GEOGRAPHICAL NOTES.

As the result of recent explorations by Lieutenant Fromm in the southern part of German East Africa, it appears probable that the difficulties which beset navigation on the Rufiji and Rovuma rivers are not so serious as has hitherto been supposed. The resources of the country traversed by these rivers are reported to consist mainly of india-rubber in the forests. An examination of a coalfield reported by Arabs as existing on a tributary of the Rovuma showed that the valuable coal-seams were practically confined to the Portuguese side of the frontier.

IN a recent number of *Petermann's Mitteilungen*, Dr. Karl Grissinger publishes an interesting investigation of the physical conditions of the Weissensee in Carinthia. The paper is accompanied by a bathymetric chart, which shows that the lake belongs to the same class as the long, narrow, deep lakes of Scotland, and by a remarkable diagram of temperature changes. The latter is constructed so as to show the diurnal change of temperature at all depths from hour to hour for four consecutive days, and is in a high degree interesting and instructive. Diurnal change of temperature becomes imperceptible at a depth of 37 metres, and the hour of maximum temperature is retarded as the depth increases. Thus the surface maximum occurs about noon, while that at a depth of 25 metres is not attained until 8 a.m. of the following day.

A RECENT official estimate of the coast line of the United States, including islands, indentations, and estuaries, gave as the total 90,900 miles. Of this the Atlantic Ocean accounted for 36,500 miles, the Gulf of Mexico for 19,100, the Pacific Ocean for 8900, and Alaska for 26,400. Considering only the general coast lines, neglecting estuaries, bays, and islands, the Atlantic margin measured 2000 miles, the Gulf of Mexico and Pacific Ocean 1800 each, and Alaska 4800, a total of 10,400 miles.

M. J. GAULTIER has elaborated a system of photographic surveying, which is attracting considerable attention in France in view of the approaching revision of the cadastral survey of that country. By means of a specially mounted camera, a series of twelve views are taken from one point, so as to comprise the entire horizon. A set of signals, the position of which is carefully arranged, enable the various plates to be afterwards fitted together. The map is subsequently traced out on waxed linen by a sharp point, a faintly printed copy of the photograph serving as a basis.

THE uncertainty of communication with the Upper Nile valley makes it difficult to determine the precise weight to give to reports of events happening there. But it appears highly probable that an expedition from the Congo Free State has at last succeeded in establishing a station at Wadelai, or some other point within the British sphere of influence. The natural outlet of the region is of course down the Nile, and it is scarcely in accordance with the principles of geography that a prosperous development can ensue with so difficult an outlet as that to the Congo. The practical aspects of the case are in their present stage more political than physical, and in this stage they are likely to remain for some time.

ON Tuesday the *Times* printed the following telegram, dated September 26, from its Calcutta correspondent :—Mr. Conway's mountaineering party, which left Askoley on July 31, reached the foot of the Baltoro Glacier after four days' march, and proceeded up the glacier for four days. They then climbed a peak north of it 20,000 feet high, which they named Crystal Peak, and hoped to get a view of the great peak "K^2," but it was hidden by a neighbouring peak. They then went another day's march up the glacier and climbed a pass to the east of Crystal Peak 18,000 feet high. From this they saw "K^2," but discovered that the map was altogether wrong in the representation of the neighbourhood of that peak. They also found the Baltoro Glacier considerably longer than the map makes it. A high peak not marked on the map stands at the very head of the glacier. This Mr. Conway named the Golden Throne. They determined to try the ascent, and went one march further up the glacier and then were stopped by a snowstorm, during which they sent the coolies down to collect firewood. They reached the foot of the Golden Throne on August 18, and then worked up behind the peak, climbing over 2000 feet through a very broken icefall. It took four days to establish and victual a camp above the ice-fall, at a height of 18,000 feet. They moved next day to a camp 19,000 feet, and the day following to one about 20,000 feet high. Thence, on the 25th, they started for a real climb, and having reached a point over 23,000 feet high, they found they were on a mountain entirely cut off from the Golden Throne, which was still 2000 feet above them. The peak they ascended—which they named the Pioneer Peak—commanded a magnificent view, especially in the Hunza direction, where they could see to the distance of at least 200 miles. They suffered from the great altitude, but not severely, and they could have climbed at least a thousand feet higher, and perhaps more. They slept that night in their camp 20,000 feet above sea-level. They were obliged to descend next day as their provisions were exhausted. Bad weather commenced on the 27th, and continued, putting an end to climbing for the present season. Mr. Conway has gone to Leh, for the purpose of comparing his barometer with the standard there, and accurately reckoning the height of the Pioneer Peak. He expects that the comparison will show that they attained a height at least a thousand feet above Schlagintweit's 22,230 feet in Nepaul, which is the highest climb hitherto authentically recorded. He will then return to India.

