THURSDAY, DECEMBER 22, 1881

ARCTIC SUCCESS AND DISASTER

THIS has been a stirring Arctic week. First we have the publication of one of the most remarkable narratives of one of the most successful Arctic voyages ever made, to which we refer in detail on another page. On Tuesday an influential deputation waited on the Earl of Northbrook, to urge upon Government the necessity of sending out an expedition to succour Mr. Leigh Smith in the *Eira*. And, also, on the same day, the wires which about two years ago transmitted the welcome news of the safety of Nordenskjöld's expedition in the *Vega*, and the successful navigation of the North-east Passage, bore to Europe the sad news of disaster to the *Jeannette*. Sad though the news be, it is not nearly so bad as was to be feared, for we doubt if many besides Mr. Gordon Bennett had any faith in the survival of the expedition, and the search parties that were to be sent out next spring were generally looked on as forlorn hopes. From the news which has been transmitted from Yakutsk to St. Petersburg, and thence to London and Paris, it is not quite easy to make out the details. The following extract is from the telegram of the St. Petersburg *New York Herald* correspondent to the Paris office of that paper; he quotes from a telegram to General Ignatieff, dated Irkutsk, December 19:—

"The Governor of Jakutsk writes that on September 14 three natives of Hagau Oulouss de Zigane, at Cape Barhay, 140 versts north of Cape Bikoff, discovered a large boat, with eleven survivors from the shipwrecked steamer *Jeannette*, who had suffered greatly. The adjunct of the chief of the district was immediately charged to proceed with a doctor and medicines to succour the survivors at Jakutsk and to search for the rest of the shipwrecked crew. Five hundred roubles have been assigned to meet the most urgent expenses. The engineer, Melville, has sent three identical telegrams, one addressed to the London office of the *Herald*, one to the Secretary of the Navy at Washington, the third to the Minister of the United States at St. Petersburg. The poor fellows have lost everything. Engineer Melville says that the *Jeannette* was caught and crushed by the ice on June 23, in latitude 77 and 157 east longitude. The survivors of the *Jeannette* left in three boats fifty miles from the mouth of the Lena. They lost sight of each other during a violent gale and dense fog. Boat No. 3, under command of Melville, having reached the eastern mouth of the Lena on September 29, was stopped by icebergs near to the hamlet of Idolaciro Idolatre on October 29. There also arrived at Bolonenga boat No. 1, with the sailors Hindmann and Hoross, with the information that Lieut. de Long, Dr. Ambler, and a dozen other survivors had landed at the northern mouth of the Lena, where they are at present in a most distressing state, many having limbs frozen. An expedition was immediately sent from Bolonenga to make diligent search for the unfortunates in danger of death."

From this and from the Reuter's telegram it would seem that Boat No. 1 has not yet turned up. The spot where the disaster overtook the *Jeannette* is a short distance east of the most easterly of the New Siberian Islands. The exact spots where the boats landed are not quite clear, and probably there has been some misspelling of names; but it is evident that it is somewhere on the complicated delta of the Lena. It will be remembered that the *Jeannette*, the old *Pandora*, was sent out two and a half years ago by Mr. Gordon Bennett, for Arctic exploration by the Behring Straits route. It now appears that Mr. Bennett's instructions were that the ship should keep by the east side of Siberia, and embrace the first favourable opportunity of making for the Pole. These instructions her Commander, Capt. De Long, had evidently been doing his best to carry out. She was last seen in September, 1879, when she was steering north-east from Wrangel Land. Probably she has run round the north side of the Island, and attempting the north-west route been caught in the drift like the *Tegetthoff*, and finally crushed. The sufferings of the unfortunate explorers must excite universal pity, though all will rejoice that it has not come to the worst with them. The route they took was a perfectly new one, and it is possible they may have something new and important to tell us. The expedition was in some respects of the old-fashioned kind, rushing blindly into regions about which absolutely nothing was known; but this is how all knowledge has been purchased. Still, had something of the scientific method of Baron Nordenskjöld been adopted, the result might have been different. Further news of the shattered but so far saved expedition will be anxiously looked for; they will have an exciting and terrible story to tell, but we trust that their sufferings will prove not barren of results to science. If they have established the existence of a line of islands to the north of the New Siberian Islands, one more of the Arctic problems will have been solved.

In view of this disaster, no doubt it will be a relief to many to learn that Lord Northbrook's reply to the deputation from the Geographical Society was quite favourable and that probably a relief expedition will be sent out for the *Eira*. At the same time we believe a Government expedition, however much Mr. Leigh Smith deserves, such attention, was not necessary; and we doubt much if Mr. Leigh Smith's relatives were not rather surprised when it was suggested to them that they should petition for Government assistance. Now that the search expedition is virtually decided on we wish it every success, at the same time hoping that it will be strictly confined to its ostensible purpose. To Government Arctic explorations we are certainly favourable; but we trust that the next expedition sent out will be constituted and organized on as thorough a scientific method as that in the *Vega*; and that, as in the *Vega*, there will not only be a special scientific staff, but that the real commander of the expedition, subject to contingencies of navigation, will be a man with the scientific training and methods of Baron Nordenskjöld. In short, let the staff consist of men trained in the various departments of science, and not primed in haste for the occasion.

The unfortunate disaster to the *Jeannette* will no more check Arctic exploration than many another greater disaster that has marked the progress of knowledge; it can only be hoped, while expressing our genuine sympathy with the sufferers, that Arctic explorers will learn from it all the lessons it ought to teach.

CHARLES LYELL[1]

Life, Letters, and Journals of Sir Charles Lyell, Bart., Author of the Principles of Geology, &c. Edited by his Sister-in-law, Mrs. Lyell. In two volumes. With Portraits. (London: John Murray, Albemarle Street, 1881.)

II.

IN our previous notice of this work we have dwelt at some length upon the insight which it affords us concerning the origin and history of the book, which constitutes Lyell's chief title to fame. But the fact must not be lost sight of that, besides writing the "Principles of Geology," Lyell gave to the world a number of other books and original memoirs of the highest scientific value, though their fame has been overshadowed, to some extent, by that of his great work. The "Principles of Geology" was not, as some would have us suppose, a mere compilation from the works of other authors, for in every page of it we find embodied the results arrived at by the author after careful personal observation and close reasoning. Lyell, in a letter addressed to Edward Forbes, in 1846, very properly protests against the idea that original observations and theories are only to be published in journals of science and the proceedings of learned societies. He says:—

"On the Continent I gain no priority for any original views or facts which have only appeared in my 'Principles' and 'Elements.' When the Geological Society of France voted a sum of money to Archaic to draw up a report on the progress of geology for ten years (1835 to 1845, I believe), he wrote to me to say that all treatises on geology were left out of such reports, as they were presumed to be compilations, authors taking care to take date for their discoveries in scientific journals, but as my book was an exception to such rules, he wished me to send him an exact list of all my original theories and facts, and their dates, which, owing to their numerous editions, no one could make out, and which he must neglect without such aid" (vol. ii. p. 107).

Among the new observations and generalisations to which Lyell may justly lay claim, we will here allude to one only. Before the appearance of the "Principles of Geology" no serious attempt had been made to bring into correlation those important deposits which overlie the chalk, which the labours of the Italian and French naturalists had invested with so much interest. William Smith's classification of strata, which had met with very general acceptance, both in England and on the Continent, dealt with the formation from the Carboniferous to the Cretaceous inclusive. But above and below those limits the greatest confusion and doubt existed in connection with all questions of geological classification.

What Sedgwick, Murchison, and Lonsdale did for the pre-Carboniferous rocks, Lyell accomplished single-handed for the post-Cretaceous; and his classification, though the advance of knowledge has necessitated modifications in it, is at the present day universally accepted so far as its main features are concerned. The amount of work undertaken by Lyell in collecting the facts upon which this Tertiary Classification is based was enormous, and is well set forth in the volumes before us (vol. i. pp. 182-319).

Besides the "Principles of Geology" and the expansions of the last part of that work, published under the successive titles of "The Elements of Geology," "A Manual of Geology," and "The Student's Elements of Geology," Lyell wrote four volumes of "Travels in North America," teeming with original facts and observations, and his "Antiquity of Man," or as the *Saturday Review* called it, "Lyell's Trilogy on the Antiquity of Man, Ice, and Darwin." And in addition to these separate works nearly seventy original memoirs contributed to scientific journals are recorded in the list at the end of the work lying before us, besides reviews, lectures, and addresses.

In obtaining the materials for these multitudinous publications Lyell was a most indefatigable worker. Every year he spent a number of months in travelling over parts of Europe or his own country, examining for himself the districts of which he had to treat in his works. It was very characteristic of Lyell that, though willing to learn from the youngest of his contemporaries, he never took anything on trust where personal examination was possible; and it was rarely indeed that his acute powers of observation and logical mind failed to extend, improve and correct the results attained by previous workers in the same field. He visited North America four times, spending thirteen months on his first tour, and nine months on his second, and subsequently resided for some months at Madeira.

But it is not only on account of the record which they contain of Lyell's own work, that the volumes before us are of such great value. Lyell was an active participator in all the scientific movements of his day, and his account of the meetings of the Geological Society, with its stormy debates, of the Geological Club and its convivial gatherings, of the Royal Society and the British Association, are full of the most lively and interesting details. Concerning a debate at the Geological Society in 1829 he writes to Mantell:—

"The last discharge of Conybeare's artillery, served by the great Oxford engineer against the Fluvialists, as they are pleased to term us, drew upon them on Friday a sharp volley of musketry from all sides, and such a broadside at the *finale* from Sedgwick, as was enough to sink the 'Reliquiæ Diluvianæ' for ever, and make the second volume shy of venturing out to sea. After the memoir on the importance of all rivers which feed the 'main river of an isle,' and the sluggishness of Father Thames himself 'scarce able to move a pin's head,' a notice of Cully, land-surveyor, was read on the prodigious force of a Cheviot stream, 'the College,' which has swept away a bridge and annually buries large tracts under gravel. Buckland then jumped up, like a counsel, said Fitton to me, *who had come down special*."

"After his reiteration of Conybeare's arguments, Fitton made a somewhat laboured speech. I followed, and then Sedgwick, who decided on four or *more* deluges, and said the simultaneousness was disproved for ever, &c., and declared that on the nature of such floods we should at present 'doubt and not dogmatise.' A good meeting" (vol. i. p. 253).

Here is his account of the anniversary meeting of the Geological Society in the same year:—

"Sedgwick quite astonished them, it seems, in the chair at the general meeting, which was very full. Among innumerable good hits, when proposing the toast of the Astronomical Society, and Herschel, their president, he said, alluding to H.'s intended marriage (for he is just about to marry the daughter of a Scotch clergyman),

[1] Continued from p. 148.

'May the house of Herschel be perpetuated and, like the Cassinis, be illustrious astronomers for three generations. May all the constellations wait upon him! may Virgo go before, and Gemini follow after!' Poor H., notwithstanding his confusion, got up after a roar of laughter had continued for three minutes, and made a famous speech" (vol. i. 251).

In the whole of these letters of Lyell there is a striking absence of anything like jealousy or ill-nature in his remarks. His judgment concerning his contemporaries, whom he had the greatest facilities for knowing, appears to be remarkably just and such as will, we believe, be endorsed by posterity. Take for example what he says concerning the great rivals Murchison and Sedgwick:—

Murchison "has a little too much of what Mathews used to ridicule in his slang as 'the keep-moving, go-if-it-kill-you' system, and I had to fight sometimes for the sake of geology, as his wife had for her strength, to make him proceed with somewhat less precipitation" (vol. i. p. 107).

"Murchison is one who has worked at science chiefly for the rewards, but not entirely, for if he had had no pleasure in it he would have failed; Sedgwick and Conybeare for the pleasure chiefly. What I shall always cherish, is a love for science, rather than its rewards; but I indulge the hope of profit, as the best earnest of usefulness, and also against its becoming a duty to accept some offer of an uncongenial situation" (vol. i. p. 373).

"Sedgwick asked me to walk home with him. I found a gloom upon him, unusual and marked. I most carefully avoided all allusion to the rejected living, but now when the first excitement of declining the boon is over, and that others have expressed their wonder at it, and that he finds himself left alone with his glory, he is dejected. He told me, Thursday last, that he wished before he left Cambridge, to *do something*. 'Now if I take a living instead of going to Wales, I abandon my professorship, and cannot get out the volume on the primary rocks with Conybeare,' &c. Then he hinted that in a year, when this is done, he may retire on some living, and *marry*. But I know Sedgwick well enough to feel sure that the work won't be done in a year, nor perhaps in two; and then a living, &c., won't be just ready, and he is growing older. He has not the application necessary to make his splendid abilities tell in a work. Besides every one leads him astray. A man should have some severity of character, and be able to refuse invitations, &c. The fact is, to become great in science, a man must be nearly as devoted as a lawyer, and must have more than mere talent" (vol. i. p. 375).

With respect to the unfortunate quarrel between these two pioneers in the study of the older palæozoic rocks, the line which Lyell adopts appears to us to be singularly just and judicious. He could not but see that Sedgwick's wrongs, like his maladies, were to a great extent imaginary, and, doing so, was filled with regret at the folly which made so able a man nurse his mortification and rage till it embittered the whole of his subsequent life. Writing in 1855 Lyell says:—

"In Phillips's new edition of his 'Geology,' just out, he makes the Lingula beds Cambrian, just as I do, which I am glad of, as however Murchison may complain, it is really we that are adhering to the original divisions and names adopted by Murchison and Sedgwick. It would be wrong to give up the term Cambrian just when we are beginning to have a distinct fauna for it, as Salter was the first to show here, and Barrande in Bohemia. Sedgwick's attempt to take the Lower Silurian into his Cambrian is even worse than Murchison claiming all that is older than the Devonian as appertaining to his Silurian" (vol. ii. p. 205-6).

Lyell had great opportunities of knowing Cuvier, and we cannot refrain from quoting what he tells us about the great naturalist's method of organising his work:—

"I got into Cuvier's *sanctum sanctorum* yesterday, and it is truly characteristic of the man. In every part it displays that extraordinary power of methodising which is the grand secret of the prodigious feats which he performs annually without appearing to give himself the least trouble. But before I introduce you to this study, I should tell you that there is first the Museum of Natural History opposite his house, and admirably arranged by himself, then the Anatomy Museum connected with his dwelling. In the latter is a library disposed in a suite of rooms, each containing works on one subject. There is one where there are all the works on ornithology, in another room all on ichthyology, in another osteology, in another *law* books! &c., &c. When he is engaged in such works as require continual reference to a variety of authors, he has a stove shifted into one of these rooms, in which everything on that subject is systematically arranged, so that in the same work he often takes the round of many apartments. But the ordinary studio contains no bookshelves. It is a longish room comfortably furnished, lighted from above, and furnished with eleven desks to stand to, and two low tables, like a public office for so many clerks. But all is for the one man, who multiplies himself as author, and admitting no one into this room, moves as he finds necessary, or as fancy inclines him, from one occupation to another. Each desk is furnished with a complete establishment of inkstand, pens, &c., pins to pin MSS. together, the works immediately in reading and the MS. in hand, and in shelves behind all the MS. of the same work. There is a separate bell to several desks. The *collaborateurs* are not numerous, but always chosen well. They save him every mechanical labour, find references, &c., are rarely admitted to the study, receive orders, and speak not."

"Brongniart, who, in imitation of Cuvier has many clerks and collaborateurs, is known to lose more time in organising this auxiliary force than he gains by their work, but this is never the case with Cuvier. When I went to get Mantell's casts I found that the man who made moulds, and the painter of them, had distinct apartments, so that there was no confusion, and the despatch with which all was executed was admirable. It cost Cuvier a word only" (vol. i. p. 249).

Although Lyell devoted all his energies to the advancement of geological science, and, as his letters show, steadfastly refused all honours and engagements which would interfere with the performance of the great tasks he had set before himself, yet he was far from being a recluse or one refusing to take an interest in the affairs of the time. His earliest essays in the *Quarterly* were employed in the advocacy of the importance of giving scientific instruction in schools and universities. In his "Travels in North America" he devoted a chapter to the subject of University Reform, and his remarks produced a great impression at the time, and before the Public Schools Commission he gave important evidence. In the reform of the Royal Society he was one of the most active members, and in many of the great movements of the day we find him playing the part of an earnest and advanced liberal.

On other than scientific subjects we may not stay to speak here, but we cannot refrain from mentioning that Lyell's works on America did much to dispel among the educated classes, on both sides of the Atlantic, the feeling of irritation which had been aroused by the publication of the caricatures in Dickens' "American Notes" and "Martin Chuzzlewit." Non-scientific readers, too, will find much to interest them in these volumes, in the conversations and anecdotes of such men as Scott, Lockhart, Rogers, Whewell, Babbage, Macaulay, Sidney Smith, Milman, and many other eminent men with whom Lyell was on terms of close intimacy. The literary gossip is indeed scarcely less interesting than the scientific.

Of Lyell's amiable and gentle nature these letters and journals afford abundant and interesting evidence. His correspondence with his wife and sisters, and his little nephew, abound with illustrations of the beautiful traits of his character ; and the warmth of his attachment comes out very strikingly in his communications with Mantell, Fleming, Horner, Darwin, and others, with whom he was in constant and friendly intercourse. His greatest weakness was perhaps the excessive caution, sometimes approaching timidity, which is exemplified very strikingly in his correspondence with Darwin and Hooker in vol. ii. pp. 361-366. But it must be remembered that it was this same cautious habit which first enabled him to gain the public ear, when it was but little disposed to attend to the teachings of science, and his reputation for this character gave to his later writings on scientific questions an authority which perhaps no other living writer could command. It was in consequence perhaps of this that Lyell's opinions on the subject of evolution, as stated in the "Antiquity of Man," were received by the public like the summing up of a judge, rather than as the speech of an advocate.

We cannot better conclude this notice of Lyell than by quoting the words of his friend the late Dean Stanley, on the occasion of the funeral sermon in Westminster Abbey :—

"Of him who is thus laid to rest, if of any one of our time, it may be said that he followed truth with a zeal as sanctified as ever fired the soul of a missionary, and with a humility as child-like as ever subdued the mind of a simple scholar. For discovering, confirming, or rectifying his conclusions, there was no journey too distant to undertake. Never did he think of his own fame or name in comparison with the scientific results which he sought to establish. From early youth to extreme old age it was to him a solemn religious duty to be incessantly learning, constantly growing, fearlessly correcting his own mistakes, always ready to receive and reproduce from others that which he had not in himself. Science and religion for him were not only not divorced, but were one and indivisible."

These words were spoken when the grave had but just closed over Lyell's mortal remains, but in the hearts of many who had the happiness of knowing and loving him, his memory will long continue green.

