at Copenhagen on September 20, the corrections to be applied to the ephemeris position were +1m. 18s. and −1′·3. Prof. H. Thiele also states that the comet was visible to the naked eye, and that the tail was 1°·5 long with a bend amounting to 13°, at 12′ from the head.

As pointed out in a letter received from Prof. Dale, the positions given by the Lick ephemeris gradually became worse until, on October 3, the error amounted to about 3°. Elements computed by Prof. Dale differ but little from those computed by Prof. Kobold, whilst an ephemeris with which he has favoured us gives the following positions for October 8 and 14 respectively:—R.A. 20h. 2·8m., dec. +61° 52′·4; R.A. 19h. 31·5m., dec. +51° 40′·8. For the Kiel ephemeris Prof. Dale's observations on October 3 indicated an error of −3·4m. and −18′, whilst later observations indicate that the departure from the ephemeris positions is steadily increasing.

COMET TEMPEL$_3$-SWIFT.—The comet Tempel$_3$-Swift, for which we gave a search-ephemeris in these columns last week, was re-discovered by M. Javelle at the Nice Observatory on September 29. The following was its position at 15h. 9·4m. (Nice M.T.) on that date:—

R.A. = 6h. 44m. 14·6s., dec. = +32° 37′ 55″.

Of the three ephemeris positions given for September 29, this agrees best with that calculated for the mean date (September 30·88) of the perihelion passage. When re-discovered, the magnitude of the comet was 14·0, and its distances from both earth and sun are increasing. Its present position is in the constellation Gemini, and it is apparently travelling, according to the ephemeris, towards Castor and Pollux.

BRIGHT BOLIDES.—A meteor, considerably brighter than Vega, was observed by Mr. W. Moss at Wimbledon Park, at 7h. 4m. p.m., on October 1. Its approximate path wa from 213°, +76½°, to 183½°, +78½°, its colour bluish-white, and its velocity medium. At its disappearance the meteor exploded, leaving a short trail. Mrs. E. Gifford, writing from Oaklands, Chard, says that at about 5.45 p.m. on October 1, while looking at the moon, which was to the south-west of her, she saw a shooting star of a brilliant blue-green colour to the east of the moon. It was still broad daylight, and the meteor gave the impression of an oblong patch of light followed by the usual streak.

THE SIXTH SATELLITE OF JUPITER.—Position measures of Jupiter's sixth satellite, made with the Yerkes 40-inch refractor during the period March 24 to May 3, are recorded in No. 4274 of the *Astronomische Nachrichten* (p. 17) by Prof. Barnard; the estimated magnitudes of the satellite were as follows:—March 24, 14·5; April 13, 14·0; April 19, 14·2; April 21, 14·5; and May 3, 14·0.

A faint nebula of the sixteenth magnitude was seen in the same field as the satellite on March 24, its position, for 1908·0, being α = 8h. 26m. 56·58s., δ = +19° 55′ 55″·4.

THE SOLAR ROTATION AS DETERMINED FROM THE MOTION OF DARK CALCIUM FLOCCULI.—In a brief note, appearing in No. 2, vol. xxviii., of the *Astrophysical Journal* (September, p. 117), Mr. Philip Fox gives a few preliminary results obtained by him in the determination of the solar rotation from measurements of the dark calcium flocculi. The evidence so far educed shows that these features are of the same order of height in the solar atmosphere as the hydrogen features, which show a constant period of rotation for all heliographic latitudes. Grouping the latitudes from 20°–25°, 25°–30°, and 30°–35°, Mr. Fox obtains mean diurnal motions of 14°·32, 14°·10, and 14°·14 respectively, thus indicating that the motion is independent of latitude; that is to say, from the results already obtained by Profs. Hale and Adams, these dark calcium flocculi belong to the higher levels of the solar atmosphere. Mr. Fox also confirms the previous observations that the dark flocculi are prominences seen in projection on the disc, but finds that they are not so easily seen as the corresponding dark hydrogen flocculi.

