner of the Institute was held on Tuesday,

May 11, at the Hotel Cecil, the President occupying the chair. Among those present were the Duke of Teck, Sir Bernhard Samuelson (past President), Sir David Dale (past President), Sir Lowthian Bell, Sir Courtenay Boyle, Sir Andrew Noble, Sir Henry Mance, Prof. Dewar, F.R.S., Prof. Ayrton, F.R.S., Dr. Ludwig Mond, F.R.S., Mr. Norman Lockyer, C.B., F.R.S., and Mr. B. H. Brough (the Secretary). After the loyal and patriotic toasts had been duly honoured, Prof. W. C. Roberts-Austen, C.B., F.R.S., proposed "Scientific and Professional Societies," which was acknowledged by Sir John Evans, F.R.S., and by Mr. J. Wolfe Barry, C.B., F.R.S. The toast of the evening, "Prosperity to the Iron and Steel Institute," was proposed by Sir Courtenay Boyle.

THE CULTURAL EVOLUTION OF "CYCLAMEN LATIFOLIUM."[1]

ON the occasion of the discussion on "Variation in Plants and Animals," which took place on February 25, 1895, it occurred to me that it might be useful to give an illustration of the amount of change which has been effected in a plant by continuous selection under cultivation in a comparatively short time. I, therefore, placed upon the table an example of the wild and of the cultivated form of the garden "cineraria" (*C. cruenta*).

The choice of this species was purely accidental. It was, however, violently impugned. It was contended that the garden cineraria was not the result of the development of a single species, but that it was of multiple origin, and the result of the intercrossing of several. It was further contended that its change from the wild form had not been gradual, but by discontinuous steps or "sports." Neither contention seemed to me well founded. But I admit that, owing to the lapse of time since the so-called "improvement" of the cineraria commenced, it is impossible to give formal proof that the process has been what I described. Mr. Darwin met with the same difficulty. He remarks: "We know hardly anything about the origin or history of any of our domestic breeds" ("Origin," 6th ed., p. 29) As is, however, well known, he regarded them as the result of accumulation by selection of successive slight variations. But he also tells us that "the chance will be infinitely small of any record having been preserved of such slow, varying, and insensible changes."

It seemed to me important, therefore, to obtain the history of some cultivated species which would not be open to the objections urged in the case of the cineraria.

After some consideration I selected the plant known in gardens as *Cyclamen persicum*. Owing to the kindness of the skilful horticulturists who have worked upon it, I am able to place on record a nearly complete history of the changes it has undergone.

The genus *Cyclamen* belongs to the small order *Primulaceæ*, which in its affinities is somewhat isolated. *Cyclamen* itself is distinguished from the rest of the tribe *Lysimachieæ*, to which it belongs, by the reflexed segments of the corolla.

Cyclamen persicum, Mill., is a name given by gardeners to a form slightly modified by cultivation of *C. latifolium*, Sibth., a species confined to Greece and Syria. There is a good figure of the type in Sibthorp's "Flora Græca" (t. 185). It has pink flowers, with a ring of darker colour at the throat. The species is said to have been first cultivated in Europe at Lille in 1731 ("La Semaine Horticole," 1897, p. 23), having been introduced from Persia. There must have been some error as to its origin, for Boissier points out that the species is not found in that country ("Flora Orientalis," vol. iv. p. 12). In all probability it was obtained from Syria. The Lille plant ultimately went to Ghent, and it has been asserted that all the cultivated forms in existence are descendants from this one individual. The assertion cannot be proved, but is not improbable. It is known to have been a variety with white flowers. As will be shown, the forms now in cultivation have been derived from a white-flowered one, which in turn might well have been derived from the Lille plant.