JOHN W. JUDD

OUR BOOK SHELF

A Treatise on the Diseases of the Nervous System. By James Ross, M.D. Two Vols. (London: Churchill and Co., 1881.)

THIS is a complete treatise on Diseases of the Nervous System, illustrated with lithographs, photographs, and many woodcuts, of which the latter have mostly been borrowed from several well-known anatomical and physiological works. The book is in many respects a valuable one, though in others it is not altogether satisfactory. The author is thoroughly accomplished in all that concerns the anatomy and physiology of the nervous system, and he is evidently fully impressed with the absolute importance of an adequate attention to details of this kind on the part of those who would master or keep themselves abreast of modern knowledge concerning disease of the nervous system. A vast amount of work has been done in strengthening our knowledge in this direction during recent years, and as a consequence in no department of medicine have greater advances in the direction of precision of diagnosis been arrived at. In no other work are these anatomical and physiological data, on which the practitioner must largely depend, so copiously reproduced. In this direction, indeed, there is some redundancy. Some of the chapters (such as Chap. I. of Vol. I.) might with advantage have been omitted altogether from the present work, whilst others (such as Chap. I. of Vol. II.), dealing with the Anatomy and Development of the Spinal Cord, might have been very considerably curtailed. An anatomical treatise is one thing, but a work on a department of practical medicine is another thing altogether, although in it many anatomical references ought to exist. On the physiological and pathlogical sides, what the author has to say concerning Inhibitory Functions generally, and concerning "Synkinesis" (or the pathology of Associated Movements), will be found to be both judicious and more or less original. But in studying the author's account of the special diseases of the nervous system, especially in the light of other previous and fuller disquisitions, one cannot help seeing that much of the work (as in the section on Paralysis of the Facial Nerve, for instance) partakes of the nature of careful compilation, and is defective in evidence that the author himself has had any very large experience of the diseases concerning which he treats. Some of the special diseases are indeed altogether inadequately discussed, considering the style of the work generally. In fine, this treatise, though not without considerable merits, is unequal and in many places over-diffuse in its treatment of different parts of the subject. Greater strength and evidence of a larger practical experience in dealing with the different nervous diseases would have made the book more evenly balanced, and caused the reader to think less of its redundancies. These blemishes might perhaps be rectified in a subsequent edition. At present it is a work which will probably possess more interest for the few who are already conversant with nervous diseases, than for the many medical men and students who desire to make themselves more acquainted with them. To the latter its bulk (about 1600 pages) will probably be alarming. The book ends with that most commendable thing, a good index.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.*]

The Function of the Ears, or the Perception of Direction

REFERRING to the letter in NATURE (vol. xxv. p. 124) I may add that M. Buhler, our French landscape gardener, judges nicely the direction of sound. Some years ago I requested him to trace a walk across a wood so undergrown with a creeping plant that it was impossible to cross it. Having fixed the entrance and exit by going round the wood, he told my negro servant to answer every call of his by a shout. It just then occurred to me that an experiment might be made; and I ordered the negro (in his own language) not to shout, but to whistle. As the ground was sloping, the walk was to be a curve; and Buhler, with little hesitation, pointed out the places where pegs should be laid by a man who opened a narrow path with a hatchet. Buhler did not retrace his steps, and left my grounds after saying that he had pegged the right side of a walk three metres broad. He then complained of the difficulty he had experienced because *that stupid darkie* had whistled in place of shouting. When the ground was cleared a few days afterwards, I found the curve even and seemingly faultless. When listening to each whistle Buhler turned his face, not towards it, but in the direction of the curve which must ultimately meet it. Have not English landscape gardeners the same faculty of judging rightly direction by sound. ANTOINE D'ABBADIE

Abbadia, Hendaye, December 11

Dante and the Southern Cross

THE question "where Dante could have learned about this constellation" (*ante*, p. 152) has been discussed by most modern commentators on the passage referred to. The general conclusion arrived at seems to be that it was through the delineation of the "quattro stelle" on Arabian celestial globes. The best scientific discussion of the question will be found in Humboldt's *Kosmos* ii. 205, 6 (ed. 1870). Might not, however, the line "Non viste mai fuor ch' alla prima gente" suggest that Dante's knowledge was derived from some record or tradition, of the visibility of these and other southern stars to the inhabitants of the Mediterranean shores before the precession of the equinoxes carried them below their horizon? "Prima gente"—generally rendered "our first parents"—recalls irresistibly Horace's "prisca gens mortalium." J. J. WALKER

University Hall, December 18

YOUR correspondent who inquires whence Dante obtained his knowledge of the existence of the Southern Cross may be referred to Humboldt's travels for one explanation of this remarkable fact. I apprehend your correspondent alludes to the lines—

"To the right hand I turn'd and fix'd my mind
On the other pole attentive, where I saw
Four stars ne'er seen before save by the ken
Of our first parents. Heaven of their rays
Seem'd joyous. Oh thou northern site! bereft
Indeed, and widow'd, since of these deprived."

Dr. Barlow, the commentator of Dante, accepts Humboldt's explanation, and says: "The principal stars of this constellation were known when Dante wrote, and in the description here given there is a reality attested by all who have seen them. They were once visible in our northern hemisphere." Alexander von Humboldt, from whose philosophic soul the poetry of nature was never absent, says of them:—"In consequence of the precession of the equinoxes, the starry heavens are continually changing their aspect from every portion of the earth's surface. The early races of mankind beheld in the far north the glorious constellations of the southern hemisphere rise before them, which, after remaining long invisible, will again appear in these latitudes after a lapse of thousands of years. The Southern Cross began to be invisible in 53° 30′ north latitude, 2900 years before our era, since, according to Galle, this constellation might previously have reached an altitude of more than 10°. When it disappeared from the horizon of the countries of the Baltic the great pyramid of Cheops had already been erected more than 500 years." Barlow therefore infers with Humboldt that Dante knew of the Southern Cross by tradition, and adds that the words our "first parents" do not refer to Adam and Eve, but to the early races which inhabited Europe and Asia.

Grosvenor Street SAMUEL WILKS

Helophyton Williamsonis

I AM sorry to see that I have overlooked two mistakes in my brief note which you published in your last number (p. 124). In the fifth line *Hymenophylloides* should have been *Myriophylloides;* and lower down Urrger should of course be Unger.

WM. C. WILLIAMSON

Victoria University, Manchester, December 9

A Smokeless London

IT is not very improbable that we shall in a few years be indebted to the electric light for our source of nightly illumination. Before such an eventuality it would be interesting to know if there are any serious objections to employing hydrogen gas as our heating agent. Smokeless and innocuous in combustion, it would relieve us from many ills under which we labour now. When it was tried—after impregnation with a hydrocarbon—as a lighting agent (at Chichester, I believe) some years ago, it was found wanting, but there was no difficulty, I think, experienced in producing it cheaply from the decomposition of water and in sending it through the mains. No notice, I believe, has been directed to this at the Smoke Abatement Exhibition. Will you kindly raise the issue, and let us know the advantage or disadvantage of the project? EDMUND MCCLURE

1, Onslow Place, S.W., December 16

Meteors

ON the evening of Wednesday, November 16, whilst sweeping the western heavens in search of comets, I was startled by a brilliant illumination to my right. Looking up hastily, a bright meteor was seen moving rapidly in the north-eastern heavens; it started about 3° north of Capella, and traversed a path of some 10° in a north-easterly direction, passing about 2° above (or west of) δ Aurigæ. Its flight did not exceed three seconds, when it burst with a dazzling brilliancy to be compared only to the whiteness of the electric light. At the moment of bursting, it must have been at least five or six times as bright as Venus at her maximum. It left in its wake, covering the full length of its path, a thin, reddish train, which drifted slowly toward the north-east among the stars, gradually collecting into a lightish cloud at its north-east end. Noting the remarkable permanency of the train, I turned the telescope (a 5 inch refractor) upon it, and was surprised to see a brightly-glowing mass of pinkish smoke. The same matter was stretched out toward the south-east into a long, straggling strip. This trail was about ½° in breadth, and could be plainly seen with the telescope for a distance of at least 10°. The whole of this drifted north-easterly over the stars, curling slowly like a mighty serpent; it was knotted in places with cumulus forms, probably due to minor explosions in the meteor. The outlines of this wonderful train of celestial smoke were well defined; it did not diffuse itself into the atmosphere, but gradually faded, becoming more contorted each moment. During the whole time of its visibility it retained its pinkish colour. The first appearance of the meteor was at 6h. 48m. local time; the train remained visible to the naked eye for about six minutes. In the telescope it was distinct up to seven o'clock, and at 7h. 03m. it could still be seen in the instrument. While visible, it drifted about 4° to the north-east. No explosion was heard, though listened for. Latitude of place of observation, 36° 10′ north; longitude west of Greenwich, 86° 49′. E. E. BARNARD

Nashville, Tennessee, U.S.A., November 27

ON Wednesday, December 14, at 10.30 p.m., I saw a very brilliant meteor. It appeared to start from the barren region of the Lynx, bordering on the Twins, a little to the east, and above Pollux, and travelled in the direction of Canis Minor. It was much brighter than any object then shining, though Jupiter and Sirius were both visible, and left a train of light behind which appeared to be granular, of a dull red colour, and fusiform in shape. I did not see the meteor through its entire path, on account of a house intervening, but the train of light behind it was not visible at the commencement of its path, and appeared to terminate before the disappearance of the meteor. This was by far the brightest meteor I ever saw. The same evening and the week previously I saw many meteors in the region of Aries, but none very brilliant. E. HOWARTH

Sheffield Museum and Observatory, December 18

Herbaceous Stem on a Palæolithic Implement

INSTANCES are so extremely rare where vegetable material (as old as the drift gravels) is found adherent to drift implements, that the following instance is probably worthy of note:—Amongst my collection of Palæolithic implements from the neighbourhood of Bedford, I have one *perfectly unabraded* example—bright ochreous yellow in colour from its long deposition in the drift. Near the middle of the implement there are the remains of some herbaceous stem firmly fixed to the flint; the colour of the vegetable material is bright ochreous, and under the microscope the vegetable structure (especially the vessels) is most clearly seen; the patch is an inch long and about a quarter of an inch in average width; it has not the stellate cells of the rush. The material has been protected in a depression in one of the artificial facets of the implement, and in a second position somewhat nearer the butt, there is further trace of the same material. My opinion is that these grass stems (or whatever stems they may be) were possibly wrapped round the basal end of the implement as a protection for the hand against the asperities of the flint. The asperities are very noticeable in the instrument referred to, as it has a sharp cutting edge at the butt, with none of the original bark of the flint left for convenience of holding. The vegetable material is undoubtedly as old as the implement, and the unabraded condition of the stone may account for its position in the facets. WORTHINGTON G. SMITH

125, Grosvenor Road, Highbury, N.

Awned Carpels of Erodium

SIR JOHN LUBBOCK's address to the British Association, and Mr. Francis Darwin's paper in the Linnean *Transactions*, on the hygrometric awns of the achenes of *Erodium* and other plants, fail to give the honour to the right man. Their references reach some thirteen years back; but if they will look further they will find the late discoveries (including those of Hildebrand and Zimmerman in *Pringsheim's Jahrbücher*) forestalled as to *Erodium* by nearly half a century. In the *Magazine of Natural History* for 1836 is a modest contribution of nearly two pages from Robert Mallet of Capell Street, Dublin, describing and figuring his observations on the achenial awns of *Erodium moschatum* and *Pelargonium peltatum*. He finds that the awns of *Erodium* possess "most wonderful hygrometric sensibility." The five awns lie in grooves of the carpophore. He gives transverse views of the awns in various conditions of torsion, and of the carpophore (not as well executed as the similar ones of F. Darwin and Hildebrand). He states that aridity causes the awns to twist, and so to extricate themselves from their grooves, and at the same time downy filaments bristle forth from the awns, and the achenes detach themselves and fall to the ground. Here the awns still continue to twist and keep tumbling over, so as to recede from the parent plant. At last by twisting they become like balloons wafted about by every zephyr. But motive power has not ceased with the awn: the slighest hygrometric change produces motion either backwards or forwards in it; and the constant tendency of this motion is to *screw the seed into the ground* (Mr. Mallet's italics). Such is the shape and great sensibility of the awns, that they may be readily applied to form most delicate hygrometers, for which purpose he had used them. Nearly all of these observations have been rediscovered and confirmed and published in elaborate form by the eminent investigators of our own day.

Princeton College, November 13 G. MACLOSKIE

The Song of the Lizard

WHILST quartered in St. Helena, at Ladder Hill, I was frequently disturbed by the "*tweet-tweet*" of a small lizard in the verandah and Melia trees which overshadowed it, which sounds for a long time I thought were produced by birds. It is, according to Melliss' description, the "*Hemidactylus frenatus* (Schleg.).—A small brown harmless lizard about four inches in length, which lives under stones and old timber in the warm lower parts of the island. It seldom enters houses unless in pursuit of flies or scorpions, but is plentiful about the neighbourhood of Jamestown, where in the evening its loud chirp is frequently heard." This may corroborate Mr. Pascoe's remarks in his letter to NATURE (vol. xxv. p. 32). S. P. OLIVER

2, Eastern Villas, Anglesey, Gosport

A Double Egg

I HAVE received a very remarkable egg, or rather, I should say, a double egg, laid by a hen belonging to Mr. Isaac Sharman, of Ranmoor, Sheffield. The egg weighed 4¾ oz., and measured round its greatest circumference 8 inches, and its least 7 inches. In measuring the egg the shell was broken, and inside the outer shell there was no yoke but simply white of egg surrounding another perfect egg of the average size. This inner egg has the shell quite complete and hard. Mr. Sharman describes the bird as a cuckoo hen. E. HOWARTH

Sheffield Public Museum, December 12

SIR ANTONIO BRADY

IT is always with a keen feeling of regret that we record the loss from the scientific ranks of men whose faces, as well as their names, were familiar to us by long association, and who were for years fellow-workers in the same geological area. Such a one was Sir Antonio Brady, F.G.S., who passed from among us on the 12th inst. from an affection of the heart.

He was the eldest son of the late Mr. Anthony Brady, of the Royal William Victualling Yard, Plymouth, by his marriage with Marianne, daughter of Mr. Francis Perigal. Born in 1811 he entered the Civil Service of the Navy as a junior clerk in the Victualling Yard, Deptford, more than fifty years since. After serving in various offices, having been promoted to head-quarters, he became head of the Contract Office and Registrar of Public Securities in 1854, subsequently assisting to reorganise that office. After the reorganisation of the office he was appointed first superintendent of the Purchase and Contract Department, retiring from the service in 1870, when he received the honour of knighthood. Since his retirement from the public service, Sir Antonio has devoted his energies to the service of the public, and having taken a leading part in the preservation of Epping Forest for the people, was appointed a judge in the "Verderer's Court for the Forest of Epping." He also took great interest in the work of church extension, and was a member of the Ray, the Palæontographical and Geological Societies; he was also in the Commission of the Peace for Westminster. The deceased married, in 1837, Maria, eldest daughter of the late Mr. George Kelner, of Ipswich, by whom he leaves a son, the Rev. Nicholas Brady, M.A., and two daughters.

But it is in his character of a geologist that we must now speak of Sir Antonio Brady. So long ago as 1844 his attention was attracted to the wonderful deposits of brickearth which occupy the Valley of the Roding at Ilford, within a mile of his residence. Encouraged by Prof. Owen and other eminent palæontologists, he commenced to collect the rich series of mammalian remains which the Thames Valley brickearths yield. Owing, however, to their porous nature, the bones had lost, during their long interment, all their gelatine, and the earlier "finds," when exhumed, were so soft and friable that they crumbled beneath the touch, and it was not until fresh gelatine had been introduced that it was found possible to preserve these magnificent remains of the old inhabitants of this district. In his Catalogue of the Pleistocene Mammalia from Ilford, Essex (1874, 4to, printed for private circulation only) Sir Antonio Brady pays a just tribute of respect to the genius and ability of his first instructor in the art of preserving fossil bones, and acknowledges that he was indebted to Mr. William Davies, F.G.S., of the British Museum, for the preservation of most of the larger specimens in his collection.

Some idea may be formed of the enormous riches of this deposit when we find that an amateur, in his leisure hours, was able to amass nearly one thousand specimens of Mammalia from a single locality, comprising: *Felis spelæa*, *Canis vulpes*, *Ursus*, sp., *Elephas primigenius*, *E. antiquus*, *Rhinoceros leptorhinus*, *R. megarhinus*, *R. tichorhinus*, *Equus fossilis*, *Megaceros Hibernicus*, *Cervus elaphus*; *C.* sp.; *Bison priscus*; *Bos giganteus*, *Hippopotamus*, sp. To this interesting series of fossil remains of the old fauna of the Thames Valley, we may add that the subsequent researches of Prof. Boyd Dawkins, F.R.S., and R. W. Cheadle, Esq., F.G.S., have added the "Musk-ox," *Ovibos Moschatus*, and the labours of F. C. J. Spurrell, Esq., F.G.S., the "Lemming." We have thus presented to us in this area the conjunction of the Northern and Southern forms of land-animals as marvellous as that which modern London exhibits to-day, in its assemblage of specimens of the genus Homo, from every clime. For with the *Hippopotamus*, the *Rhinoceros*, and the Lion from the south, we have also in abundance the *Cyræna fluminalis*, a shell now characteristic of the Valley of the Nile and the rivers of India and China: whilst from the north advance to meet them the "Musk-Ox," the Reindeer, and the Lemming; we have also evidence at Walthamstow of the Elk (*Alces malchis*).

To Sir Antonio Brady, then, we are indebted for a most valuable collection of Pleistocene mammalia, now happily preserved in the British Museum of Natural History, Cromwell Road. Nor must we omit to mention that he strove by his presence, as a resident at Stratford, and by his constant acts of kindness and hospitality to the workmen, and by the *largesse* which he freely gave, to rescue from destruction these interesting relics of a pre-historic age, which now help to swell the magnificent series of our National Museum.

HENRY WOODWARD

BRIGHTON HEALTH CONGRESS

THE Brighton Health Congress, which was opened on Tuesday, December 13, and which has been accompanied by an Exhibition of Domestic, Sanitary, and Scientific Appliances, has been one of the most successful of its kind, and by far the most successful of any of a purely local character. In origin and in progress it has, throughout, been Brightonian, and although many of the scholars who communicated addresses and papers were outsiders, they came by invitation. To the Congress in the course of the week no less number than 1200 added their names as Associates, while the Exhibition was at all times well filled, some 400 persons per day, independently of the Associates, paying for admission. It is estimated, indeed, that altogether between four and five thousand persons have been present. We stated last week that the Exhibition was presided over by Lord Chichester, and the Congress by Dr. Richardson; and we gave a detail of the sections and order of proceedings: we shall dwell more particularly on the addresses and papers which were submitted.