IRON AND STEEL INSTITUTE.

THE autumn meeting of the Iron and Steel Institute was held at Middlesbrough on September 28 to October 2 under the presidency of Sir Hugh Bell, and was largely attended. The institute was welcomed in an eloquent speech by the Mayor of Middlesbrough, and the president, after acknowledging the welcome, announced that Sir William T. Lewis, Bart., K.C.V.O., had been chosen to succeed him in the presidential chair in May, 1909. Sixteen papers were on the programme, and three mornings were devoted to their reading and discussion.

The first paper read was by Mr. J. E. Stead, F.R.S., who exhibited and described a simple form of inexpensive microscope suitable for the use of foundry foremen and of assistants in steel works.

The next paper read was that by Mr. W. Hawdon (Middlesbrough), on the iron and steel industries of the Cleveland district. He gave a brief review of the iron and steel industries of the Cleveland district during the last quarter-century, *i.e.* since 1883, on the occasion of the last visit of the institute to Middlesbrough, to the present time. The record showed that the iron and steel trade of the district had considerably increased and its position consolidated. The population of Middlesbrough had doubled, but the output of Cleveland ironstone remained about as it had been. In 1899 the first basic open-hearth steel was produced in the district, 10,154 tons being made in that year. The output has rapidly increased, and the question arises, if this increase of basic open-hearth steel continues, where is the ironstone to come from? The best ironstone is rapidly going; there is, however, a large area of stone, of a gradually diminishing richness, or rather of increasing poverty, available for many years to come. If, then, at the end of another quarter of a century the Iron and Steel Institute again visits the district, it may see, should the steel age still be vigorous, a greater output of basic steel and a larger production of pig-iron from native ironstone, which will be won, if not by manual labour, then by one of the many devices which are and will be available for the purpose.

Mr. T. C. Hutchinson (Saltburn) read a paper on the mechanical cleaning of iron ores, in which he considered the most economical method of treating any description of ore by careful selection, and the removal by mechanical means of as much of the impurities as can be easily distinguished by their appearance. He gave his experience in dealing with and smelting Cleveland ironstone when worked for a period of years from the same mine, and tabulated the yield of iron from the ore, and the consumption of fuel and flux required under various conditions due to the irregularity of impurities admixed with ore as delivered from the mines. Many years of careful observation have led him to the conclusion that, whether these impurities are charged into the furnace in larger or smaller percentages as compared with the main bed of ironstone, the coke and limestone requirements and the cost of smelting increase in exact ratio. It is cheaper to pick out impurities mechanically than to melt them out in the blast-furnace. Mechanical cleaning is desirable, and can be applied to all descriptions of ores used in the manufacture of pig iron.

The paper read by Mr. Greville Jones (Middlesbrough), on Messrs. Bell Brothers' blast furnaces, was of great historical interest and educational value. He gave full particulars and dimensioned drawings of the furnaces built by the firm from 1844 to 1908.

A paper by Prof. H. Bauerman (London), on metallurgy at the Franco-British Exhibition, was read by title only, as the author, being a member of the jury, considered that the paper should not be published until the official list of awards had been announced. In connection with this paper, a compilation of analyses of British pig-irons shown at the Exhibition was presented by Mr. Bennett H. Brough. In view of the paucity of published analyses, it forms a very useful work of reference, as the exhibits shown in the Collective Pig-Iron Stand have been carefully selected as typical for the various districts represented.

The paper read by Mr. C. H. Merz (London), on the

effect of power supply on the industries of the north-east coast, proved conclusively that manufacturers in that district are quick to avail themselves of new developments or of additional facilities. The generating plant now amounts to 56,000 electric horse-power, and power supply, though of comparatively recent development, has already had a marked effect upon the industries of the north-east coast. A great saving of coal and reduction of smoke have resulted; there is now, apart from the Power Company, practically speaking, no coal burned on the Tyne for power purposes except in chemical factories. The Tyne shipyards and engineering works may be said to have adopted electricity to the exclusion of all other forms of motive power. The application of electricity to all new uses has been facilitated. New industries have been established in the district purely because of the cheap power supply available, and a substantial commencement has been made in the utilisation of the waste heat and gases existing in the area; and in this regard the district occupies a unique position owing to the extent to which its future power requirements can be met by electricity produced as a by-product of two of its largest industries, the making of pig-iron and the making of coke.