Such a modified form was, in fact, that described by Miller, in 1768, in the eighth edition of his "Gardener's Dictionary," under the name of *Cyclamen persicum*. He describes the flowers as "pure white with a bright purple bottom." It was figured in the *Botanical Magazine* in 1787 (t. 44), and it has come down little altered to our own day. In 1875 Boissier describes it as "forma hortensis a me nunquam spontanea visa." It still exists in cultivation, and is the (old) "crimson and white" of Messrs. Sutton. It seems always to have been popular in cultivation on account of its agreeable fragrance. This confirms the Syrian origin of the original stock, for a white-flowered form "is found in Palestine which is very fragrant" (*Roy. Hort. Soc. Journ.*, N. S., vol. xiii. p. 163).

Early in the century some colour variations were in cultivation. Several as well as the typical *C. persicum* were figured in the "Flore des Serres" in 1877 (t. 2345). These record the amount of change from the wild type which had been accomplished in a century and a half. One striking seminal sport (*C. persicum*, var. *laciniatum*) is figured in the *Botanical Register* in 1827 (t. 1095). It is remarkable for spreading corolla-segments broader than usual, and cut at the edges. It does not appear to have been perpetuated, but in some degree it anticipated some of the remarkable modern developments.

I am informed by Mr. James Martin, the accomplished propagator of Messrs. Sutton, that the recent remarkable development of the cyclamen began about 1860, and, at any rate in their hands, started with the old "crimson and white." It will be seen from the accompanying figures how little this differs from the wild type. Fig. 1 represents a flower of the latter from a plant imported by Messrs. Sutton from Syria after six years of cultivation. It is not appreciably altered. Fig. 2 represents a flower of their "crimson and white"; it only differs from the wild type in having shorter, broader, and less twisted corolla segments.

In considering the progress which has been made since 1860 under the skilful hands of Mr. Martin and others, it is important

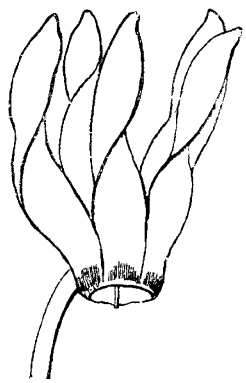

FIG. 1.

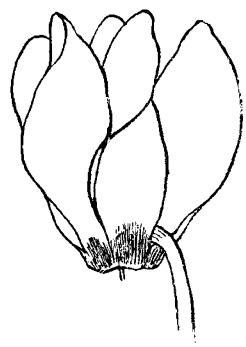

FIG. 2.

to bear in mind that there is no question of hybridity. *Cyclamen latifolium* has resisted every attempt to cross it with any other species. We are dealing then with the evolution under artificial conditions of a single species. Further, in the following statement, I have confined myself to the result of continued self-fertilisation, and have not thought it necessary to investigate the results of crossing races which have assumed characters more or less distinct.

Size.

Mr. Martin strongly insists on the principle laid down by Mr. Darwin from De Vilmorin, that "the first step is to get the plant to vary in any manner whatever" ("Animals and Plants under Domestication," vol. ii. p. 262). As Mr. Martin puts it, "the breeder must work with nature." It is his practice to seize the smallest deviation, even so small an indication as the slightest difference in a cotyledon of a germinating seed. The first direction of work would, however, for commercial purposes, be to develop the size of the corolla. Figs. 3 and 4 show two stages which have been reached by progressive selection from "crimson and white." Messrs. Sutton have sent me photographs of the largest flowers hitherto produced by them. Fig. 5 is copied from one of these. The vertical depth is 3 inches. This is more than double that of the form with which they started; the increase in breadth of the segments is at least six times. This represents the continuous work of forty years. As the work was not done for a scientific purpose, the whole of the progressive steps have not been preserved or recorded. Only saleable stages have survived. But Mr. Martin emphatically denies that they have been attained by other than progressive selection, or

[1] "The Cultural Evolution of *Cyclamen latifolium* (Sibth.)." By W. T. Thiselton Dyer, C.M.G., C.I.E., F.R.S. Received and read at the Royal Society, March 18.