The President's Opening Address

Dr. Richardson took for his theme "The Seed-Time of Health." In the opening passages he drew a picture of life and death in the time when the ancient Greeks were in the meridian of their intellectual existence. In the midst of the night, when the sun cannot see the deeds of men, certain of these were depicted carrying a dead child, in all its beauty, to the pyre. They carried it in this solemn silence and darkness because of the shame they felt that anything so young and beautiful should die in what ought to be the seed-time of health. Upon this he drew a sharp and striking contrast from our own time. He pointed out the great mortality of our children, for which we have grief, fond memories, but no shame. We accept the events, in short, as if they were natural, and erect memorials of them. After illustrating these points, the causes of the great mortality of the young were classified under four heads—the inherited, the accidental, the inflicted, and the acquired. Under the first head the influence of hereditary diseases were discussed; under the second head the diseases of an epidemic character, and which occur from exposure to one or other of the communicable poisons, were considered; under the third head the injuries arising from bad nursing, excessive competition in education, and improper feeding, were brought under notice; and under the fourth head the evils incident to early resort to smoking, the use of stimulants, late hours, and irregular meals, were made subjects of comment. What now is wanted, said the President, was the ideal of a new nobility. In the wild-boar days of human existence; in days when men, hardly emancipated from lower forms of life, crept out of their caves, their huts, their walled prisons, to see their nobler species go forth to exercise those rude arts of hunting, fighting, revelling, which formed the whole art of civilisation, there was a nobility which deserved the name—the representative of necessity. But now, when these arts have degenerated into mere childish imitations, mere apedoms of the great past, they are but injurious pretensions for nobility of soul and body. Once noble, according to the spirit of their day they are in this day ignoble. The address concluded with two applications of thought, one general, the other local. The general requested those who rule and govern us to look at the seed-time of health as it is, and take it as the test of good or bad government. The local was addressed to the people of Brighton, that the meeting then commencing might be truly useful, and the date from whence they should move onwards until the shame of mortal events, which the sun should never witness, be felt whenever they occur.

Section A.—Health of Towns

The president, Mr. Edwin Chadwick, C.B., opened the Section on Wednesday with an address on the prevention of epidemics. He set out by describing the various means adopted to stay the great outbreak of cholera in 1848, in which he took a prominent part, and the deductions made from observations then taken. The conclusions that had been come to then were that to aggregate disease in large hospitals was only to increase the danger, and that the very best means of preventing the spread of infection was by the adoption of sanitary measures at the places where, in the cycle of epidemics, they were to be expected. He described in a very interesting manner the precautions taken at York, at Merthyr Tydvil, at Mevagissy in Cornwall, and other places, and the gradual decrease of deaths that followed, and he showed that similar precautions taken at St. Petersburg, Malta, and Memphis, had had the same result. At St. Petersburg, for example, the deaths had decreased from 25,000 to 3000 in the successive decade. Some other equally startling statistics were given by Mr. Chadwick. By the returns of the Local Government Board, he calculated that we had saved in the death-rate from disease or infection a quarter of a million of lives, and three million cases of sickness, and putting this at a money value, 5*l.* for death and 1*l.* for a sickness, over four millions of money had been saved. In conclusion he portrayed with poetical picturesqueness a possible future "when medical science shall occupy itself rather with the prevention of maladies than their cure, when governments shall be induced to consider the preservation of a nation's health as important as the promotion of its commerce or the maintenance of its conquests, and when we may hope to see approach a time in which, after a life spent almost without sickness, we shall close the term of an unharassed existence by a peaceful Euthanasia."

The papers which followed the delivery of Mr. Chadwick's address were all of them good, and some of them of unusual excellence. Mr. Easton's account of the water supply of Brighton was exceedingly interesting and able. It led to a sharp and animated debate on the water softening process in large towns. Mr. Easton and the Mayor, while advocating the principle of softening water, seemed inclined rather to look upon it as a household than a municipal duty. They were opposed by several other speakers. Mr. Griffiths followed with a paper on the escape of foul gases from ventilating gratings on the main sewers of towns. The gist of his argument was that the faults were rather in the houses than in the sewers. If, he maintained, the sewer system of houses was so perfect that nothing could be retained in the sewer pipes, and if the houses were thoroughly cut off from the sewer, the risks of escape of gas were greatly reduced. What was wanted in the sewer was a current of air, not ventilation at one point. The defective house drainage throughout the country was the evil that required the most speedy rectification.

Dr. Mackay supplied an excellent paper on the geology and climate of Brighton in relation to health. He gave many details, and finally came to the conclusion that the general view was correct, that autumn was the best season for Brighton. The freshness and coolness of the town in the early summer ought also to be remembered.

Dr. Fussell pleaded the necessity for recreation spaces in all large towns. He said there were about 100 towns in England containing upwards of 25,000 inhabitants, and that much of the decrepitude and high mortality amongst the young was caused by the excessive density of the populations.

Mr. Ellice Clark dwelt on the anomalies in the administration of the sanitary laws; and Dr. Browning read paper on the correlation of public health and sanitary legislation.

One of the most interesting essays read in this section was by Mr. Frederick Walsh, and was entitled "Sanitation in Japan, a Comparative Study." Mr. Walsh, who has resided long in Japan, detailed the diseases most prevalent there, together with an account of the mode of application of the sewage for agricultural purposes. He condemned very strongly the system of London drainage, and argued against the loss which was sustained in consequence of that system, contending that we had created by it most of the evils of which we complain.

The last paper read in this section was by Mr. H. F. Lester, on "Reform in Slaughterhouses." The author described tersely the present condition of private slaughterhouses, and contended that the great reform required in them consisted in the erection of public *abattoirs* in all our large towns. The paper led to a brisk discussion, the general sentiment being in favour of the views expressed by the author. Owing to an accident of arrangement a paper by Mr. W. S. Mitchell, M.A., entitled "A Comparison of English and Foreign Watering Places," had to be taken as read.

Section B—Food in Relation to National and Domestic Economy

The president, Mr. J. R. Hollond, M.A. M.P., opened the Section on Thursday with an address on the subject of the "Production, Distribution, and Economic Use of Food." In considering the first head, he maintained that until the conditions under which the land was held were modified, and a much larger portion of the land brought up to the level of the best farming, it was premature to speak of the limit to the production of bread and meat having been nearly reached. He noticed the obstacles to agriculture in our land customs and the imposition of extraordinary tithe on market and hop gardens. Our landed system hampered the nominal owner in his power of dealing with his land; our system of transfer stood in the way of a ready change of ownership, and the cultivator had insufficient security for the capital he put into his business. Under the second head he said Free Trade for us was not only a benefit, but a necessity, and commented upon the way in which the English food-producer was hampered by the heavy carrying-rates of the railway companies, and advocated the market system of Paris. In treating of the economic uses of food he advocated the use of vegetables in greater variety, and in regard to alcoholic drinks, from the point of view of making the most of the means at command, thought the outlay on them might with advantage be made elsewhere. In conclusion he alluded to the unsatisfactory results of our cooking arrangements and the wastefulness entailed thereby. He expressed himself in favour of teaching cookery in schools in a systematic way.

Dr. C. B. Drysdale then read a paper on "Cheap Food and Longevity," and showed by the statistics of New Zealand that, while the other circumstances were not specially favourable, as against this country, there was a lower death-rate, calculated at 12 in 1000 annually, combined with great cheapness of food. He contended also that the comparative scarcity of food here was caused by the higher birth-rate, which should be publicly discouraged in all European states.

Mr. A. F. Halcombe read a paper of special excellence on "New Zealand as a Source of Food Supply," showing the great capacity of New Zealand for furnishing us with food, and the prospects ultimately of large supplies being obtained from this growing colony. The writer supported also the statements made by Dr. Drysdale as to the healthiness of the New Zealand Climate.

Miss Yates followed with a paper on Bread Reform. She especially recommended the use of wheatmeal bread. She urged the members to support this movement for the sake of the children who are ill-nourished from being fed on impoverished white bread.

Mr. T. B. Lightfoot, in a very lucid paper on the "Preservation of Food by Cold," detailed the various steps of the dry-air freezing process, and stated that there need be no further difficulty in supplying the demands of this country with wholesome fresh animal food if the matter be approached in a scientific and business-like spirit. His paper elicited from the President of the Congress the fact that he (the President) had seen the carcases unpacked from Australia, had examined the preserved flesh, had partaken of it, and had come to the conclusion that the scientific difficulties were solved, and that nothing but commercial cupidity at home stood in the way of abundant supply of cheap food for the working classes.

A paper by Mr. Wynter Blyth, on "Rational Feeding and Eclectic Dietetics"; another paper by Dr. Whittle, on "Artificial Dieting of Infants"; another by Mr. Cowan, "On Honey as an Article of Food"; and still another by Mr. Mitchell, on "Lessons on Foods," led up to a final address by Major Hallett, on "Food-Plant Improvement." In this paper Major Hallett described his remarkable experiments and successes in improving the growth of wheat and other cereals, together with his latest experiments upon the growth of the cotton-plant, all of which we must reserve for another and special occasion.

Evening Lecture—Propagation of Disease through Food and Drink, by R. P. B. Taafe, M.D., Medical Officer of Health for Brighton

Dr. Taafe's lecture was a very carefully prepared reading on the diseases of the body which are propagated through food and drink. He dealt first with the introduction of parasitic diseases in this way, next of the zymotic. He presented in a very clear manner the views of those who support what is called, commonly, the germ theory of disease. Finally he dwelt upon the subject of prevention, and at the conclusion of his lecture received a very hearty vote of thanks.

Section C—Domestic Health, including Educational Training

Dr. Alfred Carpenter on Friday delivered the presidential address on "Domestic Health." He dwelt upon the public indifference in regard to matters of health, and expressed his belief that there was a border-line between health and disease, in which the conditions necessary for the establishment of disease must have time to produce their results before the disease actually arose. Speaking of zymotic diseases, he urged that their very existence was an evidence that natural waste was retained somewhere in too close a proximity to particular persons who became subject to disease. He dealt with the error of sending wastes into sewers, and proceeded to show that these wastes as soon as they became such, changed their character unless properly and naturally dealt with by being given to the earth. The address was very warmly received.

The papers that followed were so numerous that although the section sat until nearly six o'clock they could not all be read.

The first by the late Sir Antonio Brady on "Prevention of Smoke in Fire Places" was read by Gen. Alexander, one of the secretaries of this section.

Mr. H. H. Collins followed on "Home Sanitation and House Inspection," the practical common sense of which was that every man and woman should be their own sanitary inspector.

Mr. Burton, for Prof. Fleeming Jenkin, argued the importance of associations with an annual subscription, for sanitary inspection.

Dr. Strong, of Croydon, supplied various hints on domestic sanitation, supporting earnestly a constant instead of an intermittent water supply. Mr. Bailey Denton treated on the subject of the domestic filtration of water, giving a description of the common filters in use, with special reference to those in the exhibition. Mrs. King created a great interest by an essay on "Health in Relation to Clothing," in which she proposed a radical change for the better in the clothing of women. Mr. Alderman Hallett, Mayor of Brighton, described an every-day process for the domestic softening of water from the chalk, and illustrated his paper by one or two simple and very neat experiments.

Mr. Henry C. Stephens took up the subject of public elementary education in relation to public health, presenting an exceedingly thoughtful and practical communication, in which it was urged that in the beginning of life the senses should be more carefully trained by easy exercise of observation, analysis of impression, and muscular training in connection with mental effort.

The proceedings of the section were brought to a close by an address singularly felicitous in style and matter, by Major Robert Edis, F.S.A., on "Sanitation in Decoration."

General Meeting

At the conclusion of the sectional sitting which, like all the others, had been held in the Dome, the President took the chair for the general meeting, at which the usual formal votes of thanks were moved, seconded, and carried, together with the following resolution of condolence and sympathy: "That this meeting has heard with the deepest regret of the death of their much esteemed and distinguished colleague, the late Sir Antonio Brady, and hereby requests the President of the Congress to convey to Lady Brady and her family the sincere condolence of the members in an event which to them and the public is so great a bereavement." After the general meeting a large number of the Associates attended the "Health Congress Dinner" in the Banqueting Room of the Royal Pavilion.

Lecture to the Working Classes, by Brudenell Carter, F.R.C.S.

The proceedings of the Congress were brought to a fitting close on Saturday evening, Dec. 17, by the lecture delivered to the working classes, as well as to the Associates, by Mr. Brudenell Carter. The lecturer took for his topic "Eyesight," and for an hour and ten minutes held the large audience in closest attention. He first treated on the evolution of the eye as an optical instrument; next he described the structures of which the instrument is composed; thirdly, he discussed the irregularities of structure, dealing specially with the two irregularities, short sight and colour-blindness; lastly, he treated on the practical application of the knowledge of visual defects in its relation to educational training. The bad practice of teaching children to read and write with their eyes close to the paper, by which the defect of short-sightedness is so extensively produced, was strongly condemned, as well as the faults connected with bad light, bad paper, and irregular and imperfect printing.

The Exhibition

We should be remiss if we did not add a few lines on the Exhibition. The managers of this department struck out quite a new line in making it something more than sanitary. They called it a domestic, sanitary, and scientific exhibition, and this enabled them to introduce various things that add to the useful and the ornamental, as well as the healthful. All kinds of electrical apparatus that could serve in the house were shown. Various kinds of mechanical contrivances, and numerous objects for illustrating artistic improvements, such as painting of walls in corridors, halls, staircases, and rooms. Horological instruments found a place, and a great number of instruments for recording time were under constant inspection. In addition, the bicyclists and tricyclists had their department, and were presented with a goodly show of these new machines for pleasurable and useful exercise. In a word, all was so excellently classified, selected, and arranged that on the whole we never remember to have seen so good an exhibition. In the six visits we made to it we cannot express correctly which pleased us most, the place itself and its exhibits, or the extraordinary interest with which all the visitors, rich and poor alike, took in it. Everybody seemed to show an intelligent desire to collect all practical information that could be obtained; and when from this task they passed to the fine art Loan Collection which the authorities at South Kensington had the kindness and excellent taste to supply, the transition from the useful to the beautiful was indeed a pleasurable sight.

The peculiar feature of the Brighton Health Congress was its character as an example. In numbers and importance of papers read and discussed it rivalled some of the organised congresses, which having the metropolis as their centre, proceed to different towns and make them for a short season their platform. There can be no doubt that there is some danger to what are called the peripatetic societies in this initiation. If the town of Brighton can call together twelve hundred members to a congress, secure papers for various important sections, command the services of efficient officers, issue a volume of Transactions, and get together a scientific exhibition that shall attract several thousands of visitors, what may not larger towns accomplish, such as Birmingham, Manchester, Leeds, Newcastle, Liverpool, Edinburgh, and Glasgow. These immense places cannot possibly be expected to remain uninfluenced by the example set by Brighton and the results of the example. If then each town takes to forming its own congresses, there will soon be little ground left for congresses on the visit. Towns will vie with towns in organising instead of receiving meetings organised for them to receive. For our part, however, we augur nothing but good from such a new departure and new development. The light of science and knowledge will only burn all the brighter in a place out of which it has been struck; and as every town must invite to its congresses the same workers as would go if they followed the peripatetics, the characters of the different meetings will be the same in effect and usefulness.

ANCIENT TIDAL ACTION AND PLANES OF MARINE DENUDATION

THERE is at least one question in ancient physical geology on which the speculations of Prof. R. S. Ball (NATURE, vol. xxv. pp. 79, 103) regarding the magnitude of Tidal Waves in times past seem to throw fresh light, namely, the origin of "planes of marine denudation." For those readers of NATURE who may not be familiar with this term, first proposed by Prof. Sir A. Ramsay, let me endeavour briefly to describe them. If we protract to a true scale the outlines of certain tracts of the British Isles, of Europe, or of America, we shall find that the higher portions of the ridges tend to rise to a certain level, which, on being connected by an imaginary plane, form a gently-sloping surface over a considerable area, it may be of hundreds or thousands of square miles in extent. Now, if in addition to this we insert the stratification of the district crossed by the section, and taken from actual observation, it will often be found that this imaginary plane is formed of the truncated edges of highly-inclined strata, or of the denuded summits of anticlinal arches of contorted or folded strata. When such strata are of hard and tough materials it is clear that they must have been planed down by an agent of great power and of long-continued action, but the result has been to convert originally highly uneven surfaces of flexured strata into approximately horizontal surfaces, over which inequalities have been worn off. Through such planes the existing river-valleys have been cut down, but between neighbouring valleys there is to be found the intervening ridge, trending upwards to the original, now imaginary plane. The Silurian district of Central Wales offers a remarkable example, which has been used by Prof. Ramsay ("Mem. Geol. Survey," vol. i.). Let any one on reaching the summit of one of the long ridges to the south of Cader Idris place his head on the ground, and in this position survey the tract of hilly country lying to the southwards, and he will realise the nature of the plane surface, out of which the valleys have been hollowed. But there are many more remarkable instances even than this. The central plain of Ireland is an example on a larger scale, over which the Middle and Upper Carboniferous rocks have been swept away, leaving a floor of limestone; but it would be impossible to explain the course of its great river, the Shannon, without referring its origin to a time when a sloping plain stretched from the present sources of that river amongst the Leitrim Hills to Shannon harbour below Limerick, because now its channel traverses a ridge of Old Silurian rocks at Killaloe, which could not have existed *as such* when the river first commenced to run over a tract formed of Carboniferous beds since denuded. But it is amongst mountainous districts that the evidence of the former existence of old planes is most remarkable, because least expected. The higher ridges of the Grampians seen at a distance, or accurately drawn from a hypothetical standpoint (as on Mr. Knipes' panoramic picture), forcibly bring home this idea to the mind. The ridges and peaks with very few exceptions tend to rise to an imaginary plane connecting the higher elevations, while several actual terraces coincide with the plane itself. Out of this old plane the existing valleys have been cut down, during the vast period of time descending from the pre-Devonian to the present. A still more ancient plane was that in which the Cambrian sandstones and conglomerates were strewn, formed of tough gneiss and hornblendic schists, with a gentle rise towards the east. The Scandinavian Promontory offers an illustration on a grand scale, and to these we might add the pre-Triassic plane formed of the denuded Devonian and Carboniferous rocks of Belgium and the Rhine highly tilted, convoluted, and contorted, through which the existing rivers have carved out their channels. But I refrain from adding additional illustrations, as I must pass to the consideration of the question, How have such ancient planes been formed? Where was the agent capable of abrading down hundreds or thousands of feet of the most obdurate rocks over hundreds or thousands of square miles, and of transporting power sufficient to carry away the *débris* of these vast ruins? The geologist answers, "Only give me an unlimited time, and the waves, tides, and currents of the seas acting along the coast-lines as they at present act, will effect all that you demand." Granted that with "unlimited" time all this may be effected, but this is a demand which the astronomers will not concede, and geologists must pay some respect to astronomers and mathematicians after all. But even with the aid of (practically) "unlimited" time a serious objection meets us at the threshold. It is undeniable that the crust of the earth is always on the move, either upwards or downwards; those who are not intensely uniformitarian in their views contend that this oscillatory motion of the crust was much more rapid in past geological times than at the present day. If this be admitted, and I hold that it is a necessary consequence of the constantly decreasing rapidity with which the secular cooling of the surface has progressed downwards to the present day, how, let me ask, are you to get the coast to remain sufficiently long within range of such wave action as we see at present, to admit of the abrasion of the land to any considerable distance. The effects of wave action along our existing coasts, where formed of the more solid strata, is admittedly very slow, and in order to produce any great planing effects, the same coast-level (approximately) must be presented to it for a lengthened period; but with the required (practically) "unlimited" time, the coast-level would be placed out of reach, either by elevation or submergence. The hypothesis of approximately unlimited time seems to me, therefore, to be untenable. And what *we require is not time but force*, in order to account for the planing away of vast masses of obdurate strata over extensive areas. Such additional force Prof. Ball has supplied us with. He has shown that at a comparatively early stage of geological history the tides may have had a denuding effect several hundred times more powerful than the present. With such a "stupendous tidal grinding-engine" we may indeed conceive the work we have to account for accomplished, and the hypothesis of Prof. Ball approaches certainty, when it is considered that the character of the floors of the sea adjoining our coast-lines gives but slight evidence that such planes of marine denudation as I have attempted to describe, are in course of formation at the present day. They are phenomena of the past, not of the present, when wave and tidal action has, happily for mankind, subsided into restricted limits as compared with that of Palæozoic and Mesozoic times.