Mr. C. Koettgen (London) and Mr. C. A. Ablett (London) read a paper on electrically driven rolling-mills, in which they gave figures showing the power required for rolling different sections, the figures being taken from among the results obtained from 150 rolling-mills. Such results should prove of considerable assistance in settling the correct size of the motor for a new mill for a given output of similar sections.

A paper read by Mr. S. Cowper-Coles (London) was of special interest. Hitherto it has been the universal custom to produce iron sheets, tubes, and wire by a process of smelting the iron, refining, cementation, annealing, rolling, or drawing. The author, however, describes an electrolytic process for making tubes, sheets, and wire in one or two operations from crude or scrap iron, or direct from the ore, without the processes of smelting, rolling, or drawing, at a cost that has hitherto been thought impossible. The process can also be used for the production of seamless cylindrical vessels. The process presents numerous advantages. Finished products can be produced at less cost than by the processes of smelting, refining, and rolling; a product is obtained which does not corrode so readily as steel at less cost; the process can be worked economically when no coal is available, but water-power only; iron ore that is useless for ordinary smelting operations can be advantageously utilised by the electrical process; the process is a power process, and utilises but little labour; small units can be worked economically; the process is more cleanly and healthy than the ordinary operations; and little or no scrap is formed.

Mr. E. H. Saniter (Rotherham) submitted a paper on a test for ascertaining the relative wearing properties of rail steel. The principle of the testing machine devised is that there is a round test-piece revolving a fixed number of revolutions and rotating by friction the inner ring of a ball-bearing loaded with a fixed weight, the action being similar to that of a wheel rolling on a rail.

The paper communicated by Mr. A. E. Pratt deals with the possibility of extending the utility of the modern metal-mixer by carrying out in it greater preliminary purification than is usually the case in present practice. The bearing of these suggestions on the development of the open-hearth process is also considered. Lastly, the thermo-chemistry of open-hearth ore reactions is discussed.

Prof. W. A. Bone (Leeds) and Dr. R. V. Wheeler (Manchester), who in 1907 read before the institute a very important paper on the use of steam in gas-producer practice, read a paper describing further experiments demonstrating that with still lower steam-saturation temperatures a most effective combination of high rate of gasification with thermal efficiency can be continuously maintained over long periods of time, under ordinary works conditions, furnishing a rich gas of high carbonic oxide content, and eminently adapted for either power or heating purposes.

The paper read by Prof. H. E. Armstrong, F.R.S., on the scientific control of fuel consumption, was a plea for the introduction of a new attitude towards problems of combustion and of fuel economy, an attitude of understanding based upon sympathetic and serious contemplation of the phenomena. In order that economies may be effected, it will be necessary to secure the services of a special class of chemists—of men gifted with real chemical feeling qualified to study the problems which the consumption of fuel affords. Such men must be properly paid, and in every way rank on an equality with members of the engineering staff. They should have enough knowledge of engineering to be in full sympathy with their engineering colleagues, who in turn should be sufficiently versed in chemistry to appreciate the chemists' behests.

The chemist was also championed in the paper on the chemical control of the basic open-hearth process contributed by Mr. Alfred Harrison (Warrington) and Dr. R. V. Wheeler (Normanton). Starting with the proposition that the basic open-hearth process is essentially a chemical problem, they indicated how far the chemist could control the process, and detailed a scheme for the complete following of the reactions taking place.

