THURSDAY, JANUARY 28, 1886

LOUIS AGASSIZ

Louis Agassiz: His Life and Correspondence. Edited by Elizabeth Cary Agassiz. Two Volumes, 8vo. (London: Macmillan and Co., 1885.)

SELDOM has the influence of early environment been more marked in a scientific career than in the life of Louis Agassiz. Born in 1807 at the little village of Motier, in the plains of Switzerland, he passed his childhood on the shores of the Lake of Morat, the waters of which were a perennial source of delight to him. He took more special interest in its living things; knew the haunts and habits of its fishes, and could lure them to him by various ingenious boyish spells, or track them to their hiding-places in the old walls that were lapped by the water. He began to collect birds, insects, shells, and other objects long before he had acquired any book-knowledge of natural history. Between the Lake of Morat and the larger expanse of the Lake of Neuchâtel lies a strip of fertile country rich in woodlands and flowers, and full of bird-life. On the further side of Lake Morat, towering above the scene of the great battle wherein the Swiss routed the army of Charles the Bold, rise the far snowy summits of the Bernese Oberland. Nursed amid these surroundings, and encouraged and guided by wise parental care, the child most truly was father to the man. His intense love of nature and of all living creatures developed into the enthusiasm of one of the foremost naturalists of the time. His childish devotion to the fishes of Lake Morat settled into the earnest and untiring spirit of research among living and extinct fishes which made him the leading ichthyologist of Europe. His passion for the mountains with their snow-fields and glaciers grew into that clear insight and power of philosophical generalisation which have placed the name of Louis Agassiz at the very head of the pioneers by whom the story of the wonderful Ice Age has been unravelled.

The ardent boy with his eager pursuit of natural history was designed for commerce. His father, a poor country clergyman, had no fortune at his disposal which could save his son from the necessity of choosing a profession. But the studies and discipline of school life by no means checked the boy's longing for some career that would enable him to follow his bent towards the prosecution of science. He begged for two years more of the College at Lausanne, and this was granted by his parents, who, though they seem to have been quite aware of his peculiar abilities, never allowed themselves to lose sight of the necessity that their son should at all events qualify himself for some honourable means of making his own livelihood. His future appears to have been considerably influenced by a medical uncle at Lausanne, who, recognising the lad's special bent, suggested that he should take to medicine. This advice being followed, young Agassiz went for two years to the Medical School at Zürich, and then, at the age of nineteen, betook himself to the life of a German student at Heidelberg. It was there that his scientific career received its first great impetus, and that it became certain that, though he might persevere with his medical studies and take his degree, he would ultimately distinguish himself and make his career, not as a physician, but as a naturalist. At Heidelberg he laid the foundations of some of the most precious and enduring friendships of his life, more particularly with Alexander Braun the botanist, whose sister he afterwards married, and with whom and Schimper he next year migrated to Munich, famous at the time for the varied attainments of its professors of science and philosophy. Entering there on a wider field of study, Agassiz and his comrades distinguished themselves among the students by their enthusiastic devotion to natural science. Meeting at each other's rooms, they formed a band known outside as "the Little Academy," discoursing on all manner of questions, starting new problems, proposing solutions for old ones, and creating so much interest in their proceedings, that even learned professors were sometimes to be seen among their listeners.

It was but natural that in the midst of such a life the drudgery of the medical profession should grow more and more irksome. Again and again warning comes from home that the practical aim of his University studies must not be lost sight of, and that he must surely qualify himself to practise as a doctor. His mother's strong common sense would from time to time brush away the golden haze through which the hopeful enthusiast looked at his prospects. In her letters too, she warned him against his "mania for rushing full gallop into the future," engaging in too many different undertakings, and wasting by diffusion an energy which would carry him successfully to his goal, if he would only concentrate it upon what was essential for the purpose. Long before he took his medical degree his power of original research in ichthyology was widely known, and Martius placed in his hands for description the Brazilian fishes left undescribed by Spix. This work was completed and published in 1829, when the young author was only twenty-two years of age. Next year he gratified his parents by formally taking the degree of M.D.

