ARCTIC SUCCESS AND DISASTER

THURSDAY, DECEMBER 22, 1881

The Governor of Yakutsk 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 adjutant of the chief of the district was immediately charged to proceed with a doctor and medicines to succour the survivors at Yakutsk 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 who 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 Idolacio Idolatre on October 29. There also arrived at Bolonenga boat No. 1, with the sailors Hindmann and Hoross, with the information that Lieutenant 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 unfortunate 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 Zegadloff, 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 Nordenskjold 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 there 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 Jeannette. 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 Nordenskjold. 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


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 Archibald 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 treatments 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 geologists had brought into general acceptance, both in England and on the Continent, with all questions of geological classification.

Dealing with the formation from the Carboniferous to the Cretaceous inclusive. But above and below those limits Smith's classification of strata, which had met with very little success, was not generally adopted, and is still set forth in the volumes before us (vol. i. pp. 182-319).

Besides the "Principles of Geology" and the expan-

sions 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 or authority, not even on personal observation and close reasoning, so that he might always act upon his own unerring judgment. It is not surprising, therefore, that he was entitled to be considered the founder of that school of thought which we call the "stratigraphical school," and which is really the only one of the two main schools of geological research which has so far made its way successfully to the general mass of men.

In the absence of a form of life which was, as we have seen, set forth in the volumes before us (vol. i. pp. 182-319).

1 Continued from p. 148.
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. 375).

"Sedgwick asked me to walk home with him. I found a gloom upon him, unusual and marked. I most carelessly we that are adhering to the original divisions and must have more than mere talent" (vol. i. p. 375).

"Brongniart, who, in imitation of Cuvier has many clerks and collaborateurs, is known to lose more time in giving scientific instruction in schools and universities. In his "Travel in North America" he devoted a chapter to 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 went to get Mantell's casts I found that the man who made them with which all was executed was admirable. It cost me, Thursday last, that he wished himself left alone with his glory, he is depressed. He told me, Thursday last, that he wished he had set before himself, yet he was far from being an uncongenial situation" (vol. i. p. 375).

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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 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 with the same solicitude that a summons 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 what 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.

J o h n W. J u d d

NATURE [Dec. 22, 1881]

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 presses, and the difficulty of obtaining paper, make it impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.]

The Function of the Ears, or the Perception of Direction

REFFERING to the letter in NATURE (vol. xvi. 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 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 had been made upon 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 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 enjoyed the right side of a walk three metres broad. He then complained of the difficulty he had experienced because that stupid darling had whistled in place of shouting. When the ground was cleared a few days afterward, 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 usually meet it. Have not English landscape gardeners the same faculty of judging rightly by direction by sound. —Antoine d'Abbadie

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 visae mai flor' c' 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 "on Buhler"—recalls irresistibly Horace's "rei 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 an explanation of this remarkable fact. I apprehend your correspondent alludes to the line—

"To the right hand I turn'd and fix'd my mind
On the other pole attentive. where I saw
Seem'd joyous. Oh thou northern site! bereft
Of our first parents. Heaven of their rays
On the other pole attentive. where I saw
Seem'd joyous. Oh thou northern site! bereft
Of our first parents. Heaven of their rays

D. 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 philosophical 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, 2500 years before our era, since, according to Gallé, this constellation might previously have reached an altitude of more than 10°. When it disappeared from the horizon of the countries of the Bible the great pyramid of Cheops had already been erected more than 5000 years ago." Barlow therefore infers with Humboldt which, after remaining long invisible, will again appear in these latitudes after a lapse of thousands of years. The Southern Cross was never absent, says of them:—"In consequence of the precession of the equinoxes, this constellation" (avé, p. 152) has been discussed by most modern commentators. 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 visae mai flor' c' 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 "on Buhler"—recalls irresistibly Horace's "rei gens mortalium." —J. J. Walker

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On the evening of Wednesday, November 16, whilst sweeping the western heavens in search of comets, I was startled by a brilliant illumination at 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 20° in a north-easterly direction, passing about 2° above (or west of) Alpha Aurigae. 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, it formed a low 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 3° in breadth, and could be traced back with perfect visibility to the moment of appearance. 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 contracted for each moment. During the whole time of its visibility it retained its pinkish colour. The first appearance of the meteor was at 5h. 45m. 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. 30m. it could still be seen in the instrument. While visible, it drifted about 4° to the north-east, but in the telescope the train was hard to discern; while invisible, it 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 return of Aricia, but none very brilliant. —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 after flying to the west, it had a train of light 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 return of Aricia, but none very brilliant. —E. Howarth