THE IRON AND STEEL INSTITUTE.

THE autumn meeting of the Iron and Steel Institute was held last week in Liverpool, under the presidency of Sir Frederick Abel. The meeting was fairly successful on the whole, although the weather marred some of the excursions, and the last day's sitting was simply wasted time. The following is a list of the papers read :—"On the Manufacture of Iron in its Relations with Agriculture," by Sir Lowthian Bell ; "On an Apparatus for Autographically Recording the Temperature of Furnaces," by Prof. W. C. Roberts-Austen ; "On the Alloys of Iron and Chromium," by R. A. Hadfield (Sheffield) ; "On the Liverpool Overhead Railway," by J. H. Greathead ; "On the Engineering Laboratories in Liverpool," by Prof. H. S. Hele-Shaw ; "On the Failures in the Necks of Chilled Rolls," by Charles A. Winder (Sheffield) ; "On a New Process for the Elimination of Sulphur," by E. Saniter (Wigan) ; "On the Elimination of Sulphur from Iron," by J. E. Stead (Middlesborough). A paper on the basic Siemens process, by Mr. Kupelwieser, of Witkowitz, was also on the list, but was adjourned until the Spring Meeting of next year.

Upon the members assembling in St. George's Hall, on Tuesday, September 20, they were welcomed by the Mayor of Liverpool, and the reception formalities being disposed of, Sir Frederick Abel gave a short address, in the course of which he commented on the papers about to be read, and also stated that Mr. E. Windsor Richards, of Low Moor, had been elected by the Council to be President of the Institute, in succession to himself, during the coming two years during which the presidential term lasts.

The first paper on the list was Sir Lowthian Bell's contribution, which he read from MS., the paper not having been prepared in time to be printed. Those who are accustomed to attending meetings of this kind know how difficult it is to follow the reading of a paper even when they have the help of a printed copy, but when one has to depend upon one's hearing only, in a large room and amidst many disturbances, the task is hopeless. So far as we could gather, the author treated his subject *ab ovo*, and much of the first part of the paper might be found in various elementary text-books. The main point of interest was a description of an apparatus which has been devised for arresting and securing certain products which are to be extracted from the fumes of blast furnaces using raw coal. The chief of these by-products is sulphate of ammonia, and the author pointed out how necessary it was to the harmonic working of an economic system that this sulphate of ammonia should be collected and returned to the earth as a fertilizer. Of course, there is no gainsaying this part of the argument, and, as it is perfectly possible to collect the fumes and products of combustion, the question resolves itself into one of profit and loss. Sir Lowthian quoted figures which would, in these lean times, make the ironmaker's mouth water, and almost convert the iron itself into a by-product, but unfortunately, as it appeared afterwards during the discussion, the selling prices which the author had taken were by no means those of the present day. Mr. Snelus spoke of the remarkable fertilizing properties of sulphate of ammonia and nitrate of soda. He had spread one half of a newly-sown lawn with a mixture consisting of one part of sulphate of ammonia to three parts of nitrate of soda—four cwt. to the acre—and had grass an inch long, whilst the unspread part was quite bare.

The next paper taken was that of Prof. Roberts Austen, in which was described a modification of the Le Chatelier pyrometer, which has been introduced for the purpose of securing autographic records of temperature. The apparatus was exhibited at the council table, and has been constructed under the directions of the author for Mr. E. P. Martin, of Dowlais, in order that a continuous record might be kept of the temperature of the stoves in which the blast is heated for the iron smelting furnaces. It will, of course, be understood that the apparatus is suitable for recording temperatures under other conditions, and it can hardly fail to afford valuable assistance to those engaged in many branches of manufacturing industry, and in the scientific investigating of processes; in fact, in many branches of metallurgical inquiry, and also in the study of steam engine economy, there has been no want more widely felt in times past than that of a trustworthy means of ascertaining high temperatures. The author had previously described an apparatus he had before devised, and that shown was the result of a desire to simplify the design. The original apparatus consisted of a camera containing a reflecting galvanometer of the Depretz and D'Arsonval type of about 200 ohms resistance. A thermo-junction is connected with this galvanometer, and the amplitude of the deflection of a spot of light from the mirror affords the basis in calculating the temperature to which the thermo-junction has been raised. An autographic record of the temperature may then be readily obtained if the spot of light from the mirror falls into a sensitized photographic plate actuated by an astronomical clock, or by other suitable mechanism. Such an appliance as this, though well adapted for conducting investigations, is not sufficiently simple for industrial purposes, and the author determined that it was necessary to simplify the part which receives and records the spot of light; and also to arrange for attaching several thermo-junctions, so that there would be one for each furnace, and each might be brought in connection with the recording apparatus in turn. In order to effect these changes the original moving plate was replaced by a clockwork-revolved cylinder, to which was attached sensitized paper. In the apparatus shown provision was made for placing any one of six centres of heat, such as hot-blast stoves or furnaces, in connection with the galvanometer, and for obtaining within the period of the revolution of the cylinder a record of the temperature of any one, or of all the six sources of heat. The records will, of course, be intermittent, the duration of the test in any particular case being subject to the will of the operator; or the shifting of the electrical contact from furnace to furnace could be carried on by clockwork. The apparatus would then be entirely independent of manual adjustment.