The paper presented by Prof. E. D. Campbell (Ann Arbor, Michigan), on the constitution of carbon steels, was of a most suggestive character. He reviewed the efforts that have been made to interpret the phenomena of the hardening and tempering of steel in the light of the phase rule. The analysis of the carbides obtained from martensite and from troostite in his laboratory appears to indicate marked dissociation, ionic as well as molecular, in the carbides from martensite, while the analysis of the carbides obtained from troostite would seem to indicate almost complete association and polymerisation of the dissolved carbides, since the nitro-derivatives of the troostitic carbides are as dark in colour as those obtained from equal amount of carbides derived from pearlite. These results would indicate the probability that when martensite is heated from 0° C. to 200° C. there is progressive association of ionically dissociated carbides, and polymerisation of the carbides of lower molecular weight into those of high molecular weight. This polymerisation of dissolved carbides is apparently complete by the time the metal has been converted into troostite. This conception of the changes which take place in the gradual conversion of martensite into troostite offers a simple and rational explanation of the progressive darkening of martensite with rising temperature from 0° C. to 200° C., and for the increase of what Heyn and Bauer term free carbon, but which is probably a condensation product of olefines of high molecular weight. It is suggested that there does not seem to be any inherent reason why the complete substitution of hydrogen by iron should prevent carbon atoms from assuming relations to each other similar to those which they hold in hydrocarbons. The conception of the carbon compounds of iron as metallic derivatives of hydrocarbons suggests a possible explanation of many unsolved problems in the metallurgy of steel, as, for instance, how other elements, too small in amount in themselves to affect profoundly the properties of the steel, may enter into the carbon compounds, and, by altering their constitution, bring about effects on the steel as a whole entirely out of proportion to the amount of the element present.

The paper communicated by Prof. H. C. H. Carpenter (Manchester University), on the freezing point of iron, showed that in the present state of pyrometric science the freezing point of iron is best defined either on the thermo-electric or the optical scale. The mean value calculated from several closely agreeing determinations made under entirely different experimental conditions by the thermo-electric method is 1505° C. on the thermoelectric scale. This corresponds to 1519° C. on the optical scale, which is probably the nearest approximation to the true value at present available. The optical determination of the freezing point by a surface-radiation method does not, in its present condition, yield more than an approximate value, which is slightly lower than that obtained by the thermoelectric method, viz. 1505° C. The freezing point is independent of the atmosphere in contact with the iron, whether this be oxygen, nitrogen, air, carbon monoxide, carbon dioxide, hydrogen, or mixtures of these.

Mr. A. Jouve (Paris) contributed a paper on the influence of silicon on the physical and chemical properties

of iron. In it he devoted special attention to the modification of the magnetic properties and of the chemical properties in relation to the resistance of iron to the action of chemical reagents. He gave examples showing that in cases where the silicon added to the iron attains a sufficiently high percentage the magnetic properties diminish, and the resistance to the action of acids increases with the proportion of silicon.

During the meeting visits were paid in the afternoons to the various iron works in the district and to the new graving-dock works on the river Tees. The social functions included a conversazione in the Town Hall, a ball given by the reception committee, a garden-party given by Lady Bell, a special performance at the Grand Opera House, luncheons in the Town Hall, and a luncheon given by the Tees Conservancy Commissioners at the Fifth Buoy Lighthouse.

FISHING AND SEA-FOOD SUPPLIES OF THE ANCIENT MAORI.

IN the second Bulletin of the Dominion Museum of New Zealand, the director, Mr. A. Hamilton, contributes an elaborate monograph on the fishing and sea-food supplies of the ancient Maori, based upon the investigation of numerous coastal kitchen-middens and camp sites. The importance of these sources of food supply is clearly illustrated by the Maori mythology, which abounds in tales of sea adventure and monsters of the deep. Among the mammalia, the only class affording food or valuable spoil, except the native rat and the imported dog, was the marine fauna, including the fur-seal, sea-leopard (*Ogmorhinus leptonyx*), and the sea-lion (*Macrorhinus leoninus*), of all of which traces are found in the middens in the form of bones and ornaments made from their teeth. One of the most valued prizes was the great sperm-whale (*Physeter macrocephalus*); but other members of the same group, such as the black-fish (*Globiocephalus melas*), were used for food. Of mollusca the consumption must have been enormous, one of the many middens consisting of shells of the Maori pipi (*Mesodesma novae-zealandiae*) being 340 feet long and more than 4 feet high. Many of these shells, particularly that of the beautiful Holiotus iris, were used in the preparation of ornaments. Among the crustaceans, the most valued were the red crayfish, crabs, and shrimps. Sea-urchins and many kinds of seaweed were collected from the rocks.