Sheffield Museum and Observatory, December 18

Meteors

Herbaceous Stem on a Palaeolithic Implement

INSTANCES are so extremely rare where vegetable material (as old as the drift gravels) is found adherent to drift implements, or where there is any sure indication of employing hydrogen gas as our heating agent. Smokeless and innocuous in combustion, it would relieved us from many ill's 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

The-Smokeless London

It is not very improbable that we shall in a few years be illuminated 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 relieved us from many ill's 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
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 vegetable material is undoubtedly as old as 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 the base of the flint and the basal end of the implement as a protection for the hand against the asperities of the flint.

The vegetable material is undoubtedly as old as the implement, and the untravelled condition of the stone may account for its position in the facets.

Sir John Lubbock's address to the British Association, and Mr. Francis Darwin's paper in the Linnean Transactions, on the hygroscopic 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 Hillebrand and Zimmermann in Prinz's Jähnscher) forestalled as to Zrodium 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 Capel Street, Dublin, describing and figuring his observations on the achenial awns of Zrodium moschatum and Pelargonium peltatum. He finds that the awns of Zrodium possess "most wonderful hygroscopic 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 figure by Hillebrand). 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 by twisting they become like balloons wafted about by every zephyr. But motive power has not ceased with the awn: the slightest hygroscopic 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.

The Song of the Lizard

WHILST quartered in St. Helena, at Ladder Hill, I was frequently disturbed by the "tweak-toss" 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 Mollis's description, the "Hemicentetes femuratus" (Schlegel). —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. 321).

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 Rammore, Sheffield. The egg weighed 47 oz., and measured round its greatest circumference 8 inches, and its least 7 inches. In color it was a bright brown, 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 areas. 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, Deptford, 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 again appointed, F.G.S., K.B. Kenederford, Com. for the Forest of Epping. He also took great interest in the work of church extension, and was a member of the Ray, the Palaeontographical 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 had two sons, 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 1841 his attention was attracted to the wonderful deposit which the Thames Valley brickearth yields. Owing, however, to their porous nature, the bones had lost, during their long interment, all their gelatine, and the earlier workers had either removed the bones, or crumbled the touch, and it was not until fresh gelatine had been introduced that it was found possible to preserve them magnificently remains of the most important and extensive excavations. From 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 : Fossil spaltera, Canis vulpes, Ursus, sp., Elaphus primigenius, E. antiquus, Rhioceros leporinus, R. megavirginus, R. libi- nonus, Equus fossilis, Megacerus Hystericus, Cerus cephalus, Bos primigenius, Bos primigenius, Equus ca- tattus, 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. Cheddle, 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 been shown to us in this area that are 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...
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 its kind, and by far the most successful of any of its kind, and by far the most successful of any of its kind. 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 it all, the natural current of things, the needs 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 of mortal events, which the sun should never take it as the test of good or bad government. The pleasures of the ancient Greeks 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.

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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 much to the present condition of private slaughterhouses, 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 a 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 consequence of that system, contending that we had created by it most of the evils of which we complain. Owing to an accident of arrangement, a paper by Mr. W. S. Mitchell, M.A., entitled "A Comparative View 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 land改良, and the imposition of extraordinary tithe on market and hop gardens. Our landlords 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 a systematic way, if the cultivation of vegetables were to be carried as far as they became economical, and to be supported 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 such, changed the character unless properly and naturally dealt with by being given to the earth. The address was very warmly received.

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 wholemeal 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 would be no further difficulty in supplying the demands of this country with wholesome fresh animal food if the matter was 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 carcasses un-packed from Australia, had examined the preserved flesh, had partaken of it, and had contended that the scientific difficulties were solved, and that nothing but commercial decide 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 Food," led up to a final address by Major Hallnett, on "Food-Plant Improvement." In this paper Major Hallnett described his recent 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. Taaffe, M.D., Medical Officer of Health for Brighton

Dr. Taaffe'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 and circumstances 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 the practice of 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 such, changed the 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. C. Collins followed on "Home Sanitation and House Inspection," the practical course brought 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 the evolution of the eye as an optical instrument; next he dealt 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 by which the defect of short-sightedness is so ex- tended, was strongly condemned, as well as the faults connected with bad light, bad paper, and irregular and imperfect printing.