But the prospect of settling down as a country medical practitioner was more than ever distasteful to him, though there seemed no very clear outlook in any other direction. He himself, however, was full of hope. His Brazilian fishes had brought him no money indeed, but it had given him a reputation throughout Europe as one of the rising naturalists of the day. Already he was full of schemes for the production of a work on fossil fishes, and he had actually made considerable progress in the preparation of a monograph on fresh-water fishes. He felt sure that he could command his own terms from publishers, and that the sale of the works would enable him to live in the quiet way he desired to do. So he went home for a year, which he spent in increasing his collections of natural history—now large and valuable—and in prosecuting the works on which he had been occupied at Munich. But his ambition to take a leading place among the naturalists of Europe, and the necessity for increasing his knowledge by study in some of the best museums of the Continent, led him at last irresistibly to Paris, where he arrived towards the end of the year 1831. From Cuvier he received much kindness. The veteran naturalist had made some progress with a work on fossil fishes, but when he saw what Agassiz had done and proposed to continue, he generously presented him with all his own drawings and notes upon the subject. A. von Humboldt also took the warmest interest in the young Swiss, aiding him by help of the friendliest and most practical kind. But Agassiz was still without any regular means of self-support; the publishing schemes were not so successful financially as he had fondly anticipated, and at last, after some months of over-strain among the treasures of the Paris museums, he gladly accepted, in the autumn of the year 1832, the offer of a Professorship of Natural Science created for him at Neuchâtel by the exertions of his friends. For the first time he had now the opportunity of appealing to a wider circle of listeners than his own fellow-students. The enthusiasm of his nature soon made itself felt in the new vigour with which natural science was followed in the canton. A Society for the prosecution of the study of nature was founded, with Agassiz as one of its leading spirits. Hill and dale, river and lake were explored far and near, and the systematic lectures of the class-room were supplemented by even more valuable discourses in the field. From this period onward a large part of Agassiz's time and thought was given to the promulgation of a knowledge of nature, not only to professed students but among the general public. With his extraordinary energy he still found time for an amount of original research that would have been more than enough for most naturalists. Bold almost to recklessness, in his disregard of financial difficulties, he now (1833) launched the first number of his "Poissons Fossiles," and, in spite of incredible obstacles, continued the preparation and publication of the work for the next ten years. In the course of his researches for this great monograph he came several times to England, bringing with him the artists he had trained in drawing natural history specimens, and spending much time in the public museums as well as in the private collections where he found such a wealth of palæontological material.

The "Poissons Fossiles" will ever remain as a monument of extraordinary industry and of a remarkable insight into the relationships between recent and extinct types of life. The keynote of all Agassiz's work in natural history sounds out clear and distinct in the introduction to this great work. He proposed a new classification of fishes which, though it has been subsequently considerably modified, was of great geological value in showing the true history and importance of the great order of Ganoids, which he first recognised. With a keen eye for real or supposed analogies and relationships, he saw in the earlier fishes of the geological record a commingling of ichthyic with reptilian characters which suggested to him his "prophetic types," and, following out the same idea, he made the startling announcement that in the phases of the embryonic development of our living fishes there is a close analogy to the successive types of fishes which have appeared in the past history of the earth. It is curious to remember that a naturalist who saw so far ahead of his contemporaries remained a consistent opponent of all theories of evolution. He admitted in the fullest sense the evidence of "the most admirable progressive development to which our own species is linked," but to him the progress was one of plan in the mind of the Creator, and not the mere material change of one form into another.

One of the most characteristic features of Agassiz's mind was its restless activity and untiring energy. The labour entailed by his great work on fossil fishes would have been enough or more than enough for any ordinary man. But while it was in progress he found time for the prosecution of his researches among recent fresh-water fishes; for an investigation of Echinoderms recent and fossil, and for the study of fossil Mollusca, and the evidence for these added labours appeared in bulky quarto memoirs with numerous plates. Besides these works, however, he undertook the almost incredible drudgery of compiling a zoological "Nomenclator," containing the names of living and fossil genera of animals, and a "Bibliographia Zoologiæ et Geologiæ," giving a full list of published papers on these sciences. Dissatisfied with the delays and defects of the Munich engraving establishments, he founded a lithographic workshop at Neuchâtel, and astonished the world by the beauty of the chromolithographed fossil fishes which he there produced, the art of chromolithography being then in its infancy.

With this mental activity was combined a bodily vigour which carried him unwearied through long excursions. As a recreation he turned to the glaciers of the Alps. Before his student days at Heidelberg he had made himself acquainted with that mountain-world. But in the summer of 1836, under the guidance of Charpentier, he began the systematic study of the glaciers. Before the end of that excursion he had seized the meaning of the scattered erratic blocks and ice-worn bosses of rock that lie far above and beyond the present limits of the ice. He saw as by a kind of inspiration the evidence for the former vast extension of the Alpine glaciers, and though he continued in later years laboriously to fill in the details of the picture, his first rough draft remained unchanged in all its essential features. As soon as he began to make known his ideas in glacial geology, he was met with a storm of opposition. Even his kind friend Humboldt could not forbear words of gentle reproof and warning. But he remained unshaken in his faith, and eventually had the satisfaction of seeing one after another of his opponents candidly acknowledge themselves mistaken. From 1836 to 1846 he continued with unabated enthusiasm his glacial researches, scaling mountain-pass and glacier, and publishing first his "Études sur les Glaciers" (1840), and then his "Système Glacière" (1846), besides separate papers in scientific journals. Among these minor contributions, undoubtedly the most memorable is the short communication made to the Geological Society of London in 1840 on the evidence of glaciers in Britain. Agassiz came to this country in that year convinced beforehand that there must be abundant evidence of former glaciers among our uplands. With the genial Buckland he went into the Scottish Highlands, and found everywhere, as he had anticipated, the most convincing proofs of ancient glaciers. From that time onward the study of Pleistocene geology took a new departure among the geologists of this country, and the opposition to glacial agency soon died out.