EDWARD HULL

TELEGRAPHS IN CHINA

ON December 2 a telegram was received from Reuter's agent at Shanghai, announcing that the telegraph line between that town and Tientsin was finished. In a few weeks we may expect to hear of the completion of the line to Peking. The capital of the Chinese empire, the chief seat of bigotry and hostility to foreign innovation, will then be in direct communication with Europe and America. There is, we believe, no doubt in the minds of those acquainted with the origin of this undertaking, that political motives alone dictated it. Hitherto, during the winter, when the mouth of the Peiho was closed by ice, couriers taking from twenty to thirty days on the journey travelled down the Grand Canal to the Yangtsze conveying letters to Shanghai; or they were sent across Manchuria, in from fifteen to twenty days to Kiachta, where they reached the Great Northern Telegraph Company's Siberian lines. These slow and uncertain modes of communication with the outer world were severely felt by the Chinese Government during the winters of 1879 and 1880, when its relations were almost broken off with Russia, when the land and sea forces of the latter were hanging like a thundercloud on the frontiers of China, and a peaceable solution of the Kuldja question seemed impossible. It was then brought home to the Peking authorities that their coasts might be invaded, their principal cities captured, and the foe be almost at their gates weeks before they heard the news. The bitter experience of these years taught the Chinese a hard lesson, but one which they speedily took to heart. Long before the Marquis Tsêng brought the question to a peaceable conclusion the Chinese Government had ordered large quantities of telegraph material from England, and within a few months of the ratification of the treaty with Russia, we find the port of Peking connected by telegraph with the rest of the world. The Chinese may occasionally be slow in their mental processes, but the present instance shows that when once the utility of an innovation is clearly presented to their minds, they seize and assimilate it with a rapidity worthy of their more mercurial neighbours, the Japanese; and this, it will be observed, is as true of the Government as of individuals.

It is not yet known how far the new lines will be open for public use; but, judging by the rapid spread of other foreign inventions in China when once introduced, we cannot be far wrong in anticipating a vast extension of the telegraph for all purposes in that country. Ten or twelve years ago there was hardly a Chinese-owned steamer engaged on the coasts or inland waters of the empire; 84 per cent. of this trade is now carried on in Chinese bottoms. Large and well-appointed steamers, Chinese-owned and manned, now ply to every port along the coast and on the Yang-tsze. As we write, a Chinese steamer has arrived in the Thames, bringing several native merchants who are about to enter into competition with us on our own ground. From time to time we have recorded in NATURE the various stages in the progress of the new telegraph line, because it marks one of the most important steps that has ever been made in China towards the adoption of the results of Western science and civilisation. It is one of the very few improvements which she has adopted without external advice and pressure; in this instance she has sat at the feet of the best of all teachers, experience, and has profited by its precepts. Nor is the event any the less important when we reflect on the development possible for the other appliances of steam and electricity, now that the ice of dislike and distrust of innovation has been spontaneously broken. The intelligence and enterprise of the three hundred millions of the people of China will not long remain content with a single line of telegraph across a comparatively small corner of their vast territory. A race of men with strong mercantile instincts who seize with avidity on every time—or labour-saving appliance, the Chinese, now that their government has abandoned its most cherished prejudice, may well be expected to call for the extension of an invention such as the telegraph.

We may fitly conclude this attempt to forecast the future in China of one of the most remarkable productions of western science in the nineteenth century, by mentioning the lesson which may well be derived from our past intercourse with that country. It is worse than useless to thrust our improvements by force or threats on the Chinese. When left themselves to the results of their own experience and slow methods of thought, their advances, though occasionally tardy, are surer and more satisfactory. It can hardly be a matter for wonder that a people who have been taught to revere the teaching of their sages for nearly 3000 years as the highest products of human wisdom, and whose minds have been cast in the same mould from a period long anterior to our era, should look askance at the inventions of the modern man of science who knows nothing of the system of ethics and politics of Confucius and Mencius, and the other sages of antiquity. A few years ago a foreign company in China constructed, without the formal sanction of the Chinese authorities, a line of railway a few miles in length between Shanghai and Woosung, at the mouth of the Shanghai River. The government repeatedly called for the cessation of the traffic on the ground that its consent had not been obtained, and that it did not want railways in its territories. Finally, in order to prevent any complications respecting ownership, it purchased the line, destroyed it utterly, and sent the materials to Taiwan in Formosa, where, according to the latest accounts, they were lying rotting; and they did all this notwithstanding the arguments and protests of foreign ministers and diplomatists. They were determined at all cost to rid themselves of an innovation which had been thrust on them. On the other hand, a recent *Peking Gazette* published a memorial from the Governor-General of Shansi, one of the most powerful officials in the Empire, requesting authority to lay down a line of railway to certain mines in his province. Preliminary surveys have already been made, and the memorialist goes so far as to demonstrate to the Emperor that had such a railway been in working order a few years ago, much of the misery and horrible loss of life in the Shantung famine might have been prevented. It is from bitter experiences such as these that the Chinese learn; the devices of diplomatists or promoters are thrown away on them.

THE VOYAGE OF THE "VEGA"[1]

THE voyage of the *Vega* will be in many respects one of the most memorable events in the history of navigation. For the first time a continent has been circumnavigated, so far as authentic record goes, and at last the North-East Passage has been won, after heroic efforts begun nearly three and a half centuries ago. As Baron Nordenskjöld reminds us in these volumes, the North-West Passage, although explored, has never been navigated entirely by any ship, McClure's famous journey having been accomplished partly in sledges over the ice. But the voyage will be still more memorable by the two rich volumes in which it finds copious record, volumes which have scarcely a parallel in the whole literature of geographical exploration. For Baron Nordenskjöld has not contented himself with merely telling the story of his own successful voyage and its results. That voyage, as we have said, crowns the efforts of centuries, and it has been by the results of these efforts that the *Vega* has accomplished her work with scarcely an adverse incident. It will be remembered that some six years ago Baron Nordenskjöld showed that the voyage from Norway to the mouth of the Yennissei could easily be accomplished in a week or two, if taken at the proper time. Since then trading ventures have gone over the course every year, and a regular trade-route may be held as established by the well-informed enterprise of the eminent Swedish professor. For something like twenty years Baron Nordenskjöld has been at work in the seas to the north of Europe, and mainly in Spitzbergen, and the rich results of them are known to all students of science, and their story was told about two years ago in an interesting work noticed in these pages. Thus he became probably more familiar with the ice-conditions of these northern seas than any other authority; and his success in the Yennissei expedition led him to think that there was no reason why the whole North-East Passage should not be navigated. But Baron Nordenskjöld is, above all, a man of science, and accustomed to go about his work in a scientific method. That he has the true spirit of adventure is proved by the work of half his lifetime, but then he has a weakness for entering upon his enterprises with his eyes open, of knowing where he is going, and what are likely to be the results to science. So before making up his mind about the North-East Passage, the Baron examined carefully all the records of previous voyages along the north coast of Europe and Asia, from the time of Othere, a thousand years ago, down to the latest adventures of the brave Norwegian skippers. Thus he found that at one time or other the whole of this stretch of coast had been navigated piecemeal, except the most northerly point of the old continent, Cape Chelyuskin,

[1] "The Voyage of the *Vega* round Asia and Europe; with a Historical Review of previous Journeys along the North Coast of the Old World." By A. E. Nordenskjöld. Translated by Alexander Leslie. Five steel portraits, numerous maps and illustrations. Two vols. (London: Macmillan and Co., 1881.)

which had baffled all the attempts of those daring Russian sailors of the seventeenth and eighteenth centuries,

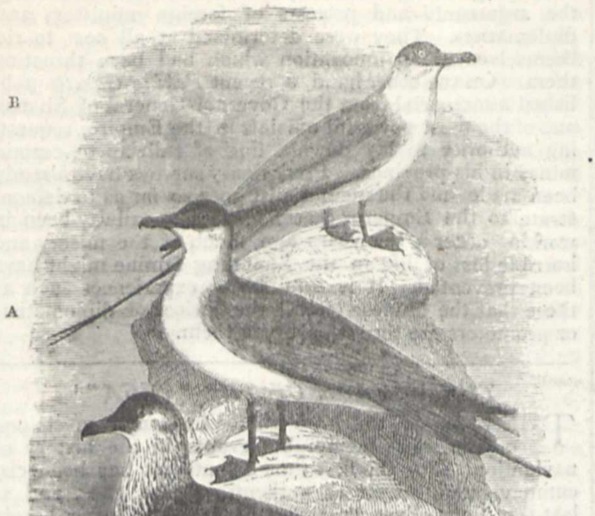

FIG. 1.—A, the Common Skua; B, Buffon's Skua; C, the Pomarine Skua.

who, in "floating coffins" and with many disasters, had explored the entire coast of Siberia. Baron Nordenskjöld saw that the ice in these regions has its times and seasons. To set out earlier than the middle of July he found would be to court delay and disaster. About that time the ice about Novaya Zemlya and in the Kara Sea begins to break up, and later on it generally retires from the north coast of Asia, being liable, however, to be blown south again by a north wind. In ordinary seasons, however, he inferred from the records of previous voyagers, a broad free lane of water might be looked for on to Behring Straits. In this respect the north coast of Asia differs materially from that of America. The eastern half of the latter is so hemmed in by islands that the ice has no scope for retiring completely, and so the North-West Passage under existing conditions is almost impossible for a ship. The fact that the ice is so easily blown black by a north wind to the coast of Asia gives ground to infer that a ring of islands stretches from Franz Josef Land to Wrangel Land, an inference confirmed by other characteristics. With his scheme so clearly and fully worked out, Baron Nordenskjöld went to the King of Sweden, who gave it hearty support. The result was that the king, in conjunction with the munificent Mr. Oscar Dickson of Gothenburg, who has spent a fortune in the cause of science, and Mr. Sibiriakoff, a Siberian merchant, agreed to advance the funds for an expedition round the continents of Europe and Asia. The *Vega*, a barque-rigged steamer of the best oak, 357 tons register, with engines of 60 horse-power, steaming 6 to 7 knots an hour, was bought, and specially fitted for her peculiar work. A staff of officers and men of science was carefully selected, and a picked crew of twenty-one men, with Baron Nordenskjöld himself as the leader of the expedition. The chief officer was Capt. Palander, of the Royal Italian Navy; Dr. F. R. Kjellman acted as botanist, Dr.

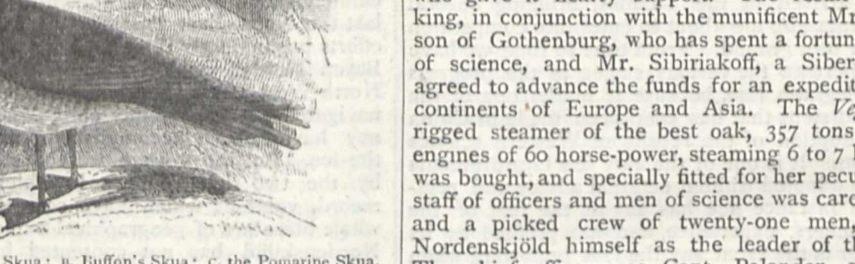

FIG. 2.—Section of Inland-ice. A, open glacier canal; B, snow-filled canal; C, canal concealed by a snow-vault; D, glacier-clefts.

Stuxberg, zoologist, Herr Almquist, medical officer and lichenologist, Lieut. Brusewitz, second officer, Lieut. Bove, of the Italian Navy, hydrographer, Lieut. Hovgaard, of the Danish Navy, for magnetism and meteorology, and

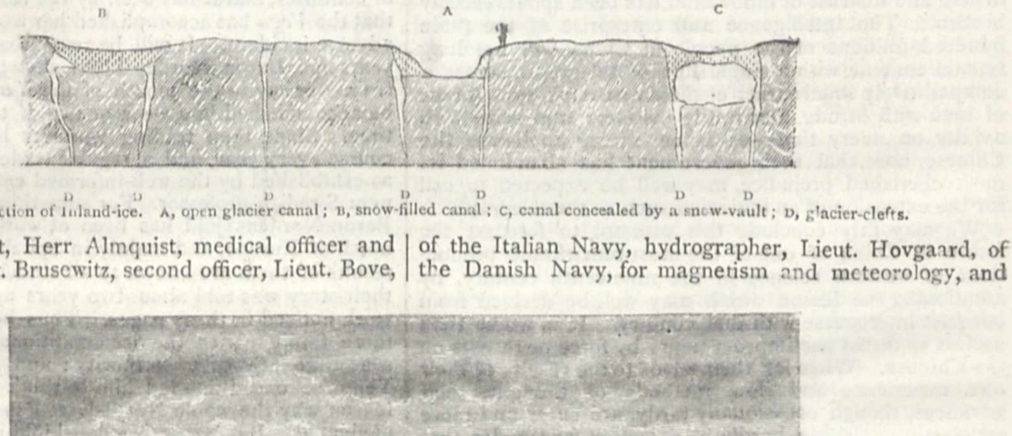

FIG. 3.—Glacier with stationary front, Udde Bay, on Novaya Zemlya, after a drawing by Hj. Theel (1875).

Lieut. Nordquist, of the Russian Guards, interpreter and zoologist. Baron Nordenskjöld, besides being eminent as a geologist and mineralogist, we need not say, was a host in himself. It will thus be seen that the expedition was perfectly equipped for scientific work.

We have said that Baron Nordenskjöld's work is far more than a mere narrative of the voyage of which he was the organiser and commander. Not only does he give an exhaustive account of all previous voyages in these regions, but enters into the amplest details as to the scientific results achieved up to the present time. The work is thus a mine of unusual richness for the student of science, while it is so written as to be not only intelligible but delightful to any ordinary intelligent reader. As the *Vega* pursues her course, the leader stops every now and then to tell his readers of the voyages associated with a particular region, or of the knowledge we have of its geography, geology, and biology. Many matters of the widest scientific importance thus come to be introduced, and questions discussed of burning interest in various departments of science. In following the course of the *Vega* we shall attempt to give our readers some faint idea of the riches stored up in these two volumes.

The *Vega* was accompanied by the *Lena* as far as the mouth of the river of that name, for the commercial navigation of which she was destined, and part of the way by the *Fraser* and *Express* as tenders. Coming round from Karlskrona, the expedition left Tromsoe on July 21, 1878. At Moosoe, near the North Cape, it was discovered that cloudberries and rum formed an excellent antidote to scurvy, and a stock was laid in, and whether from their use or from the carefully regulated diet on board the *Vega*, of which details are given, there was not a trace of scurvy during the whole voyage, and indeed no illness at all to speak of. As he rounded the corner of Europe, the Baron stops to tell us of early voyages in this direction, of Othere, whose story was told by King Alfred, Willoughby and Chancellor, Pet, and Jackman, and others. and to show us some old maps in which the coast is rudely laid down. The work is specially rich in maps from the tenth century down, including a large scale map of the north coast of Europe and Asia, in which the *Vega's* data have been incorporated. The vessels *rendezvoused* at Yuger Schar, between Waygats Island and the mainland on July 31. And here opportunity is taken of telling us all that is known about the Samoyeds of the island and mainland, from the earliest voyages down to the visit of the *Vega*, with abundant illustrations. Then follows a chapter of the greatest possible interest on the animal world of Novaya Zemlya, which becomes really an account of Arctic zoology. First we have a complete account of the birds, with wealth of illustration. The variety is wonderful, and evidently the habits of the interesting creatures have been carefully studied by Baron Nordenskjöld. Here, for example, is a graphic picture, with its accompanying illustration (Fig. 1):—

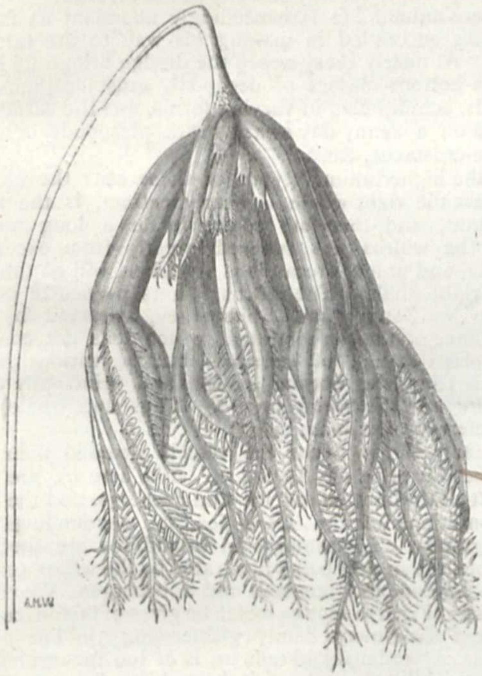

FIG. 4.—Umbellula from the Kara Sea.