In the discussion which followed the reading of the paper the most important point was that raised by Dr. W. Anderson, the Director-General of Ordnance Factories, who asked what was the durability of the thermo-couple, and whether the intensity of the current would alter owing to changes in the metals after exposure to high temperature. It will be remembered that the metals used are platinum and rhodium. Mr. T. Parker also asked if the couple was protected. Sir Lowthian Bell, who has had considerable experience with the Le Chatelier pyrometer in practical use at the Clarence Iron Works, said that in regard to durability and constancy of record, the device was most successful. He had only had to renew three or four couples, and they certainly would give accurate readings for the space of several weeks. He had proved this by comparing new and old couples, and also by testing at known temperatures. The author subsequently stated that the couples were put naked in the blast, and did not require protection unless subject to the impact of a shower of metal, in which case they were placed in a porcelain sheath.

Mr. Greathead next read his paper on the Liverpool Overhead Railway. This is a new railway which follows the "Line of Docks," and extends for a distance of about six miles. It is composed, for the whole distance, with the exception of a length of a few hundred feet, of an iron viaduct of uniform height, and which is continuous from end to end; unless some of the swing bridges on its course be open. The railway itself has been previously described, but the rolling stock has not, we believe, before been dealt with. Electricity will supply the motive power, there being a generating station situated about the middle of the line, where there will be four engines working up to 400 horse-power, each driving a separate Elwell Parker dynamo. The current will be carried along the line by a steel conductor placed on porcelain insulators. Hinged collectors of cast iron, sliding upon this conductor, will make the connection between the motors on the train and the generating dynamos. There will be no separate locomotives, the motors being on the cars, two cars forming a train to seat fifty-six passengers, the total weight being about forty tons. The signals will be worked by the trains themselves through an automatic device. The total cost of the railway is to be £85,000 per mile.

The second day, Wednesday, September 21, was opened by the reading of Mr. Hadfield's paper. This is a production of the kind that brings despair to the heart of those who prepare brief notices of these meetings. It consists, with the appendices, of over eighty-three pages, besides numerous sheets of tables, diagrams, &c. It begins with Vauquelin, and ends with a bibliography—*ab ovo usque ad mala*, as the author himself says; but the difficult part of the matter is that throughout the whole treatise there is not a part that could well be left out without disadvantage to the reader. Having said so much it will be evident that we can give but a very faint indication of the contents of Mr. Hadfield's paper. It is well known that he has made a special study of the alloys of iron and chromium, generally known as chrome-steel, and his success as a practical steel maker has been most marked. He has now put the results of long research and experiment at the disposal of all steel makers, and we cannot do better than refer those interested in the subject to the original work, which will duly appear in the volume of the proceedings of the Institute. It is noteworthy that chromium appears not to be in itself a hardener of steel, but that it acts indirectly by influencing the action of carbon upon the iron. Some of the photographic reproductions of chromium steel projectiles attached to the paper are very interesting, as showing what punishment this metal will stand. The shells go through nine inches of compound armour and eight feet of oak backing without apparent damage, the points being as sharply defined as in the shell as it comes from the shops. At a range of eighty yards two six-inch shells went through the thickness of armour mentioned, the striking velocity being 1825 feet per second, and the energy 2250 foot tons. One projectile altered ·01″ in diameter and the second ·013.″ One of these projectiles was fired through another 9″ plate without apparent damage. A 13·5″ projectile, also of Hadfield's make, was fired at a target consisting of two armour plates with 20″ of oak between. The first plate consisted of 18″ of compound armour backed by 6″ of wrought iron. Next came the 20″ of oak, and then a 10½-wrought iron, and finally a 2″ wrought-iron plate. This gave a total of 36½″ of steel and iron, besides the oak. The penetration was complete, but the illustration shows the projectile to have been broken into three parts. The striking velocity was 1950 feet per second, and the energy on impact 34,280 foot tons. The weapon was a 63-ton B.L. gun.