FIG. 1.—Large Wooden Hook for Shark.

The variety of fish-hooks in greenstone, bone, or steatite is astonishing. Some objects of similar form seem to have been used as amulets, over which charms were recited to bring luck to the owner when he went fishing. This explanation accounts for some curious conventionalised examples, the use of which is otherwise not apparent. Like these are the remarkable greenstone pendants in the shape of an eel, which seem to have been employed for a similar purpose. The luck of the fishing community was also embodied in certain stones. When one of these was stolen, so recently as 1894, the natives attributed an unsuccessful season to its loss.

In the sandhills many tools have been recovered which were used in preparing bone fish-hooks. The material was worked into shape by the use of a drill moved by the alternate pulling of strings attached to the top of the spindle, the end of the drill being armed with a point of flint or quartz. When the hook was roughly shaped it was finished with rude sandstone files. The smaller hooks are usually formed of a single piece of bone, only one remarkable specimen of a small composite hook having been recorded, though large examples are common. Sharks were captured in a net or with an immense wooden hook, young roots or branches being sometimes artificially bent while growing for this purpose. Still ruder are the double-pointed pieces of albatross bone, round which the bait being wrapped they were used as "gorges"—one of the most elementary of fishing implements, common in the European lake dwellings. When the explorer and whaler came upon the scene these bone and stone hooks were quickly replaced by those of iron or copper; but the ancient forms were reproduced in the new materials. A curious appendage to a fishing-rod is a carved figure to the lower part of which a number of valves of shell were attached. These rattle when a fish takes the bait and attract the attention of the fisherman. The net-sinkers form a large class. One specimen at Auckland, formerly described as a sea-god, seems to belong to this class, the sinker being worked into a semi-human shape and used to produce magical effects. The various kinds of modern fish-baskets and nets display considerable ingenuity and constructive skill.

FIG. 2.—Figure carved on a fishing-rod.

Among the inland fish the ancient Maori depended chiefly upon the eel, which more than any other kind of food provided the much desired fat. For its capture they constructed huge works, only excelled in magnitude by their fortifications, in the shape of canals and weirs. They were well acquainted with the art of drying superfluous fish in huge earth ovens erected on the beach, and heated with a special kind of wood. When sufficiently cooked, the fish were taken out, as far as possible unbroken, placed on raised stages to dry, and finally packed in large flax baskets for winter use.

Mr. Hamilton's monograph, which is well illustrated throughout, is an interesting contribution to the study of the commissariat and industries of primitive man.

CHEMICAL DATA FOR THE GEOLOGIST.[1]

GEOLOGY, as has sometimes been said, is less a distinct science than the meeting-ground of all the sciences as applied to a distinct object, viz. as elucidating the history of the earth and its inhabitants. The working geologist therefore feels, more than most of his brethren, the necessity of gaining some acquaintance with numerous branches of knowledge in which he cannot pretend to be a specialist. In particular, the problems of physical geology and petrology are closely bound up with the modern developments of inorganic chemistry, and require not only a familiarity with general principles, but a knowledge of specific results, scattered through the pages of many journals and transactions of societies.

It is with results, rather than with principles, that the work before us is concerned; and the author has gathered into one volume a large body of information which is not to be found elsewhere in collected form. The work is necessarily that of a chemist rather than a geologist, but

1 "The Data of Geochemistry." By Frank Wigglesworth Clarke. Bull. No. 330 United States Geological Survey. Pp. 716. (Washington, 1908.)