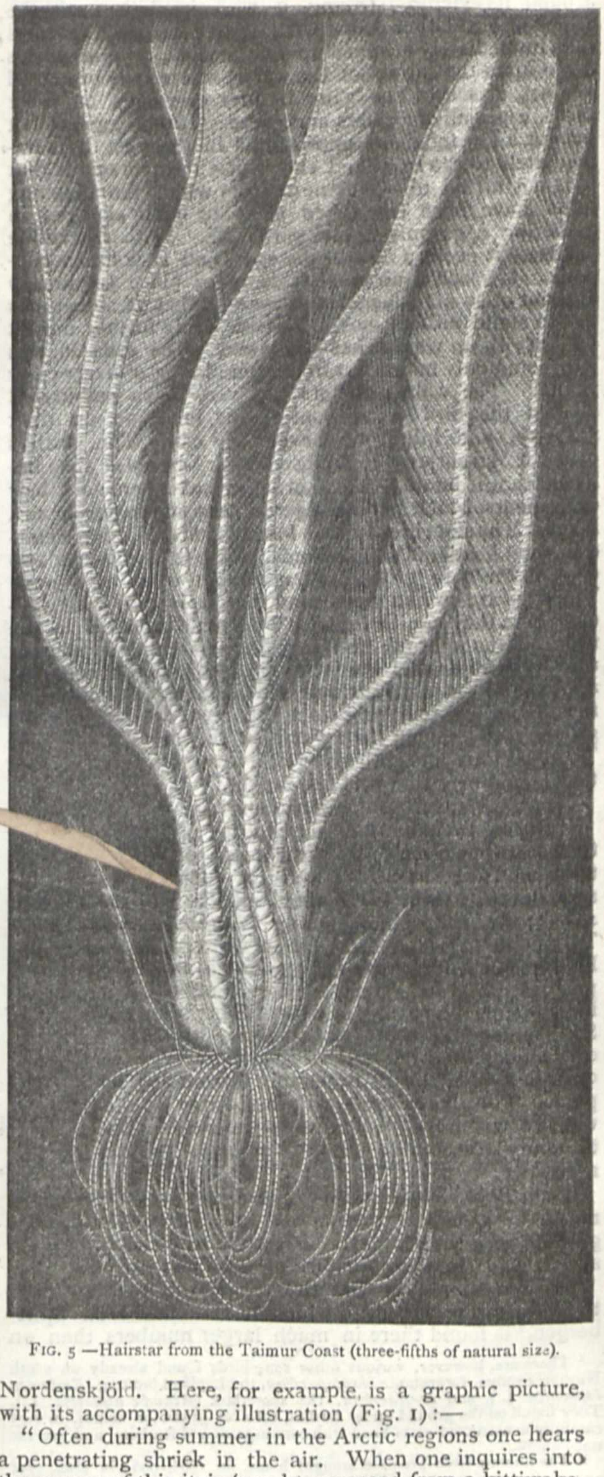

FIG. 5 —Hairstar from the Taimur Coast (three-fifths of natural size).

"Often during summer in the Arctic regions one hears a penetrating shriek in the air. When one inquires into the reason of this it is found to proceed from a kittiwake, more rarely from a glaucous gull, eagerly pursued by a bird as large as a crow, dark-brown, with white breast and long tail-feathers. It is *labben*, the common skua (*Lestris parasitica*, L.), known by the Norwegian walrus-hunters under the name of *tjufjo*, derived from the bird's cry, '*I-o i-o*,' and its shameless thief-nature. When the 'tjufjo' sees a kittiwake or a glaucous gull fly off with a shrimp, a fish, or a piece of blubber, it instantly attacks it. It flies with great swiftness backwards and forwards around its victim, striking it with its bill, until the attacked bird either drops what it has caught, which is then immediately snapped up by the skua, or else settles down upon the surface of the water, where it is protected against attack. The skua besides eats eggs of other birds, especially of eiders and geese. If the eggs are left but for a few moments unprotected in the nest it is immediately to the front and shows itself so voracious that it is not afraid to attack nests from which the hatching birds have been frightened away by men engaged in gathering eggs only a few yards off. With incredible dexterity it pecks a hole in the eggs and sucks their contents. If speed is necessary this takes place so quickly and out of so many eggs in succession that it sometimes has to stand without moving, unable to fly further until it has thrown up what it has swallowed. The skua in this way commonly takes part in the plundering of every eider island. The walrus-hunters are very much embittered against the bird on account of this intrusion on their industry, and kill it whenever they can. The whalers called it 'struntjaeger'—refuse-hunter—because they believed that it hunted gulls in order to make them void their excrements, which 'struntjaegeren' was said to devour as a luxury. The skua breeds upon low, unsheltered, often water-drenched headlands and islands, where it lays one or two eggs on the bare ground, often without trace of a nest. The eggs are so like the ground that it is only with difficulty that they can be found. The male remains in the neighbourhood of the nest during the hatching season. If a man, or an animal which the bird considers dangerous, approaches the eggs, the pair endeavour to draw attention from them by removing from the nest, creeping on the ground and flapping their wings in the most pitiful way. The bird thus acts with great skill a veritable comedy, but takes good care that it is not caught."

Again he tells us of the snow-bunting :

"During excursions in the interior of the land along the coast, one often hears, near heaps of stones or shattered cliffs, a merry twitter. It comes from an old acquaintance from the home land, the *snoesparfven* or *snoelaerkan*, the snow-bunting (*Emberiza nivalis*, L.). The name is well chosen, for in winter this pretty bird lives as far south as the snow goes on the Scandinavian peninsula, and in summer betakes itself to the snow limit in Lapland, the *tundra* of North Siberia, or the coasts of Spitzbergen and Novaya Zemlya. It there builds its carefully-constructed nest of grass, feathers, and down, deep in a stone heap, preferably surrounded by a grassy plain. The air resounds with the twitter of the little gay warbler, which makes the deeper impression because it is the only true bird's song one hears in the highest north."[1]

Then Baron Nordenskjöld goes on to do for the mammalia the same service he has done for the birds, beginning with the reindeer. It thrives as far north as 80° and 81°, and in a temperature of – 40° to – 50° C.

"It is remarkable that the reindeer, notwithstanding the devastating pursuit to which it is exposed on Spitzbergen,[2] is found there in much larger numbers than on North Novaya Zemlya or the Taimur Peninsula, where it is almost protected from the attacks of the hunter. Even on the low-lying part of South Novaya Zemlya the reindeer, notwithstanding the abundance of the summer pasture, is so rare that when one lands there, any reindeer-hunting is scarcely to be counted on. It first occurs in any considerable numbers farther to the north, on both sides of Matotschkin Schar."

Notwithstanding the immense destruction of the reindeer in recent times their numbers in Spitzbergen keep so well up that it has been supposed they migrate from Novaya Zemlya. But Baron Nordenskjöld shows that this is not the case, as the reindeer of the two islands belong to different races. The fact that *marked* reindeer have been found in Spitzbergen has also led to the supposition that they found their way from some more northerly inhabited land, a supposition that does not seem probable, but is certainly worth verifying. Then we have our old friend the Polar bear, followed by the mountain-fox and the lemming. The marine life of these northern regions makes up amply for any scarcity of life on land.

"Here animal life is exceedingly abundant as far as man has succeeded in making his way to the farthest north. At nearly every sweep the dredge brings up from the sea-bottom masses of decapods, crustacea, mussels, asterids, echini,[1] &c., in varying forms, and the surface of the sea on a sunny day swarms with pteropods, beroids, surface-crustacea, &c."

Of the higher animal types of these seas the walrus, now that the right whale is nearly extinct, is the most important, and therefore comes in for a long notice. Even the walrus has suffered greatly from excessive hunting, and unless precautions are taken, will go the way of the right whale. The walrus haunts particular places of Novaya Zemlya and Spitzbergen, attracted by the abundance of their special food, which does not consist, as is often stated, of seaweed, but of various living mussels from the bottom of the sea, principally *Mya truncata* and *Saxicava rugosa*. Seals and whales are also referred to at some length.

Through Yugor Schar the vessels steamed their way into the Kara Sea on August 1. And here we are told a great deal about inland ice and icebergs, and the rich life-conditions of the Kara Sea, its surroundings and hydrography. The remarks on inland ice are specially valuable, the subject being illustrated by the writer's extensive experience in Greenland and Spitzbergen. We reproduce here (Fig. 2) a section which he gives of inland ice, and a picture of a Novaya Zemlya glacier (Fig. 3). The inland ice, Baron Nordenskjöld tells us, is of too inconsiderable extent to allow of any large icebergs being formed. There are none such accordingly in the Kara Sea, and it is seldom that even a large glacier ice-block is to be met drifting about. Indeed the Baron tells us that the popular notion as to the frequency of true icebergs in the far north is quite erroneous, the actual fact being that icebergs occur in far greater numbers in the seas which are purely accessible. The abundance of life in the Kara Sea is remarkable, though this has only been recently known, the old notion on this point being quite erroneous. As a specimen of the life to be found in this sea, we give here an Umbellula (Fig. 4).

Dickson's Harbour, at the mouth of the Yennissei, was reached on August 6, and so the first stage of the voyage was happily completed. Beyond this all was new, but it seemed to be felt that if Cape Chelyuskin was safely passed, all the rest would be comparatively easy. Here upwards of 100 pages are devoted to various topics of

[1] There are, however, various other song-birds found already on south Novaya Zemlya, for instance, *lappsparfven*, the Lapland bunting (*Emberiza lapponica*, L.), and *berglaerkan*, the shore-lark (*Alauda alpestris*, L.). They hatch on the ground under bushes, tufts of grass, or stones, in very carefully constructed nests lined with cotton-grass and feathers, and are not uncommon.

[2] The hunters from Tromsoe brought home. in 1868, 996 ; in 1869, 975 ; and in 1870, 837 reindeer. When to this we add the great number of reindeer which are shot in spring and are not included in these calculations, and when we consider that the number of walrus-hunting vessels which are fitted out from Tromsoe is less than that of those which go out from Hammerfest, and that the shooting of reindeer on Spitzbergen is also carried on by hunters from other towns, and by tourists, we must suppose that at least 3000 reindeer have been killed during each of those years. Formerly reindeer stalking was yet more productive, but since 1870 the number killed has considerably diminished.

[1] Echini occur only very sparingly in the Kara Sea and the Siberian Polar Sea, but Novaya Zemlya at certain places in such numbers that they almost appear to cover the sea-bottom.

interest suggested by the arrival of the Expedition at the mouth of the Yennissei. Evidence is given to prove that the lower Yennissei must at one time have been thickly inhabited, but is now quite deserted, probably owing to the difficulty of procuring food, a difficulty that may be solved by the enterprises begun by Baron Nordenskjöld. A long list of phanerogams is given, collected during the stay of the expedition. Some interesting dredging results were obtained, and on this subject Baron Nordenskjöld writes:—

"For the science of our time, which so often places the origin of a northern form in the south, and *vice versâ*, as the foundation of very wide theoretical conclusions, a knowledge of the types which can live by turns in nearly fresh water of a temperature of $+10^{\circ}$. and in water cooled to $-2^{\circ}7$, and of nearly the same salinity as that of the Mediterranean, must have a certain interest. The most remarkable were, according to Dr. Stuxberg, the following: a species of Mysis, *Diastylis Rathkei*, Kr., *Idothea entomon*, Lin., *Idothea Sabinei*, Kr., two species of Lysianassida, *Pontoporeia setosa*, Stbrg., *Halimedon brevicalcar*, Goës, an Annelid, a Molgula, *Yoldia intermedia*, M. Sars, *Yoldia* (?) *arctica*, Gray, and a Solecurtus."

On the long Yalmal Peninsula on the west of the Gulf of Obi, the author collects all the information known, but that is not much. The ground everywhere seems to consist of sand and sandy clay, and Baron Nordenskjöld, when he landed, could not find a stone so large as a bullet or a pea. Two chapters are devoted to a history of the navigation of the North-east Passage from 1556 to 1878; an admirable summary, containing much that is the result of the author's own research, and which never before has seen the light. Especially is this the case

Fig. 6.—The *Vega* and *Lena* saluting Cape Chelyuskin.

with the numerous Russian voyages of the seventeenth, eighteenth, and nineteenth centuries, of which little is known, but the results of which Baron Nordenskjöld acknowledges have been of the greatest service to him in forming his own plan. To the efforts of the Norwegian walrus hunters, too, Carlsen, Tobiesen, Johanessen, and others, he does full justice; and indeed their contributions to science have often been of substantial value; Johanessen, was awarded two medals by the Swedish Academy for his discoveries.

Port Dickson was left on August 10, and as the *Vega* steamed north-east to Chelyuskin over an imperfectly mapped coast, she came across many new islands, and other novelties which we cannot refer to in detail. Animal life along the Taimur coast was much scarcer than in previous parts of the voyage, though on the other hand the sea yielded some fine specimens. We give as an example a hairstar (Fig. 5) from off the coast.

The northern promontory of Asia was reached on August 19, and Baron Nordenskjöld describes the landscape as "the most monotonous and desolate I have ever seen in the High North" (Fig. 6). Here, however, we must leave the *Vega* till next week.

(*To be continued.*)

NOTES

Taking a retrospective *coup d'œil*, in a recent issue of his paper, of the Paris Exhibition, Count du Moncel notes, among other points, the marked success of the lectures, and the eagerness of the public to be instructed. A permanent electrical exhibition, with like facilities, would greatly promote the development of electric industries. The number of practical electricians in France is at present very limited, and while there are some very skilful makers of telegraphic apparatus and instruments for electrical physics, yet (if electroplating be excepted) there are no great industries giving rise to electric works like those of the cable-manufacturing houses in England, or those of Siemens and Felten in Germany. The Count hopes "our *élan* henceforth will not be confined to mere publication of electric papers." Again, a desideratum at the Exhibition was the attachment of placards to apparatus, indicating its object and general arrangement. This is a matter worth attention in our forthcoming Exhibition. At first there was some talk about giving evening concerts at the Paris Exhibition, but the fact that the city had agreed with the concert at Besselièvre, behind the Palais de l'Industrie, not to allow any concert performances within a radius of 100 m., was a difficulty. It is doubtful (the Count says) if such concerts would have much increased the evening attendance, which was always large. With regard to the Crystal Palace Exhibition, he considers it should have been put off for a year.

On the proposition of M. Cochéry, Minister of Posts and Telegraphs, the Minister of Foreign Affairs and President of the Council has nominated Dr. Warren De La Rue, F.R.S., correspondent of the Institute (Academy of Sciences), a Commander of the Legion of Honour, in recognition of his services at the Electrical Congress and as vice-president of the jury. We regret to learn that Dr. Warren De La Rue, in consequence of ill health, has been compelled to resign the important post of Honorary Secretary to the Royal Institution.

The Lightning-Rod Conference formed by delegates from the Meteorological Society, the Royal Institute of British Architects, the Society of Telegraph Engineers, and the Physical Society, which has been at work since November, 1878, has at last completed its labours and prepared its report, which, together with an enormous mass of information that has been most assiduously got together, will very soon be published. The report will consist of a brief description of the purposes which a lightning-conductor is intended to serve; a statement of those features in the construction and erection of lightning conductors respecting which there is a great difference of opinion; and the final decision on the points in question arrived at by the Conference. It will also contain a simple code of rules for the erection of lightning-conductors which any ordinary non-technical individual will be able to understand. It is hoped that the success of the publication will justify the labour that has been expended upon it. It will be published in the form of a book by Messrs. Spon and Co.

In view of the recent great development of the telephonic system, the Directors of the Magdeburg Fire Insurance Company have lately sought information from the Secretary of the Imperial Post Office, Dr. Stephan, as to whether the danger from lightning was increased by the overhead wires and iron supporting rods, and whether special conditions of insurance should be made for houses in proximity to such wires. Dr. Stephan has replied that no case had yet come to his notice in which lightning had done injury in the way referred to. The experience of the German Post Office with telephone lines was indeed short; but in other countries there was an experience of overhead telegraph lines, which was of several years' extent, and he was not aware that observations had occurred in this connection which had given any occasion for anxiety about lightning. It was important, in arranging those telephone lines, to take care that any atmospheric discharges which might affect them should have a sufficient path to earth. Such being the case the telephone wires might even afford houses a protection against lightning which they would otherwise lack. The directors of the insurance company think it at present unnecessary, therefore, to make any change in their terms in the case of houses over which telephone lines pass.

We regret to have to record the death of Mr. Charles Moore, the well-known geologist of Bath. Mr. Moore was known as a most indefatigable and successful collector. On one occasion he carted from a fissure near Bristol two tons of the celebrated bone-bed. This when sifted and examined afforded no less than 45,000 teeth, besides portions of many fish and reptiles. Most important of all, it yielded nineteen teeth of the Triassic mammifer *Microlestes*, which Mr. Moore had thus the good fortune to discover. On another occasion he astonished the British Association by his power of predicting from the forms of nodules the genera of fish which would be found inclosed in them when they were broken open. His interesting discovery of Liassic shells in lead veins traversing the carboniferous limestone was the subject of a most valuable communication to the Geological Society, and he was also one of the first to recognise the importance of the Rhætic formation in this country. The Museum at Bath owes much to the persevering labours of Mr. Charles Moore.

A Reuter's telegram, dated New York, December 18, announces the death of Dr. Isaac J. Hayes, the Arctic explorer. Dr. Hayes, it will be remembered, was surgeon of Dr. Kane's second Arctic expedition, with which he returned to the United States in 1855. A conviction that there existed an open Polar sea induced him in 1860 to undertake a voyage of exploration on his own account. He sailed from Boston in the schooner *United States*, and by means of sledges he penetrated as far north as 81 deg. 37 min. He again visited Greenland in 1869. To the last he was desirous of heading another expedition to the North Pole by way of Smith's Sound. His voyage in the *United States* was described in "The Open Polar Sea;" and among other works from his pen were, "An Arctic Boat Journey," relating to his first voyages; "Cast away in the Cold," a supplementary narrative of his second voyage, published in 1870; and an account of Greenland under the title of "The Land of Desolation." The Geographical Society of London and the Société de Géographie of Paris awarded him gold medals for his discoveries.

The death is announced, at the age of seventy two, of the Rev. Dr. John Ludwig Krapf. Dr. Krapf was a missionary of the Church Missionary Society in East Africa from 1837 to 1853, and did much for the exploration of the region north-west of Zanzibar, in company with Dr. Rebmann. They are known specially as the discoverers of Kilimanjaro and Mount Kenia.