In the discussion which followed this paper—which the author read in abstract, having previously distributed printed copies—Prof. Roberts-Austen pointed out that the author's researches supported the views taken by himself and Osmond as to the dual form in which iron exists. This was shown by the diagrams showing the rate of cooling which accompanied the report. In these, when the cooling was from a high temperature, 1320° C., the curve was continuous throughout, but when the cooling was from about a thousand degrees, there was a point of recovery indicating recalescence. The diagrams formed part of a report by Mr. Osmond on Hadfield's chromium steel, which the author had incorporated in his paper. Prof. Roberts-Austen said he had arrived at the same results working independently. Another point worth recording is that remarked upon by Mr. Vickers, who dwelt upon the difficulty of deciding whether the effects noted in the steel were due to carbon or chromium, as it seemed impossible to separate the one from the other, the chromium invariably disappearing with the carbon. Mr. Vickers also started the old question of hardening by oil or water, a process which he advocates. Dr. Anderson put the matter in its true light by pointing out the danger from untrustworthiness due to the hardening process, defects being sometimes set up of which there was no outward indication. This, of course, refers to metal in large masses, such as gun-hoops, &c. Mr. F. W. Webb, the Mechanical Engineer to the London and North-Western Railway, gave high praise to chromium steel, saying he used it entirely for springs and also with advantage for tyres. He likewise found it an excellent material for tool steel.

Mr. Winder next read his paper on the failure of chilled rolls. The breakage of rolls is one of the most annoying of the many troubles with which the producer of manufactured iron has to contend. This is a matter which has hitherto received too little attention, it being generally considered to be in the nature of rolls to break, and nothing man could do would prevent it. It is as evident as like produces like, that if some rolls will last for considerable periods of time, others of exactly similar description, and working under the same conditions, would stand equally long. Sometimes four or five rolls—the author instances eleven in a fortnight—will give out one after another, until at last one will be found to accomplish the work. Mr. Winder, as a roll founder, endeavours to bring some sort of order into the process of manufacture. He points out that when a train of rolls is hard at work in the present day they will turn out as much as 1000 tons a week, and the passing of this great weight of red- and white-hot billets or blooms will be almost equal to putting the rolls into a furnace. The necks of the rolls are, however, kept cool by water, so that the lubricant may not be burnt off, and the sudden cooling thus caused produces a molecular change in the metal which, the author considers, accounts for much of the mischief. In order to overcome this difficulty it is recommended that there should not be too sudden a reduction of the diameter of the body of the roll where the neck is formed. That, in brief, appears to be the author's opinion, and doubtless his advice is good; in fact, it follows one of the cardinal laws observed by good iron-founders in the casting of other articles besides rolls. A good practical discussion followed the reading of the paper. We think that foundry practice is a little behind in this country, and in this respect we might, with advantage, take a hint or two from American methods, perhaps more especially in regard to smaller castings than chilled rolls, which often fail unaccountably in the United States also. The advice to roll founders to cast with a bigger head should not be, but apparently is, necessary. Prof. Turner's remarks were to the point, and it would be of advantage if he would make his researches in this direction more fully public.

Prof. H. S. Hele-Shaw was the author of the last paper read on the Wednesday of the meeting. The Walker Laboratories form part of University College, Liverpool, and are among the most recent and best arranged establishments of the kind. They have been erected under the guidance of the author of the paper, who occupied the chair of Engineering Science when the school was in a far less magnificent form. We have not space to follow the author in his description of the buildings, or the method of instruction. The latter appears to be framed in a manner calculated to turn out good engineers, a class which cannot be too large for the welfare of the country, although complaints are growing daily that they are already too numerous for their own advantage.

The last day of the meeting was Thursday, September 22, when two papers were read. The first was the contribution of Mr. Saniter, and in it he described the process by which he proposes to remove sulphur from iron by calcium chloride and lime. The experiments quoted go to prove that lime alone removes a considerable quantity of sulphur from iron if the contact is sufficiently prolonged; and, further, that a mixture of calcium chloride and lime completely eliminated the sulphur in the space of half-an-hour. Chloride of calcium is a by-product of the manufacture of ammonia, of soda (by the ammonia process), and of Weldon's bleaching process. The author states that the production amounts to many thousands of tons, of which only ten per cent. finds useful employment, the remainder running to waste. The subject is one of considerable importance, and no doubt the process will be freely criticized when it comes up again for discussion at the next spring meeting.