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 afternoon, Dec. 17, by the lecture delivered to the working classes, as well as to the Associates, by Mr. Brudenell Carter, in the lecture-room. For his long "Eye-sight," 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 members of which it 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 extended, 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 to the healthful. All kinds of mechanical contrivances, and numerous objects for illustrating artistic improvements, such as painting of walls in corridors, halls, staircases, and rooms. Here were instruments in abundance, and 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 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 of the surface of the earth. When such a smooth surface is strong and solid and maintained long enough to allow the waters to flow over it, the motion of the water will be slow, and the denudation that takes place will be slow and gradual. Now, in this we are not to be confounded with the abrasion of the surface of the earth by the action of the atmosphere, or the abrasion of the surface of the earth by the action of the ocean. The abrasion of the surface of the earth by the action of the atmosphere is rapid and irregular, and is caused by the action of the wind and by the action of the water. The abrasion of the surface of the earth by the action of the ocean is slow and regular, and is caused by the action of the waves and of the tides. The abrasion of the surface of the earth by the action of the atmosphere is rapid and irregular, and is caused by the action of the wind and by the action of the water. The abrasion of the surface of the earth by the action of the ocean is slow and regular, and is caused by the action of the waves and of the tides. The abrasion of the surface of the earth by the action of the atmosphere is rapid and irregular, and is caused by the action of the wind and by the action of the water. The abrasion of the surface of the earth by the action of the ocean is slow and regular, and is caused by the action of the waves and of the tides.
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 mind, they take to it and assimilate it with a rapidity worthy of their more mercantile neighbours, 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 the vast variety 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 had been 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-tse. As we write, a Chinese steamer engaged on the Thames, bringing several u of western science in the nineteenth century, 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 Nordenskjold has not contented himself with merely telling the story of his own successful voyage and its results. That voyage, as we have said, crowned the efforts of centuries, and discovered by the results of which the Vega has accomplished her work with scarcely an adverse incident. It will be remembered that some six years ago Baron Nordenskjold showed that the voyage from Norway to the mouth of the Yennisei 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 Nordenskjold has been at work in the seas to the north of Europe, and mainly in Spitzbergen, and the rich results of his M and the Yennisei expedition led him to think that there was no more familiar with the ice-conditions of these northern seas than any other authority; and his success in the Yenissei expedition led him to think that there was no reason why the whole North-East Passage should not be navigated. But Baron Nordenskjold 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 Othore, 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,

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which had baffled all the attempts of those daring Rus-

sian sailors of the seventeenth and eighteenth centuries,

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 sea-
sons. 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, how-
ever, 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 charac-
teristics. 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 Dick-
son of Gothenburg, who has spent a fortune in the cause
of science, and Mr. Sibirjakoff, a Siberian merchant,
agreed to advance the funds for an expedition round the
continents of Europe and Asia. The Vega, a barge-
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.

Stuxberg, zoologist, Herr Almqvist, medical officer and
lichenologist, Lieut. Bruzewitz, second officer, Lieut. Bove,
of the Italian Navy, hydrographer, Lieut. Høgaard, of
the Danish Navy, for magnetism and meteorology, and

Lieut. Nordquist, of the Russian Guard's, 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 most ample 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 highest 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 Lona 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 from Karlskrona, the expedition left Tromsøe 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 Vager 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):—

“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 (Larista parasitica, L.), known by the Norwegian walrus-hunters under the name of trussjo, derived from the bird's cry, 'I-tso,' 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 quick and out of so many eggs in succession that it sometimes has to stand without moving, unable to fly further until it has drawn upon itself to the far end. 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 have named it 'trussjaeger'-refuse-hunter—because they believed that it hasted to the shore after the excrements, which 'trussjaegeren' was said to devour as a luxury. The skua breeds upon low, unsheltered, oftentimes 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 to the pale behaviour to draw the intruder off 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 great 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 shatterers of the sea, a merry twitter. Some come from an old acquaintance from the home land, the snoepjaroen or snoelaaruen, the snow-bunting (Emberiza nivalis, L.). The name is well chosen, for in winter this pretty bird lives in the drifted snow, and in summer betakes itself to the mountains. It is found 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."

Then Baron Nordenskjöld goes on to do for the mammals 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 deep snow burying up to which it is exposed on Spitzbergen, is found there in much larger numbers than on North Novaya Zemlya or the Taimyr 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 food, 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 Matotshkine Schar.