In a paper published in the July number of the *Archives des Sciences Physiques et Naturelles* of Geneva, which we referred to at the time, M. F. Forel established, by observations of the oscillations of the lowest extremity of the glacier of the Rhone since 1856, that, although two causes determine the position of the end of a glacier, nevertheless the chief of them is not the fusion of this end by the summer heat, but the rate of advance of the glacier. As the latter depended upon the thickness of the glacier, he concluded that the variations of the length of a glacier depend chiefly upon the variations of its thickness. Measurements having shown considerable variations of thickness at the lower end of the Rhone glacier, these might be easily explained by very small changes in the thickness of the *nevé*, which changes are, so to say, exaggerated by the mutual relation of the rate of advance and the thickness, producing thus immense changes in the length of the glacier. Glacialists will appreciate the great importance of these observations of M. Forel, as they may explain an immense increase of glaciers without great variations of temperature, but only by small changes in the distribution of snow and rain which fall upon a country. However, as is pointed out by those glacialists who have sought for the key of the glacial period in an accurate study of what is going on now in Arctic countries, this relation has been rather neglected. In a second paper, which has just appeared in the November number of the *Archives*, M. Forel discusses the influence of ablation on the thickness of a glacier, the ablation, together with the amount of snow fallen on the surface of the *nevé*, being the two chief causes of changes in thickness. Our knowledge of the influence of ablation is almost nothing; but the influence due to an increase, or decrease, of the feeding of a glacier being felt, and exaggerated, throughout the whole length of a glacier, while the ablation has an importance only in its lower parts, M. Forel concludes that this second cause never would have the importance of the first. In any case both causes never can be simultaneous, the *nevé* taking fifty or a hundred years to reach the low end of the glacier; thus the thickness of a glacier at this end depends upon the quantity of snow fallen on the *nevé* some fifty or a hundred years ago, and on the ablation during a few recent years, which causes may be either concurrent, or opposing, in increasing or decreasing the thickness. He remarks also that altogether it seems that the retreat of glaciers, which reached its maximum about the year 1875, was not a local phenomenon, but was simultaneously observed in the Austrian Alps, in the Pyrenees, in the Caucasus, in Scandinavia, and in Greenland. M. Forel concludes by asking the naturalists of all countries to indicate the advance and retreat of glaciers as much as possible in figures, and to measure the thickness of glaciers at several well-determined parts.

WE fear all hope must be given up as to the safety of Mr. Powell in the *Saladin* balloon. A balloon was seen on the night of the 16th, going by Santander and Bilbao towards the sea, but nothing more has been heard of it. It may have been the *Saladin*, but if so, and Mr. Powell had been in it and conscious, he would certainly have made some sign. Mr. Powell was an ardent and intelligent aëronaut, and his death, which we fear is only too certain, must be regarded as a loss to science in the pursuit of scientific knowledge.

THE Royal Italian Scientific Institution at Venice offers a number of prizes for various memoirs. Among them we note the following two as of more general interest:—(1) "A Statement of the Hypotheses recently advanced by Physicists on the Causes of the Phenomena of Light, Heat, Electricity, and Magnetism" (prize 3000 lire (about 110*l*.), term March 31, 1883). (2) "A Systematical and Critical Enumeration of the Cryptogamic Plants hitherto observed in the Venetian Provinces" (prize and term for this treatise are not yet fixed).

THE death is announced, on November 29 last, of Dr. Wilhelm Weith, Professor of Chemistry at Zürich University. He died in the Island of Corsica, where he was staying on a visit, at the early age of thirty-seven years.

IN the night of November 19-20 the tunnel through the Col di Tenda, on the frontier between France and Piemont, was broken through. Cuneo is the nearest place on the Italian side of the mountain, where the Italian railways will join the new French branch extending through the tunnel.

WE have on our table the following books:—Cultivation of Liberian Coffee, by H. A. A. Nicholls (Silver and Co.); Report of the Scientific Results of H.M.S. *Challenger*, 1873-76, Vol. iii. Zoology; Koumiss, by G. L. Carrick (Blackwood); Every-day Life in Our Public Schools, edited by C. E. Pascoe (Griffith and Farran); Statistical Atlas, Parts x. and xi., by C. P. Bevan (W. and A. K. Johnston); Perfect Way in Diet, by Anna Kingford (Kegan Paul); Educational Theories, by Oscar Browning (Kegan Paul); The Bedfordian System of Astronomy, by J. Bedford (H. Vickers); Description of the Chemical Laboratory at the Owens College, Manchester, by Prof. H. E. Roscoe, F.R.S. (Cornish); Ideality in the Physical Sciences, by B. Peirce (Little, Brown and Co.); European Ferns, by James Britten (Cassell, Petter, and Galpin); The Encyclopædic Dictionary, by Robert Hunter (Cassell, Petter and Galpin); John Amos Comenius, by S. S. Laurie (Kegan Paul); Elementary Treatise on Electricity, by Prof. Clerk Maxwell (Clarendon Press); Astral Origin of the Emblems and Hebrew Alphabet, Rev. J. H. Broome (Stanford); Encyclopædia Brittannica, vol. xiii. (A. and C. Black); Old Greek Education, by J. P. Mahaffy (Kegan Paul); Practical Chemistry, by Howard (William Collins); British Almanack and Companion (Stationers Company).

THE following recently-published Norwegian and Danish books may interest some of our readers:—"A Geological Description of the Lofoten and Vesteraalen Districts of Norway," by K. Pettersen, with maps, and with interesting remarks on the coal-bearing Jura formation of those provinces; "A Flora of Iceland," by M. Chr. Grönlund, being the results of his visits to Iceland during the years 1868 and 1876, from which he has brought back very rich collections of plants; the flora of Iceland includes, according to M. Grönlund, 870 species, of which 332 are Phanerogams, the total number having to be increased by many Algæ; "From Fields and Forests: Pictures of the Life of Insects," in two volumes, by M. v. Bergsöe; and a pamphlet, by M. R. Lehmann, on the former coast-lines in Norway.

S. A. LEXE, who steadily pursues his studies on the recent geology of Norway, contributes to the last number of the Norwegian *Archiv* for mathematics and natural science, a paper on the upheaval of Norway, and its coast-lines and terraces.

ADVICES received at Plymouth give some particulars of a destructive typhoon which visited Haiphong and Tallee on October 8, causing great destruction and loss of life. The wind blew with tremendous violence, and the heavy sea flooded the whole of the surrounding country. In Tallee there were six feet of water in the houses three and four miles distant from the seashore. The current was so strong that it swept away the entire town, the number of persons drowned being estimated at over 3000.

IN the December number of the serial *Auf der Höhe*, Prof. Palmieri, the Director of the Observatory on Mount Vesuvius, communicates a discovery with regard to volcanoes. In a series of spectro-analytical examinations of the lava Prof. Palmieri has, it is stated, just discovered a new line which corresponds exactly with that of helium, the famous element hitherto seen in the solar spectrum only.

THE displacement of *isotherms* (or lines drawn through places having an equal mean temperature), with the season, has some interesting practical bearings. Several years' recent (so-called) phenological observation in Sweden proves that in general each phenomenon of plant-life occurs only at a certain temperature. A similar rule applies to the arrival of many birds of passage. Comparing the times such phenomena take to advance one degree of latitude, it is found on the Baltic coast that their greatest velocity is in midsummer. The numbers of days for an advance of one degree are in sundry cases as follows:—Freeing of lakes from ice 6·0, flowering of April plants in Southern Sweden 4·3, of May plants 2·3, of June plants 1·5, of July plants 0·5, appearance of leaves (general average) 2·3, ripening of fruit 1·5, fall of leaves 2·3, freezing of lakes 5·1. A recent study by Herr Hildebrand (of Upsala) of the movement of isotherms in the north of Europe throws light on these facts, showing (among other things) that while in Sweden the rate of the movement increases with the temperature, in Russia it remains nearly constant. The author gives a number of maps for various temperatures. Taking 0° it is found that the isotherms running nearly north and south move eastwards, but in the interior of the continent they are bent at a right angle, extending east and west, and moving to the north. In the map for 9° the influence of greater heating of land than of sea is apparent. The isotherms are nearly straight lines east and west, and move from south to north. For 12° they extend west-south-west to east-north-east, and move towards north-north-east.

IN the wave of administrative economy which has passed over Japan during the past three years, education has, we regret to notice, suffered. The allowance to the Education Department for the current year is only 914,601 *yen* against 1,181,100 *yen* last year—a reduction of 266,499 *yen*, or nearly 25 per cent. The expenditure on working the mines has also been diminished nearly 50 per cent. It is right to observe, however, that the estimates of every department have been largely cut down, and that much of the decrease under the head of education may be attributed to the substitution of native teachers for highly-paid foreign professors.

MR. H. TRUEMAN WOOD, Secretary of the Society of Arts, asks us to draw the attention of our readers to the Exhibition of Photographic Apparatus which the Society proposes to open next month. They hope to be able to include in the Exhibition apparatus illustrating some at least of the many applications of photography to scientific purposes, and Mr. Wood will be very grateful to any person who will entrust the Society with any such apparatus to be shown during the short time the Exhibition will remain open. Mr. Wood will gladly send full particulars of the Exhibition to anybody sufficiently interested in the matter to apply for them.

PROF. R. S. BALL, Royal Astronomer of Ireland, will give the first of a Course of Six Lectures on the Sun, the Moon, and the Planets (adapted to a juvenile auditory), at the Royal Institution on Tuesday next, the 27th instant.

A VIOLENT shock of earthquake is reported from Agram on November 20, at 8.27 a.m. The duration of the shock was two seconds, its direction perpendicular, and its intensity so great that a panic was caused, and the schools remained closed for the day. Earthquakes are reported (1) from Stassfurt, where a violent shock occurred on December 2 at 4.18 a.m., causing considerable damage in the salt-mine of Leopoldshall; (2) from Siders (Valais), where a strong shock was noticed on December 4 at 2.55 a.m.; (3) from Agram, where a shock of two seconds duration occurred on December 9 at 9.55 a.m.

THE annual meeting of the Geographical Society of Paris has been held for the first time under the presidency of M. de Lesseps. The meeting was numerous and enthusiastic. M. de Lesseps gave an address in which he eulogised his predecessor, Admiral La Roncière le Nourcy, who died recently. On the following evening the usual banquet took place at the Hotel Continental.

THE additions to the Zoological Society's Gardens during the past week include a Chacma Baboon (*Cynocephalus porcarius*) from South Africa, presented by Capt. Wyld; two Squirrel Monkeys (*Chrysothrix sciurea*) from Demerara, presented by Mr. F. N. Apthorp; a Black-backed Jackal (*Canis mesomelas*) from South Africa, presented by Capt. C. Hollard Smith; two Ferrets (*Mustela furo*) from Japan, presented by Mrs. J. F. Faed; a Bosch-bok (*Tragelaphus sylvaticus*) from South Africa, presented by Mr. E. W. Berryman; a Rose-coloured Pastor (*Pastor roseus*) from India, presented by Mr. F. Lubbock; a Herring Gull (*Larus argentatus*), a Greater Blacked-backed Gull (*Larus marinus*), European, presented by Mr. E. W. Ebsworth; six Dwarf Chameleons (*Chamæleon pumilus*) from South Africa, presented by Col. Hassard, R.E.; a Green Monkey (*Cercopithecus callitrichus*), a Mona Monkey (*Cercopithecus mona*) from West Africa, a Cerastes Viper (*Vipera cerastes*) from Algeria, deposited; four Snow Buntings *Plectrophanes nivalis*), two Common Siskins (*Chrysomitris spinus*), British, purchased.

OUR ASTRONOMICAL COLUMN

A VARIABLE OF THE ALGOL TYPE.—A telegram to the Earl of Crawford's Observatory at Dunecht, notifies that Mr. Sawyer of Boston, U.S., has detected a variable of the comparatively rare type of Algol, with a period of 5·24 days, its brightness varying between 6·0 and 6·7, and 1881, November 30·84 being an epoch of minimum. It is number 854 of Sir J. Herschel's third series of observations with the 20-feet reflector, published in Vol. iii. of the *Memoirs* of the Royal Astronomical Society; it is there called 5m. with a minute companion 88° n.p. 25″, and a note says, "not in Piazzi": these observations were made in 1827–28. The star is Lalande 31384, observed 1797, May 24, and estimated 6½; Bessel calls it 7m. in July 1822, and Santini has the same magnitude at the end of July or beginning of August 1838. Lamont has two observations at which it was estimated 7m. and 8m. In the *Durchmusterung* it is 5·5, and on the Atlases of Argelander and Heis 6m. Schjellerup called it 7·7 on 1863, June 9, and in his catalogue of 1864 he pointed out the differences in the estimated magnitudes of previous observers. Dr. Gould, in the *Uranometria Argentina* mentions that a series of comparisons between August and October 1871, indicated "an oscillation of magnitude from 6·0 to 6·5, but exhibiting no regular law in the variation"; in the catalogue he has "6·7 var.?" Taking into consideration the estimates of various observers it might be inferred the true limits of magnitude may be somewhat wider than assigned above. The position of the star for 1882·0 is in R.A. 17h. 10m. 33s. Decl. + 1° 20′·6.

A PROBABLE VARIABLE-STAR.—The following is a case which appears to be worthy of attention:—D'Agelet observed a star in 1783, on July 26, 27, and 29, which he estimated on the three nights 6, 6, and 6·5 respectively. It is No. 5057–59 in Dr. Gould's reduced Catalogue, and there called *Anonyma:* in fact it is not found, so far as we know, in any modern catalogue except the *Durchmusterung*, where it is +17°, 3997, and estimated only 9·4. The place of the star from D'Agelet, brought up to 1880·0, is in R.A. 19h. 27m. 22·10s., Decl. +17° 29′ 28″·0.

THE BINARY STAR η CASSIOPEIÆ.—The elements of this beautiful revolving double-star, which had been already calculated by Duner, Doberck, and Gruber, in 1875 and 1876, have been newly investigated by Ludwig Struve, son of the present director of the Imperial Observatory at Pulkowa. The principal characteristic of the new orbit consists in its depending entirely upon the measures of Bessel and the two Struves between 1830 and 1878, the early data of Sir W. Herschel, which, if taken into account, would exercise an influence much greater than is due to their degree of accuracy, being left out of consideration. The resulting elements are as follow:—

Periastron passage ...	1905·02	Inclination ...	56° 22′
Node	45° 3′	Eccentricity ...	0·6296
Node to periastron ...	238°·17	Semi-axis major	8″·786
For Eq.	1850·0	Period of revolution	148·90 yrs.

Duner had found the period 176, Gruber 195, and Doberck 222 years. A comparison with the measures of Dembowski (1856–76) and Duner (1868–75) exhibit constant differences, upon which M. O. Struve remarks at some length in a note to his son's memoir (*Bulletin de l'Acad. des Sciences de St. Petersbourg*, tome v.).

According to the above orbit the components close in until the year 1907, when their apparent distance is at a minimum of 1″·9 on an angle of about 305°. To test the longer and shorter periods we have:

	In Doberck's Orbit.		In L. Struves's Orbit.	
	°	″	°	″
1882·0	162·1	5·54	165·8	5·44
1883·0	164·6	5·51	168·1	5·40

M. Otto Struve's observations gave for the parallax of this star 0″·1543 ± 0″·0450, whence the mass of the two components results 8·33 times that of the sun, and the author of the memoir further concludes that the larger star has a mass 6·57 times, and the smaller one 1·76 times the solar mass. Prof. Auwers finds the proper motion of η Cassiopeiæ + 0·1346s. in right ascension, and − 0″·481 in declination, or 1″·196 in great circle, in the direction 113°·7.

SOLAR PHYSICS[1]

II.

We now have to consider what is the best method by which we can obtain, not a reversed image of the infra-red region, but a direct image of that portion of the spectrum; the problem had to be attacked in an experimental manner. It was really a matter of physics, and nothing more; the chemical question was *hors de combat*. Every silver salt which I have already shown you, you saw absorbed in the blue end of the spectrum, and not in the red; and therefore from what I had previously told you, you were prepared to hear that those salts would not be photographically effective for the red end of the spectrum, although they would be eminently so for the blue end. The question then we asked ourselves was this: Is it possible to obtain a silver salt which shall absorb in the red end of the spectrum? Is it possible, for instance, to obtain a salt of silver which will exhibit two molecular states—one absorbing in the blue, and the other in the red? If we turn to other bodies I think I can show you that there are bodies which exist in two or more molecular states. The very example of obtaining a reversed negative in the red of the spectrum by Draper's plan is an example of it. I have here another very good example of the oxidation process. This is chloride of silver paper which has been darkened by white light, and you will see that it has a tint which naturally would absorb to a certain extent the red rays. You will further see by the oxidising action we are able to produce a coloured oxide of silver. In other words, we have a coloured spectrum produced by the action of light itself, owing to the oxidising process. Alongside of this is the spectrum, taken on similar paper, without any preliminary exposure to light. You see where we get a darkened salt we have an impression of the spectrum in various colours, beginning with the blue, green, and then the red of the spectrum. Where the red end of the spectrum is you have a red oxide of silver formed.

Now let me show you that there are two different molecular states of elementary matter with which we are well acquainted. First of all I will throw a spectrum on the screen, and try to show you that there are two forms of iodine which absorb in different parts of the spectrum, telling us that they are molecularly different, when in solution at all events. The spectrum is on the screen, and I place a solution of iodine which has been dissolved in water in front of the slit, and you see that it cuts off the whole of the blue end of the spectrum, leaving only a red band. If you look at the white screen on the wall on the right you willsee an image of the slit reflected from the back of the prism, which gives the real colour of the iodine in solution. In this form, then, we have one molecular state of iodine. We will take another molecular state obtained by dissolving it in bisulphide of carbon. You see that we have a totally different absorption. The yellow is cut out, and the blue and also the red are left behind. Here, then, is one proof that we can have two molecular states of an element. But there is another interesting example in gold. If you will allow me to read from a book written by my colleague, Mr. Lockyer, he refers to the two molecular states of gold; and if possible, I should like to show you those different molecular states as far as we can on the screen. After talking about different kinds of spectra he goes on to say: "Gold is sometimes yellow, as you know, but gold is sometimes blue and sometimes red. It must be perfectly clear to all that if particles vibrate, the colours of substances must have something to do with the vibrations. If the colours have anything to do with the particles it must be with their vibrations. Now as the spectrum in the main consists of red, yellow, and blue, the red and the blue rays are owing to something in a substance which only transmits or reflects the yellow light: if we put gold leaf in front of the limelight, we can see whether the yellow light does or does not suffer any change. The yellow disappears; we have a green colour; the red and blue are absent. The gold leaf is of excessive thickness. What would happen could I make it thicker? Its colour would become more violet. This I have proved by using aqua regia. But we can obtain a solution of fine gold which lets the red light through. Its particles are doing something with the blue vibrations. We can obtain another solution which only transmits the blue. Now what is the difference—the 'particular' difference—between the gold in these solutions and that which is yellow by reflected light, and green or violet by transmitted light? It is a question worthy of much study."[1]

I will now throw on the screen an image of a thin film of gold kindly lent me by Mr. Lockyer, and you will see the colour of gold as it really is. It is not yellow, as we ordinarily know it, but is green when of that particular thickness, and it cuts off the red of the spectrum. I have here a solution of gold, which however does let red light through. It is purely metallic gold precipitated in water, and you will see what a beautiful red colour this has. This ruby colour of gold was first obtained by Dr. Hugo Müller, and experimented upon by Faraday. You can obtain also another solution of gold which is a greenish blue. It is rather a ticklish thing to show on the screen, but I daresay we shall be able to show it to you. Thus, then, we have gold in three states: the red molecular state, the blue molecular state, and the green molecular state; or perhaps the green may be referred to the difference between those two, or a combination of those two. Evidently, then, it is possible to obtain matter in two or three molecular states at the very least.