Mr. J. E. Stead's paper on the same subject—the elimination of sulphur from iron—was a much more imposing contribution, covering 40 pages of the proceedings. It dealt broadly with the whole question, and forms a most valuable contribution to the literature of the subject. At the conclusion of the reading of his paper Mr. Stead said that since it had been written he had had further light thrown on the matter by experiment and otherwise. He therefore proceeded to read from a MS. certain fresh matter, which appeared to occupy as much space as the paper itself. No doubt Mr. Stead will weld the original paper and the additions into one harmonious whole, which will then form a standard work of reference on a subject which has come to the fore so much within the last year or two. We congratulate Mr. Stead upon his courage in dealing with this matter in the way he has, and especially upon the practical disclaimer of infallibility which the appendix to his paper supplied.

There was no discussion of these papers, their consideration being adjourned until the spring meeting of next year. The matter should be well thrashed out, as speakers will have had an opportunity of consulting authorities, marshalling facts, or even making fresh experiments. It is to be hoped that in the future more discussions will be arranged on similar lines.

The proceedings closed with the usual votes of thanks to those in Liverpool to whom the Institute was so largely indebted for the success of the meeting.

There were several excursions during the week. The chief of these were to the Manchester Ship Canal, the Vyrnwy Water Works, the Lancashire and Yorkshire engineering shops at Horwich, the Liverpool Overhead Railway, and Laird's shipyard. A visit was also paid to the Walker engineering laboratories, where Prof. Hele-Shaw had collected some very interesting models for the occasion. The most striking of these was an exceedingly intelligent chain-making machine which has recently come over to this country from the United States. The whole of the operations are automatic, reels of wire going in at one end of the apparatus, and coming out one continuous length of chain at the other, and this without human intervention of any kind. The machine may, in the ingenuity of its design, rank with Laycock's horsehair loom, which we described in connection with the visit of the Institution of Mechanical Engineers to Sheffield of two years ago. It is really surprising to see what complicated operations mechanism may be made to perform by means of cams, levers, and springs. Mr. Laycock's loom exhibited perhaps a higher intelligence than the chain-making machine, inasmuch that it would select suitable hairs from a bundle, and would refuse to continue the work unless the proper kind were supplied. The chain-making machine, on the other hand, has to deal with a more stubborn material and has to connect each link. We do not know the name of the inventor of this machine, but the chain is known as "Triumph Chain."

FUELS AND THEIR USE.

AT the annual meeting of the Society of Chemical Industry, held in London on July 20, the chair was occupied by Dr. J. Emerson Reynolds, F.R.S. He chose, as the subject of his presidential address, "The modern developments in regard to fuels and their use"—a subject, as he explained, which had occupied much of his attention. The address was one of popular, as well as of scientific, interest.

After some preliminary remarks, Dr. Reynolds said:—

The fuel question is one which concerns those of us who live on the western side of St. George's Channel even more seriously than it does you, as our coal beds have been washed away in ages past, and of native fuel there is practically none save peat; hence industries which require large quantities of cheap coal cannot flourish in Ireland under existing conditions. It is, therefore, our interest to watch closely the development of improved and economical methods of using such fuel as we can obtain from other countries, and apply them in the utilization of our bulky but abundant peat. It is evident that no other fuels need be considered save coal, peat, and petroleum; hence, my remarks can take somewhat the form of a trilogy, minus the dramatic element, precedence being given to the solid fuels, and the first place necessarily to coal. . . .

The Royal Commission on Coal Supply, which commenced its sittings in July, 1866, and reported in July, 1871, after inquiring into all probable sources of coal in Great Britain, arrived at the conclusion that not more than 146,480 million tons were available at depths not exceeding 4000 feet from the surface. Therefore, at our present rate of increase of population and of coal consumption, our supply would not last for 230 years. But Mr. Hall, one of Her Majesty's Inspectors of Mines, who has special experience of coal mining, forms a much lower estimate of the supply practically available with our present means, and considers 170 years as the more probable duration of our coal beds. This estimate is based on fuller information than that possessed by the Royal Commissioners; we are therefore justified in concluding that the inhabitants of Great Britain 170 years hence will have little, if any, home-raised coal to burn if we continue to use it in our present wasteful fashion.