Notwithstanding the immense destruction of 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 us ample for any scarcity of life on land.

"Here animal life is exceedingly abundant as far as we have succeeded in making observations to the farthest north. At nearly every sweep the dredge brings up from the sea-bottom masses of decapods, crustacea, mussels, astérides, echinid, &c., in varying forms, and the surface of the sea is covered by swarms with pteropeds, beridæ, 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 one. The hunters from Tromso brought home in 1863, 996; in 1869, 975; in 1872, 819, of these, the males are worth, as is stated from time to time, more than all the other catches. 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 and there we meet with 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, for not only are the subject-matter lists of the Baron'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 of Spitzbergen, the Baron Nordenskjöld tells us, is of too enormous 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 with. 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 a picture of a Novaya Zemlya glacier (Fig. 4). Dickson's Harbour, at the mouth of the Yenissei, 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 and more of the Zemlja have been seen; 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 100 reindeer have been killed during each of those years. Formerly reindeer hunting has been yet more productive, but since 1870 the number killed has considerably diminished. The hunting is only very springing in the Kara Sea and the Siberian Polar Sea, but Novaya Zemlya at certain places in such numbers that they almost appear to cver the sea-bottom.
interest suggested by the arrival of the Expedition at the mouth of the Yensenné. 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 versa, as the foundation of very wide theoretical conclusions, a knowledge of the way which can live by turns in nearly fresh water of a temperature of +10°, and in water cooled to 2°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, a species of Mysis, Diastylys Rathkeii, Kr., Idiothea ontogenen, Lin., Idiothea Sabinei, Kr., two species of Lysianassida, Pontoporeia setosa, Stbrg., Halimedeon brevicalcar, Goës, an Annelid, a Molgula, Voldia intermedia, M. Sars, Voldia (q) arctica, Gray, and a Solecurtus."

On the long Yalmal Peninsula on the west of the Gulf of Ob, 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 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.

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
We regret to have to record the death of Mr. Charles Mount, the well-known geologist of Bath. Mr. Mount 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. Mount 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 general fish and which would be found included in them when they were broken open. His interesting discovery of Tertiary shells in lead veins containing the carboniferous limestone was the subject of a most valuable contribution to the Geological Society, and he was also one of the first to recognize the importance of the Rhaetic 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 1856 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 St.igt. 37 min. He again visited Greenland in 1859, 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 1879; 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 1875, and did much for the exploration of the north-west of Zanzibar, in company with Dr. Rebmann. They are known specially as the discoverers of Kilimanjaro and Mount Kenya.

In a paper published in the July number of the *Archives des Sciences Physiques et Naturelles de Genève*, which we refer 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 thickness of the 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 *neve*, 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. Glaciologists 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 glaciologists who have sought for the key of the glacial period in an account
only 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 *neve*, 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 *neve* 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 *neve* some fifty or a hundred years ago, and 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 to arrest 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 adding 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 10th, 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 aeronaut, 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'), term March 31, 1883). (2) "A Systematical and Critical Enumeration of the Cryptogamic Plants hitherto observed in the Venetian Provinces" (price and term for this treatise are not yet fixed).

The death is announced, on November 29 last, of Dr. Wilhelm Welth, Professor of Chemistry at Zürich University. He died in the Island of Coroica, 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 Piedmont, 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); British Almanack and Companion (Stationers Company).
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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-southwest 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 914,001 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. Truean Wood, Secretary of the Society of Arts, asks the draughtsmen, presented by Capt. G. A. Smith; two 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 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 at 2.55 a.m.; (2) from Agram, where a strong shock was noticed 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 eulogized his predecessor, Admiral La Ronciere le Nourry, 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 pannonicus) from South Africa, presented by Capt. Wyld; two Squirrel Monkeys (Chrysothrix sciureus) from Demerara, presented by Mr. F. N. Aphorph; a Black-backed Jackal (Canis mesomelas) from South Africa, presented by Mr. W. E. Wetherall; two Ferrets (Mustela furo) from Japan, presented by Mrs. J. F. Faed; a Bosck-bok (Trogphysus syriacus) from South Africa, presented by Mr. E. W. Berryman; six Dwarf Chameleons (Chameleon pumilus) from South Africa, presented by Col. Hassard, R.E.; a Green Monkey (Cercopithecus callorhinus), a Mona Monkey (Cercopithecus mona) from West Africa, a Cerastes Viper (Vipera cerastes) from Algeria, deposited; four Snow Fainting Butterflies (Colias callidryas), two Common Siskins (Chrysocephalus spinus), British, purchased.