Now to apply this to our silver salts. Experience seems to show that the green molecules will be much more likely to absorb in the red than the blue molecules. I will just try to explain this by passing one or two green bodies before the slit of the spectrum apparatus (Fig. 6). In this green glass, for instance,

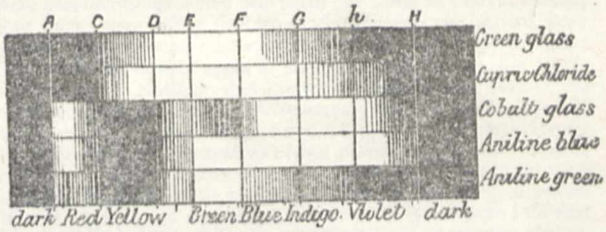

Fig. 6.—Absorption spectra of different coloured matters.

you see that the red is cut off markedly from the green. Now if we take a solution of a salt of copper—chloride of copper—you will remark that the same phenomenon presents itself; we have the red cut off as well as the blue. You may ask the question whether a blue colour may not be equally as effective in absorbing the red as the green. I think I can answer this question experimentally. Here we have a piece of ordinary blue glass; you will see that although the red of the spectrum is dimmed to a certain extent, still a streak of red appears, and the principal absorption takes place in the yellow. One would naturally infer that as the red was not entirely cut off, those rays which lie below the red would also not be cut off. That, practically speaking, is found to be the case. We will take an ordinary blue dye, and you will find that we get the same phenomenon occurring. You will notice that the image of the slit on the side screen is a most beautiful Oxford blue, and you notice in the spectrum that it is gradually cutting out the yellow. Such experiments might be multiplied, but from what you have seen it is evident that a green is more likely to be effective as a red absorber than is blue, and this would apply also to the silver salt as regards the molecular state which we wish to produce.

You may ask me—why cannot we use a green dye according to Vogel's method, which I mentioned last time? I can show you on the screen what would have happened with a green dye. There are greens and greens: some greens absorb in the red, others do not. In the ordinary green dye, which is a very complex body, part of the blue and part of the yellow is cut off, but not the red or the green, and consequently, as the red appeared it was perfectly useless to attempt to dye a film in order to produce a photograph of that end of the spectrum. What remained then to do? It simply remained to take some *simple* silver salt itself, and then to convert it into the molecular state, which would absorb the red. After four years of labour we succeeded in effecting this. In this test-tube we have some precipitated bromide of silver, which, as you saw on the screen last time, is of a yellow tint, or rather of an orange tint. Now bromide of silver is to a very small extent soluble in nitrate of silver, more particularly when acidified with nitric acid; and if such bromide of silver as we have here be boiled in a solution of

[1] Lecture delivered on May 25, 1881, at the Lecture Theatre, South Kensington Museum, by Capt. Abney, R.E., F.R.S. Continued from p. 166.

[1] P. 129, "Studies in Spectrum Analysis," by J. Norman Lockyer, F.R.S.; "International Scientific Series." (Kegan Paul and Co.)

nitrate of silver together with nitric acid, particular particles of bromide of silver are dissolved by the nitrate of silver, and then are re-deposited, built up, as it were, into bigger and bigger molecules, until finally we find we have a bromide of silver which literally is green when placed before the lantern. These two plates are respectively coated with the two kinds of bromide; first we have the ordinary bromide; and second, the bromide modified in molecular structure in the way I have described. The light from the lantern traverses the two films placed side by side, and you will see that they are eminently different in every way: the one being of an orange tint, absorbs the blue rays, the other being of a greenish-blue tint, absorbs the red. Now to show you that those two states are identical as far as the chemical composition of the molecules is concerned, I will take the green bromide of silver film which I had just now, and rub it with my finger; you will find that the blue bromide is once more reconverted into the red bromide. It has been scratched a little in the rubbing, and you will see, where the scratching has taken place, that it is of a fine orange tint. Here then we have a solution of the problem, the production of a bromide which will absorb in the red as well as one which can absorb in the blue, which is the ordinary state.

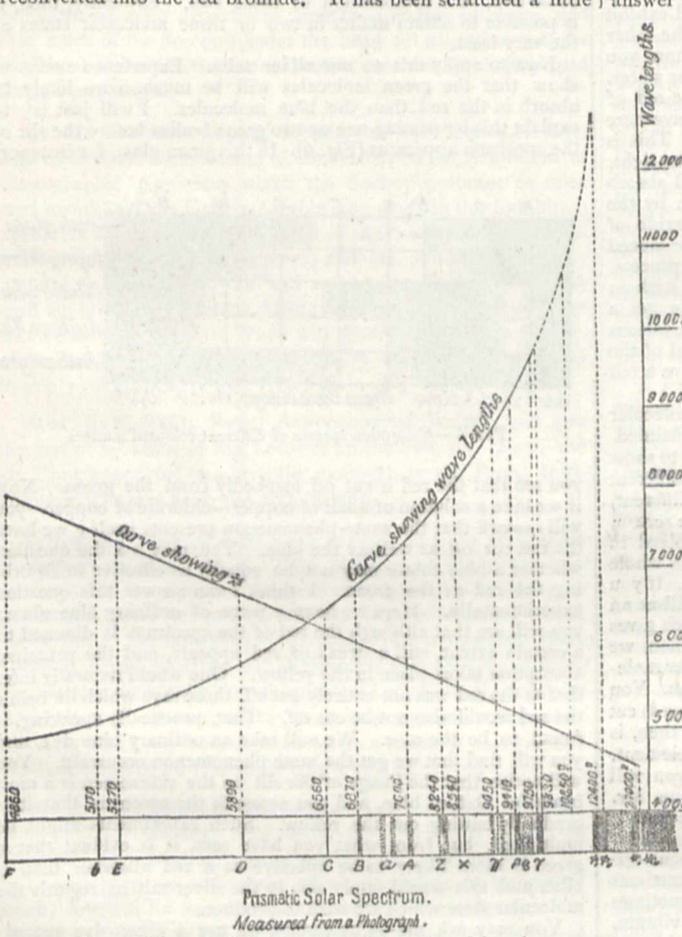

Fig. 7.—Diagram of the least refrangible portion of the solar spectrum.

Now no sooner was this bromide obtained than, of course, there was great interest displayed to test its effect as regards its being a photographic salt. To do this we naturally appealed to the spectrum. But here I have something which will be perhaps more efficacious in showing you what that salt can do than anything else. This is a photograph of the poles of an electric light taken through this sheet of black ebonite. It is perfectly opaque to all visible radiation, but through it those rays which are below the red can penetrate to a certain extent. You see then we are able to photograph with the dark rays, absolutely without using the visible rays at all. Another example of this might probably be interesting for you to see, and that is this: it is an experiment I carried out to-day, so that it is fresh in my memory. Here I have a card pierced with a few holes That card was taken and laid very nearly, but not quite, in contact with this blue bromide film, and over it was placed a blackened kettle of boiling water. If those dark rays had any effect on the blue bromide, the radiations from the kettle of boiling water ought to alter the salt. Let us see whether it did so. The photograph is rough, but still I daresay it is specific enough to show you the result. You will see that the images of these holes are exactly reproduced, and the source of illumination, if it may be so called, was the kettle of boiling water, the radiations of which sufficed to cause an alteration in the silver salt. I have been able once—I have not tried to repeat the experiment—to photograph a kettle of boiling water by its own radiation; that is to say, it became a source of light.

We will next appeal to the spectrum to see whether it is sensitive to all the radiations, and I think you will find that it will answer our expectations to the highest degree. I have on the screen the first photograph of the prismatic spectrum which was taken with this salt. You will be able to note the position of the spectrum with regard to the blue, the green, the yellow, the red. Below the impression made by the latter we have the famous A line, and below this again we have an impression made by the infra-red rays. What we next attempted was of course to get better photographs than the one I have already shown you; and next to draw a map of the prismatic spectrum.

In the following diagram we have the results of the measurements of these photographs. You see to what an enormous extent the solar spectrum extends below the limit of the visible spectrum—the A line is seen with great difficulty in the spectroscope (Fig. 7). The last band in the photograph that I last showed you was the band marked τ, but below that there are other bands which I was subsequently able to obtain. It is very rarely that these bands can be photographed at all, not because the plate is not sensitive to those radiations, but simply because of the atmospheric absorption which cuts off these particular radiations and prevents them from reaching our earth. I may say that the theoretical limit of the prismatic spectrum is very nearly reached here—not quite, but nearly. Cauchet showed that if you set up along the length of the spectrum, as we have it here, the inverse square of the wave-length of any two lines, say the inverse square of the wave-length of the B line, and erected a perpendicular line of a length representing that particular number, and also of the wave-length of the F line say in the same way, and then joined of the points thus obtained, we should get a line on which the inverse squares of the wave-lengths of H G C D would lie, and also theoretically the wave-lengths of lines below the red. Thus if we took and joined two points, all the other inverse squares of the wave-lengths would lie along that line, very nearly. In that way a theoretical limit of the prismatic spectrum can be obtained; in other words, the prismatic spectrum must stop where the wave-length is infinity. You will see that in this diagram we very nearly reach the theoretical limit. Where there is no atmosphere to interfere with the radiation, it would be easy to reach it. Since the spectrum we photographed is the solar spectrum, between the slit and the source of radiation many miles of atmosphere with more or less aqueous vapour intervene, which prevent us obtaining the limit; but with the electric light the absolute limit can be reached on some occasions, though with some difficulty. It may be asked if we can assume that there is a practical as well as theoretical limit of the prismatic spectrum; and in answer to this I may say that the measurements made from other photographs, to which reference will be made, will demonstrate that one is fully justified in adopting the theory.

The disadvantage of using the prismatic spectrum for measurement is this: you will notice the waves are very much compressed as you get down towards the red. The ordinates to the curve (Fig. 7) represent the wave-length; and if you calculate the wave-lengths from the inverse squares given by the nearly straight line it forms a curve like the above.

Now owing to the compression of the ultra-red it was very difficult to decipher the full meaning of the impressions obtained in this ultra-red region, more particularly as regards the resolution of bands into lines. You saw there were very few lines apparently, but there were bands, and the question asked was, Could we resolve these bands into lines? You recollect that Draper had in his photograph three lines below the limit of the red end of the spectrum taken by the oxidising process. They did not go very far down as it turned out, but still, there they were, and I think I can show you that those lines and bands are resolvable into lines. To do that, of course, we have to use a diffraction grating. On that stand I have a diffraction grating similar to the one Mr. Lockyer showed you, which was used in all the researches on the spectrum. We have on the screen the spectra produced by the grating; you will see that even the first two which lie next to the bright central image of the slit are much feebler than the spectrum you ordinarily see on the screen, as Mr. Lockyer pointed out. If you turn the grating further round you will see that another spectrum comes on, and by turning it still further we get a third, and so on. They are all feeble, but the two last very feeble indeed, but still they are present; of course by turning the grating in the other direction we should get similar spectra on the other side of the central image of the slit. By holding the screen up rather closer to the source of light, we shall be able to see the spectra better. I want you to notice that the violet of the third spectrum overlaps the red of the second spectrum. In order to photograph the ultra-red of the first spectrum it was necessary to use some artifice to cut out those invisible rays which lie between the violet and the red, and belong to the ultra-violet of the second spectrum, and also the violet and the blue, and the green of the same spectrum. In order to do that we used various absorbing media, but the most practicable for the purpose we had in view was a solution of bichromate of potash in water of about 1-25th of an inch in thickness. You will see that bichromate of potash cuts off the violet and the blue, and leaves the red and yellow intact. This solution was used with the diffraction spectrum to photograph the ultra-red regions. I will throw a diagram on the screen to show the overlapping of the different spectra, to make it more clear. You see in the second order the H lines comes a little beyond A (Fig. 8), and in the third line they come as far as the

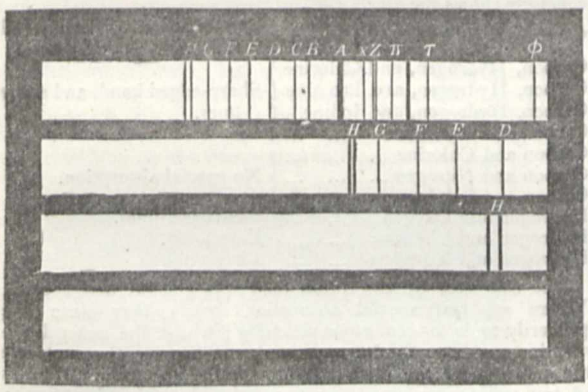

FIG. 8.—Overlap of the diffraction spectra of the 1st, 2nd, 3rd, and 4th orders.

D line. You will also notice that the bichromate of potash cuts off certain rays in the first order-spectrum, the same rays of the second-order spectrum, and those also in the third-order spectrum.

I will now throw on the screen some photographs taken with this diffraction spectrum [shown and explained].

That is as far as we have been able to distinguish with the diffraction grating up to the present time, although we have hopes that with more labour we shall be able to get further down, not to the theoretical limit of the spectrum as shown by the diffraction grating, since that is infinitely far down, but at all events towards that way. In order to show how we can plot the wave-lengths it is only necessary to use the same plate of green bromide and to expose half the slit to the second-order spectrum for the blue end, and the other half to the first order of the red end of the spectrum, using, of course, proper absorbing media. In this photograph we adopted this artifice. The top half of the slit was exposed to the red end, and the bottom half to the blue, and so you see two spectra superposed one above the other (Fig. 9). Now we know that in the second order the wave-length of a line will be exactly half that of the wave-length of the next order which is above it. That is to say, suppose the wave-length of the H line to be 3900, the ultra-red ray which lies over it would be exactly 7800, and so on. By these means, by the coincidences of these lines one with the other, one is able to ascertain the exact wave-length of lines which lie in the ultra-red rays of the spectrum.

Then came the question, were we able to separate Draper's lines into bands, and were we able to separate these bands which

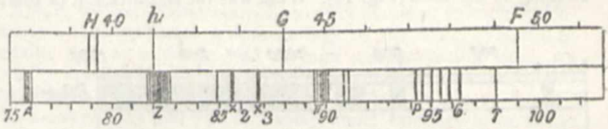

FIG. 9.—Method of determining the wave-lengths in the supra red region.

we photographed into lines? Draper's three lines were separated into 250 distinct lines, and the bands on the screen into somewhere over 500.

Having obtained means of photographing in the ultra-red region of the spectrum, what was the natural use to make of it? To introduce it into the photographic art? Not so, because there were considerations which prevented our doing so; but it seemed that there were other problems which might be settled very readily by recourse to another investigation. It seemed probable that colourless liquids ought to exercise absorption in the ultra-red regions. Nothing was known regarding them beyond the remarkable and well-known experiments made by Prof. Tyndall with a thermopile, with some source of radiation at a comparatively low temperature. He used a red-hot platinum spiral or a cube of hot water, and noted the radiation which was allowed to pass through different liquids and gases. But the knowledge obtained by this method was very much the same as if we were told that so much total visible light was cut off when examining the absorption spectra of coloured bodies. No definite knowledge was obtained as to the parts of the spectrum where the absorption of the liquids took place; in other words, Tyndall gave us a notification of the absorptions, and not their locality—a most important point.

Col. Festing joined with me in investigating this question, and we commenced, as might naturally be expected, by testing the absorption spectrum of water, and then we went on to a variety of hydrocarbons, such as the alcohol series, benzine, and so on. I need not recount to you all the various difficulties we found in our way; they were varied, but ultimately we were able to overcome them. Early in our work we had glimmerings of the truth that subsequently burst upon us in its full and truest light. The method we adopted was as follows:—You may imagine a source of light—the positive pole of the electric light forms a very brilliant source when cast by a lens upon the slit of the photo-spectroscope (Fig. 10). A tube of liquid, T, was placed between

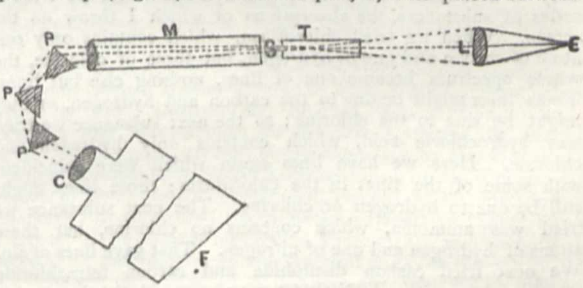

FIG. 10.—Apparatus used in photographing the absorption spectra of liquids.

the lens and the slits: the rays were passed through prisms P, and eventually were received on the photographic plate F such as we have here. Passing sunlight through the top half of the slit, and then using the electric light to get the absorption spectrum of the liquid through the bottom half of the slit, we were able to compare either the solar spectrum with the absorption of the electric light after passing through any liquid; or by placing two different liquids before the top and bottom half of the slit we were able to compare their absorption spectra with each other.

Some of the first results we obtained were with hydrocarbo n containing oxygen. Alcohol and ether are both hydrocarbons—they contain hydrogen, carbon, but also oxygen; and we noticed that in these oxygen compounds these bands of absorption were shaded bands, and not sharp and defined, as it were. We then went on to another series of compounds, or rather, part of the same group which contained no oxygen at all. Thus we worked with methyl iodide, ethyl iodide, and propyl iodide, and we found a very marked difference between the two spectra. We found that in the cases where there was no oxygen there were no shaded bands—that is to say, that if there were bands, they were sharp bands without shading at the sides (Fig. 11). What was the signification of this?

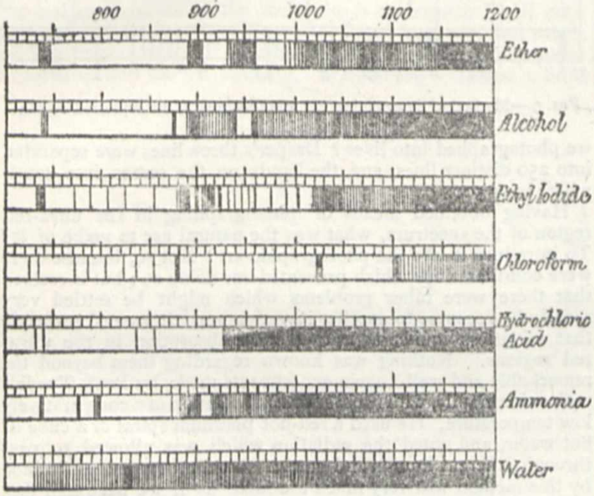

FIG. 11.—Absorption spectra of hydrocarbons, &c.