OUR ASTRONOMICAL COLUMN

A VARIABLE OF THE ALGOLTYPE.—A telegram to the Earl of Crawford's Observatory at Dunwich, notes that Mr. Sayce 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 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 8n. p. 2'/, and a note says, "not in Piazzi"; these observations were made in 1827-28. The star is Lalande 3138, observed 1875, May 24, and estimated 6/. Bessel calls it 7, 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 5m. and on the Atlases of Argelander and Heis 6m. Schjellerup called it 77 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 Uebertrum, mentions that a series of comparisons between August and October 1871, indicated "an oscillation of magnitude from 6m. to 5m., 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 proper motion of the star for 1882 is in R.A. 17b. 50m., Decl. +1° 26'/6.

A PROBABILY VARIABLE-STAR.—The following is a case which appears to be worthy of attention. D'Agelet observed a star in 1873, on July 26, 27, and 29, which he estimated on the three nights 6, 6, and 6'/ respectively. It is No. 5207-59 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, is in R. 19b. 27m. 22, Decl. +1° 26'/6.

The Binary Star e Cassiopeia.—The elements of this beautiful revolving double-star, which had been already calculated by Duner, Dobrèck, 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 being entirely determined by measures of the separation 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 follows:

Period 77.225 days
Node to periastron 238°17' Semi-axis major 7°730
For Eq. 1850° 0 Period of revolution 145°970
Duner had found the period 176, Gruber 155, and Dobrèck 222 years. A comparison with the measures of Dembowski (1878-79) 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. Petersburg, 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° on an angle of about 305°. To test the longer and shorter periods we have:

from Dobrèck's Orbit. In L. Struve's Orbit.
1882° 162° 7°54° 164° 8° 54°
1883° 164° 6° 54° 165° 1° 54°
M. Otto Struve's observations gave for the parallax of this star 0°154 ± 0°156, whereas the mass of the two components is equal or nearly equal to the mass of the sun; the period of revolution of 222 years further concludes that the larger star has a mass 6.57 times, and the smaller one 17.6 times the solar mass. Prof. Anslev finds the ratio of masses of e Cassiopeia = 01346, in right ascension, and = 0°481 in declination, or 1°106 in great circle, in the direction 113°7.
SOLAR PHYSICS

II.

We now have to consider what is the best method by which we can obtain the direct 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 de la carte. Every silver salt which I have already shown you, saw absorbed in the blue end of the spectrum, and not in the red; and yet two or three of them had, I had previously in front of you were prepared to hear that those salts would not be photographically effective for the red end of the spectrum, although they could be eminently so for the blue end. The question that 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 that there are bodies which exist in two or more molecular states.
The very example of chemical reversibility here is a very good example of the oxidation process. This is oxidising action we are able to produce a colored 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 parts of the spectrum, telling us that they are molecularly different, and that which is yellow by reflected light, and green or violet by transmitted light?

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 not reflect 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 blocks of crystal before the screen, and you will 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 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 the thread 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, I 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 the bromide of silver is to a very small extent soluble in nitrate of silver, more particularly when acidified with nitric acid; and such bromide of silver as we have here is a solution of

1 Lecture delivered on May 23, 1880, at the Lecture Theatre, South Kensington Museum, by Prof. Abney, R.E., F.R.S. Continued from p. 100.
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 molecule, 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 recovered into the red bromide. It has been scratched a little 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 Cæterum to see what 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, and 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 spectrocope (Fig. 7). The last band in the photograph that I showed you was the band marked T, but below that there are other bands which I was sub-equally able to obtain. It is very rare that these bands can be photographed at all, not because they are not sensitive to those radiations, but simply because of the atmospheric absorption which cuts off these particular radiations and prevents them from reaching our ear. I may say that the theoretical limit of the prismatic spectrum is very nearly reached here—nearly, but not quite, Cauchet and Joly say 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 H line, and erected a perpendicular line of a length representing that particular number, and also of the wave-lengths of the F line in the same way, and then joined 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 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 a 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 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 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 re-searches on the spectrum. We have on the screen the spectra produced by the grating; you will see that even the first line which lies 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 faint, but the two last very feebler 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 the absorption 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 of 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 how the optimation of the different spectrum, to make it more clear. You see in the second order the H lines come a little above one A (Fig. 8), and in the third line they come as far as the

**Fig. 9.—Method of determining the wave-lengths in the infra-red region.**

(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 can 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 those bands which 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 theinfra-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 trusty 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 spectroscope (Fig. 10). A tube of liquid, T, was placed between the lens and the slit: the rays were passed through prisms, p, and eventually were received on the photographic plate r 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 hydrocarbons...
containing oxygen. Alcohol and ether are both hydrocarbons, the former hydrogen and oxygen, and the latter carbon and oxygen. 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 significance of this?