There must have been some meaning in it. Were the lines or the shaded bands due to carbon or to hydrogen? The lines could not be due to oxygen, because they were not present when oxygen was present. To what, then, could they be due? They must be due to carbon, hydrogen, or iodine; and which of these it became important to ascertain. In Fig. 11 we have a map of a selection of the different alcohols and the iodides, which were photographed. You will see that what I have said about alcohol is correct; that we have the shading off of the bands in the case of the alcohols. But when we come to the iodides we have a marked difference; we have lines springing up, as in ethyl iodide—distinct lines—which are also found in the other iodides. The question then was to trace these lines to their origin. If they were due to carbon we ought, of course, only to find them in carbon compounds; if they were due to hydrogen we ought only to find them where there was hydrogen. So we tried a series of substances, the absorptions of which I throw on the screen. When we tried chloroform, which contains only one atom of carbon and one of hydrogen, but three of chlorine, the whole spectrum became one of lines, nothing else but lines. These lines might be due to the carbon and hydrogen, or they might be due to the chlorine; so the next substance we tried was hydrochloric acid, which contains only hydrogen and chlorine. Here we have lines again which were coincident with some of the lines in the chloroform: those lines might still be due to hydrogen or chlorine. The next substance we tried was ammonia, which contains no chlorine, but three atoms of hydrogen and one of nitrogen. That gave lines again. We next tried carbon disulphide and carbon tetrachloride which contain neither hydrogen nor oxygen, with the result that we had neither bands nor lines. Evidently we had tracked the lines to their source; they were due to the oscillation of hydrogen in these particular compounds we had examined. When we took sulphuric acid we found the same result again; the bands were rather shaded, and to a certain extent it was the same in water also. The oxygen, as we shall see, formed these bands, but at the same time at the limit of the bands a distinct line was formed. Thus then we found in all the absorption spectra which contained lines, that those lines were due to hydrogen and nothing else.

I should next like to show you the further information we gained from these photographs. In the diagram we have the alcohol absorption spectrum, with a chloroform spectrum beneath it. The question to be answered is—Why should we have bands with sharp edges and fine lines in one case, and bands with sharp edges and bands shaded off in the other? In both cases the bands with sharp edges seem to be due to the base of the compound. Thus, in the case of the chloroform, the thick line or sharp-edged band seems to be due to the combination between carbon and hydrogen, and those other lines seem to be due to the vibration of hydrogen and nothing else.

What was the meaning however of the shaded bands as (say) in alcohol? When we came to the photographs it was found without exception that hydrocarbons containing oxygen, when not contained in the radical or base of the compound, always gave some shaded bands, and on measurement it was found that the shading always stopped at points where, in other spectra, we had marked the hydrogen lines. This coincidence was very remarkable, and could not be fortuitous; in fact, it seemed that there must be some connection between the position of these lines and the termination of the bands. The bands must be due to the oxygen in the compounds. What we eventually arrived at at last was this, that the oxygen blotted out the spectrum between two hydrogen lines; that is to say, if you look at it in one way, the oxygen oscillated between two hydrogen lines and cut out that particular portion of the spectrum. When we came to the benzine series, or in fact any other series, we found the same hold good: where we had hydrogen and no oxygen we had lines; where we had oxygen with the hydrogen we had bands. Where we had carbon, hydrogen, and oxygen, you see we had a shaded band and few lines; where we had carbon, hydrogen, and chlorine, or carbon, hydrogen, and bromine, or carbon, hydrogen, and iodine, or carbon and hydrogen alone, we had sharp-edged bands and many lines. Where we had carbon and chlorine, or carbon and nitrogen, or carbon and sulphur, we had no absorption whatever. That is to say, if you place bisulphide of carbon or cyanogen before the slit in one of these tubes we shall see no absorption take place except a general absorption. In other words, the absorption gradually increased and mounted up from the least refrangible end of the spectrum towards the blue end of the spectrum, and that was the only absorption which could be traced. The following table concisely shows the above:—

Carbon, Hydrogen, and Oxygen	Shaded band spectrum and few lines.
Carbon, Hydrogen, and Chlorine Carbon, Hydrogen, and Bromine Carbon, Hydrogen, and Iodine... Carbon and Hydrogen	Sharp-edged bands and many lines.
Carbon and Chlorine ... ... Carbon and Nitrogen ... ... Carbon and Sulphur	No special absorption.
Hydrogen and Oxygen	Bands and lines.
Hydrogen and Chlorine	Lines only.
Hydrogen and Nitrogen	Lines only.

The character of absorption then was general and special. Where we had special absorption bands they were due primarily to hydrogen *atoms* vibrating; whilst the general absorption was due to the *molecules*; the heavier the molecule the more it let the ultra-red through the spectrum. If bases of two series were present we found the absorption due to each base of these particular compounds present in the spectrum. Thus, by taking the absorption spectrum of, say, a compound of ethyl and benzine, we are able to say that the ethyl base was there and the benzine base was there also; the bases of these particular series being denoted by these thicker bands with sharp edges to which I have already referred.

Thus then spectrum analysis opened a way for the chemical analysis of these organic compounds, not of course in their entirety, but so as to get a qualitative idea of what they may contain.

The length of liquid generally employed was six inches, and the natural question to ask is, What is the difference caused by increasing or diminishing the thickness of the liquid between the slit and the source of light? If you increase the thickness of the liquid between the slit and the source of light, it is this: Where you have oxygen bands you have them shaded off; increasing in intensity, but spreading further—they do not spread further in a nondescript way, but in a very marked manner they spread out to the next hydrogen line, and so on. Therefore, supposing with a very small thickness we have oxygen bands extending between two hydrogen lines, in the next six inches of liquid the absorption will cover three hydrogen lines, and so on. Where you have lines, the lines never alter; where you have those base bands, or radicle bands, as they are called, they never alter; they are always in the same position, and never spread out or diminish either to the right or left. When you diminish the thickness of the fluid those bands are always present, and they are the last things to disappear in the absorption spectra.

Another remarkable thing with regard to these compounds is, as a rule there are two bands which are characteristic of their base. There is a band which is nearly always situated near the limit of the red, and another between wave-lengths 8000 to 11,000. That is to say, there is always a band to be seen somewhere about "a," and another somewhere about ρ. Those are characteristic of any particular compound we may have present.

You may say that I have been giving you a lecture on chemistry but in reality it is one which I hope may lead to results in solar physics. And I now venture to tell you how (Fig. 12). Here

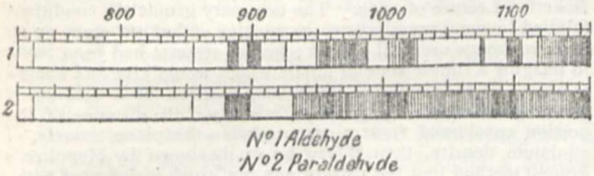

FIG. 12.—Absorption spectra of aldehyde and par-aldehyde.

is a pair of bodies which we examined, to which I wish to draw your particular attention, namely, the spectra of aldehyde and par-aldehyde. Now aldehyde and par-aldehyde are the same bodies exactly in composition, only chemists tell us that par-aldehyde has three molecules of aldehyde in its one molecule—the only difference then between them is that there are three molecules of aldehyde combined to form par-aldehyde; aldehyde of course being one molecule by itself. Not only do chemists tell us that this is the case, but they know it, because if they heat par-aldehyde they get aldehyde formed again, and can reconvert this into par-aldehyde. Now I want you to notice the difference in the spectra between these two bodies. We have two bodies of the same chemical composition and of different molecular grouping, and you will see there is a total distinction in the two absorption spectra they yield. The only thing in common is the radical band. There may be one or two other coincidences, but all the rest of the spectra are perfectly distinct. Now if you refer back to Mr. Lockyer's lectures I think this alone will throw some light on what he has already said to you. He has told you, for instance, that the spectrum of iron in the flames and the spectrum of iron in the

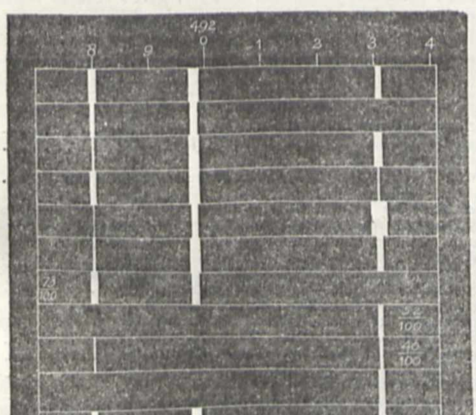

FIG. 13.—Diagram of three iron lines as observed by Lockyer.

spots are dissimilar; and he has kindly furnished me with a photograph which shows one little part of the spectrum in which this is exemplified in a remarkable degree. In it we have three iron lines close to one another (Fig. 13). In the sun-spots two of those only appear, and in the flames the third alone appears If you look at this by the light of that photograph of aldehyde and par-aldehyde which I had on the screen, I think it is a reasonable deduction to make that the iron in the flame and that in the sun-spots have different molecular groupings. I say that this spectral analysis to which we have subjected aldehyde and par-aldehyde, and many other similarly constituted bodies, lends confirmation to that view. Of course, in the case of organic compounds, we can appeal to the chemist to analyse them for us, and he tells us that they are different molecular groupings. It is scarcely fair in one case to admit that the two spectra are given by two molecular groupings of the same substance, and in the other to deny it.

Again, we found that many lines were common to each hydrocarbon: thus we found a line at 867 of the scale, common to benzine and to alcohol; and to take one particular case, we found a special line common to water, hydrochloric acid, and chloroform. Has this any bearing on what you have heard? Mr. Lockyer has told you that some short lines are to be found in two, three, four, or even six different metals, not taking the long lines into account, as they might be considered to be due to impurities in the different spectra. Let us apply this to our case. A certain substance, A, has certain lines coincident with B; B also has certain lines coincident with C; and C also has other lines coincident with A. Now we will suppose these hydrocarbons were looked upon as elements, but that eventually the chemists split up what they considered elements, and found that the only substance which was common to the three was hydrogen. I leave you to draw the parallel between Mr. Lockyer's experiments and those which I have endeavoured, in a very rough and unsatisfactory manner, to bring before you. I think, if the chemist will admit that in the case of the hydrocarbons it is hydrogen which produces the lines common to all, there is no reason on earth, supposing the metals are not elements, why you should conceive that they should not have a common constituent in the same way that the organic compounds have a common constituent in the shape of hydrogen. I leave that for your consideration.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

OXFORD.—Among the professorial notices of next term's lectures already published are those of the Professors of Astronomy, Geology, Botany, and Medicine.

Prof. Pritchard will give three courses at the University Observatory. He will lecture on the Lunar and planetary Theories, and will form two classes for practical instruction in the evenings. Prof. Prestwich will lecture on Stratigraphical Geology in the University Museum. Prof. Lawson will lecture on the Elements of Systematic Botany at the Botanic Garden.

The Professor of Medicine, Dr. Acland, gives notice that the next examination for a Radcliffe Travelling Fellowship will commence in the second week of February. Candidates are requested to communicate with the Professor.

The professors and lecturers engaged in teaching Physics have settled a combined system of lectures for next term as below:—

Hydromechanics, by Prof. Price; (1) Distribution of Terrestrial Magnetism, (2) Electricity developed by Contact of different Substances, by Prof. Clifton; Instruments and Methods employed in Optical Measurements, by Prof. Clifton; Practical Physics, by Prof. Clifton, Mr. Stocker, Mr. Heaton; The Generation and Measurement of Electric Currents, by Mr. Baynes; Electrostatics (treated Mathematically), by Mr. Hayes; Elementary Mechanics (treated Experimentally), by Mr. Stocker; Problems in Elementary Mechanics and Physics, by Mr. Heaton; Elementary Physics treated Experimentally (Heat and Light), by Mr. Dixon. The lectures on Optical Instruments are intended to serve as an introduction to the practical work in the laboratory. The last three courses of lectures are intended to meet the requirements of candidates for the Preliminary Honour Examination.

An examination for a Fellowship in biological subjects will be held at University College in February, 1882, beginning on Wednesday, February 22, at 9 a.m. Candidates are desired to call on Mr. C. J. Faulkner with the usual testimonials and certificates on Tuesday, February 21, between 5 and 6 p.m. But intending candidates are desired to send in their names to him before February 1, 1882, with a list of the subjects which they offer for examination, and at the same time to mention any branch of biology to which they have turned special attention, or on which they may have written original articles. Copies of any such articles should also be sent in. The examination will comprise (A) Papers of Questions, and (B) Practical Work, in Zoology, Physiology, and Botany. Further and more detailed information may be obtained of Mr. Faulkner.

CAMBRIDGE.—Prof. Stuart has received the offer of an engine from Dr. Siemens for his class-rooms of mechanism. The extension of the workshops is to be proceeded with at once.

Practical anatomy will commence next term on January 20. Demonstrations on Heat, by Mr. Glazebrook, and Electricity and Magnetism (advanced), by Mr. Shaw, will be given next term in the Cavendish Laboratory.

Mr. Garnett will give elementary lectures on Heat in St. John's College, beginning February 2, adapted to the 1st M.B., the Special Examination in Mechanism and Applied Science, and the first part of the Natural Sciences Tripos.

GLASGOW.—The Clark Fellowship in Natural Science (225*l.* per annum for three years) has just been awarded to Mr. John H. Fullarton, M.A., B.Sc.

SOCIETIES AND ACADEMIES

LONDON

Chemical Society, December 15.—Prof. Roscoe, president in the chair.—The following papers were read:—On some higher oxides of manganese and their hydrates, by W. H. Veley.—On a new alkaloid from Cinchona bark, by D. Howard and J. Hodgkin. The authors have extracted from the bark of China Cupræa an alkaloid closely resembling quinine in its general properties. It differs in the solubility of its salts; and from the readiness with which the alkaloid crystallises from ether; they have named it homoquinine. In the discussion which followed this paper Mr. Cownley mentioned that he, in conjunction with Dr. Paul, had separated apparently the same alkaloid, and that the results would be published in the next number of the *Pharmaceutical Journal*.—Contributions to the chemistry of the rare earth metals, by B. Brauner. This paper gives an account of a most thorough investigation of some compounds of cerium and didymium, and the determination of the atomic weight of lanthanum. The author has prepared a tetrafluoride of cerium and a pentoxide of didymium; he places these metals in the eighth series (horizontal) of Mendeljeff's system, thus: Cæsium 133, barium 137, lanthanum 139, cerium 141·6, didymium 146·6.

Royal Horticultural Society, December 12.—Lilies attacked by larvæ of *Brachycerus*, sp.: Mr. Maclachlan exhibited larvæ received from Mr. G. F. Wilson of Weybridge, which eat into the centre of the bulbs of lilies.—Cocoanut attacked by larvæ of *Hylocœtus*, sp. The same gentleman also showed some remarkable larvæ with a curiously indurated joint below the head. The species, he observed, was remarkable in penetrating the soft wood of palms, as the European species attacks hard wood, such as firs. He had met with the latter in the Black Forest.—Proliferous fir cone: Dr. M. T. Masters exhibited a cone of *Abies Douglasii*, in which the bracts were foliaceous, but the seed-scale partially atrophied, as is usually the case in proliferous cones. He contrasted this with a proliferous state of *Sciadopitys verticillata* (see Veitch's "Manual of Coniferæ," Fig. 46), in which the seed-scale became foliaceous, the bract remaining normal. The importance of this latter specimen in relation to the nature of the so-called leaves of *Sciadopitys* and of the seed-scale of the Abietineæ was commented on.—Embryo-bud of oak; Mr. W. G. Smith exhibited a specimen about one and a half inches in diameter. It was removed from beneath the bark. Such are extremely common in beeches, in which they vary from the size of peas to that of one's fist.

Society of Telegraph Engineers and of Electricians, December 15.—Annual general meeting.—The following gentlemen were elected as the council of the Society for the ensuing year:—President, Lieut.-Col. C. E. Webber, R.E.; Vice-presidents:—Willoughby Smith, Prof. W. G. Adams, F.R.S., C. E. Spagnoletti, M. Inst., C.E., Prof. D. E. Hughes, F.R.S., Hon. Treasurer, E. Graves; Hon. Secretary, Lieut.-Col. Frank Bolton; Council: W. S. Andrews, William T. Ansell, Sir Charles Bright, M. Inst. C.E., C. B. Bright, the Earl of Crawford and Balcarres, F.R.S., H. G. Ericksen, H. C. Forde, M. Inst. C.E., Matthew Gray, John Fletcher Moulton, F.R.S., Alexander Siemens, Augustus Stroh, C. F. Varley, F.R.S.; Associate Members of Council: Capt. J. T. Bucknill, R.E., C. H. B. Palen, T. R. Crompton, M. Inst. C.E.

EDINBURGH

Royal Society, December 5.—The Right Hon. Lord Moncreiff, president, in the chair.—After a few introductory remarks, the president proceeded to read the obituary notices of Dr. J. Hill Burton, Dr. Andrew Wood, Prof. Sanders, Dr. Handyside, and the Rev. Dr. Cumming.—A quaternion paper on Hamilton's symbolical cubic, by Dr. Gustav Plarr, was presented by Prof. Tait, who then made an interesting communication on the subject of Mirage. By means of a simple assumption as to the law of variation of density in a stratum of air near the earth's surface, a complete explanation could be given of the very curious erect, inverted, and again erect images which were observed by Vince towards the end of last century, and formed the subject of the Bakerian Lecture of 1799. The necessary geometric conditions fulfilled by contiguous rays so as to give either an erect or an inverted image are well known; but no attempt had been made to imagine a simple state of affairs which would give *both* images at once. If the refractive index of a portion of a medium is given by the equation $\mu^2 = a^2 + y^2$, where y is the distance of the portion considered from a given plane—the plane, namely, of minimum density, then it can be easily shown by Hamilton's general method that the path of any ray which is deflected without touching the plane of minimum density is a distorted inverted catenary, and is obviously symmetrical with respect to a vertical line through its vertex. Whatever the law of density, the upper of two such contiguous rays emanating from a given point must in general have its vertex either a little behind or a little in front of that of the lower ray. In the former case the rays *cross* before they return to the same level from which they started, and an inverted image is the consequence; in the latter case they do not cross, and the result is an erect image. Hence the mere inspection of the locus of vertices of all possible rays coming from a given point is enough to tell the kind of image seen by any given pencil of rays belonging to the system. Also all rays that pass between any two given points on the same level must have their vertices on the vertical line half way between these points. If then the locus of vertices is such that it can be cut in three distinct points by a vertical straight line, evidently three images will be possible, two direct and one inverted, precisely as seen by Vince. That under certain circumstances the locus is of this nature can easily be demonstrated. It is not essential that the alteration of refractive index should extend through a large stratum of air; indeed the supposition that it holds only through a limited stratum, and that below the air may be of practically uniform density, gives results much more in accordance with what has been observed in nature.

CONTENTS