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 the 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 one of nitrogen. That gave lines again. 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 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. We had the same thing, but oxygen added in. We have bands with sharp edges and fine lines in one case, and bands with sharp edges and bands shaded off in the other. It became clear that the bands were 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 seemed to be too much an accidental thing to 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, 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 hydrocarbons we had bands. Where we had carbon, hydrogen, and oxygen we had a shaded band and a fine line; where we had carbon, hydrogen, and chlorine, or carbon, hydrogen, and bromine, or carbon, hydrogen, and iodide, or carbon and hydrogen alone, we had sharp-edged bands and many lines. Where we had carbon and chlorine, or carbon, or carbon and sulphur, we had no abso-ption 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 whatever, but those other substances which contain oxygen, we have bands with sharp edges and fine lines, and so on. Thus, by taking the absorption spectrum of, say, a compound containing two series being denoted by these thicker bands with decreasing or diminishing the thickness of the liquid between the slit and the source of light? If you increase the thickness of the liquid it is this: Where you have a compound containing two series we found the absorption due to each of these tubes we shall see no absorption whatever, but those other substances which contain oxygen, we have bands with sharp edges and fine lines, and so on. Thus, by taking the absorption spectrum of, say, a compound containing two series being denoted by these thicker bands with decreasing or diminishing the thickness of the liquid between the slit and the source of light, it is this: Where you have a compound containing two series we found the absorption due to each 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 in the benzine series, or in fact any other series, we found the absorption due to each of these particular series 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 three particular series being denoted by these thicker bands with sharp edges to which I have already referred.

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 the ultra-red it let through the spectrum; that is to say, the more it let the ultra-red through the spectrum. If bases or compounds contain neither hydrogen nor oxygen, with the result that 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 seemed to be too much an accidental thing to 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, 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 hydrocarbons we had bands. Where we had carbon, hydrogen, and oxygen we had a shaded band and a fine line; where we had carbon, hydrogen, and chlorine, or carbon, hydrogen, and bromine, or carbon, hydrogen, and iodide, or carbon and hydrogen alone, we had sharp-edged bands and many lines. Where we had carbon and chlorine, or carbon, or carbon and sulphur, we had no abso-ption 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 whatever, but those other substances which contain oxygen, we have bands with sharp edges and fine lines.
absorption will cover three hydrogen lines, and so on. Where
you have lines, the lines never alter; where you have those base
bands, or radii bands, as they are called, they never alter; they are
always in the same position, and never spread out or diminish
other to the right or left. When you diminish the thickness of
the fluid those bands are always present, and they are the last
differences to disappear in the absorption spectra.

Another remarkable thing with regard to these compounds is,
that there are two bands which are characteristic of their
husbands. There is a band which is 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 some-
where about r, and another somewhere about 9. Those are
characteristic of any particular compound we may have present.

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

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 hydrogen 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,
leads 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
clearly 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, I found that many lines were common to each hydro-
carbon: 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 impu-
rities 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 chem-
ists split up what they considered elements, and found that
the only substance which was common to the three was hydro-
carbon. 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 con-
stituent 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 lec-
tures already published are those of the Professors of Astronomy,
Geology, Botany, and Medicine.

Prof. Pritchard will give three courses at the University Ob-
servatory. He will lecture on the Lunar and planetary Theories,
and will form two classes for practical instruction in the evening.
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 com-
mance 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:

- Hydro-mechanics, by Prof. Price; (1) Distribution of Ter-
  restrial 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;
Electricity (treated Mathematically), by Mr. Hayes; Elementar-
y Mechanics (treated Experimentally), by Mr. Stocker; Pro-
blems 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 labora-
tory.

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, be-
ginning on Wednesday, February 23, at 9 a.m. Candidates are
desired to call on Mr. C. 1. Fairfax, the University Physi-
trons 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 11, on the subject in which
they hold a li: to the subject in which they wish to be

attention, on which they may have written original articles. Copies of any articles which 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 from Prof. Fankamer.