The "Poissons Fossiles" was followed soon after by the publication of the monograph on the fishes of the Old Red Sandstone—another land-mark in the progress of palæontology. Since the appearance of these works a new generation has appeared; the number and size of public and private collections have greatly increased, and the acilities for transport and for comparison of specimen with specimen have been enormously augmented. Those who revise the work of the great pioneer in fossil ichthyology will no doubt find much to amend, and no one knew this better than he himself. But hey will not forget the difficulties under whic worked, and which he so pathetically describes. It was an enormous service to science to group and describe, as he did, all that was then known of the fishes of the past.

During the years in which Agassiz was engaged upon these and kindred researches he often turned his eyes wistfully to America as a land where many of the problems that so profoundly interested him could be even better studied than in Europe. There were many obstacles in the way of his crossing the Atlantic. In 1833 he had married the sister of his old college friend, Braun, and a young family was growing up round him. The emoluments of his Professorship at Neuchâtel were scanty enough even for his domestic needs, and he always had scientific work on hand that could not make progress without money. At last, however, he saw his way to visit America and pay the expenses of the journey by lecturing.

It was in the beginning of October 1846 that Agassiz arrived in Boston. Intending at first merely to make a lecturing tour, seeing what he could of the country and the people, but returning eventually to his home and its duties at Neuchâtel, he was gradually led to prolong his stay in the United States. His pleasant, genial ways, his captivating enthusiasm as a naturalist, and his activity of mind and body, gained him many friends; and at last, in the early part of 1848, he was offered and accepted the Chair of Natural History in a scientific school then organised in connection with Harvard University. Thenceforward he became an American citizen, and the record of his life is that of the growth of a remarkable personal influence which, holding up constantly before the public the claims of natural science for recognition, carried away all kinds of obstacles, personal, political, and financial, and planted firmly in the national mind a deep respect for scientific worth and the value of scientific training—an influence too which powerfully affected the young intellects that came in contact with it, kindling in them a spirit of brotherly co-operation and emulation in the study of nature. Without following the details of his busy and useful career, we may note the frequent excursions to distant regions for the purpose of gaining fresh materials for study. Thus we find the Professor at one time navigating the bays and creeks of Lake Superior; at another exploring the Florida reefs; then sailing up the Amazon and investigating its natural history; or dredging among the West Indies; studying glaciers in the Straits of Magellan, and voyaging up the western coast of America to San Francisco. Of these various expeditions narratives were published giving a pleasant picture of the life of the naturalists and of the chief scientific results obtained by them. Turning over the reports, we every now and then come upon some pregnant suggestion, some luminous generalisation, or some significant deduction, showing how the characteristic breadth of grasp and clearness of insight had undergone no diminution by transference to the New World. What, for instance, can be more suggestive than the sentence with which Agassiz begins one of his reports on these deep-sea dredgings? "From what I have seen of the deep-sea bottom, I am already led to infer that among the rocks forming the bulk of the stratified crust of our globe, from the oldest to the youngest formation, there are probably none which have been formed in very deep waters." In this conclusion and in his inference that the oceanic and continental areas have retained from the beginning the same general positions, he anticipates some of the most remarkable results of later research. Again, how prescient was his expectation that the deeper sea would show relics of older types of life that had vanished from the shallower waters!

One of the most important of Agassiz's labours in America was the founding of the Museum of Comparative Zoology at Cambridge—a museum which should not only present an orderly reflection of the structure and history of the whole animal creation, past and present, but which should contain such ample store of duplicates as to offer to students unlimited means of practical study, and should thus become one of the great centres for the radiation of knowledge throughout the community. To the realisation of his dream of founding such a museum he devoted the best energies of the last twenty years of his life, and lived to see it established and recognised as one of the great scientific institutions of the world. Full of labours to the last, happy in the hearty recognition of his scientific contemporaries, happier still in troops of friends in the Old World and in the New, and soothed by the tender affection of a loved home circle, Agassiz died on December 14, 1873.

The memoir which is the subject of this article has been written by his widow, whom he married in America after the death of his first wife. It is a most interesting narrative, bringing before us the man as he was, and, though making no pretence to appraise his scientific work, yet giving a graphic picture of the conditions under which the work was done. A simple boulder from the glacier of the Aar rests above his grave in the cemetery at Mount Auburn; a few sapling pine-trees sent from his old home in Switzerland throw their shadow over stone and grass. And no more fitting memorial could have been added to these tributes of affection than the story of his life so simply and gracefully told by Mrs. Agassiz.

ARCH. GEIKIE

OUR BOOK SHELF

Die äusseren mechanischen Werkzeuge der Thiere. Von Vitus Graber. (Leipzig: G. Freytag, 1886.)

THIS little work appears as the 44th and 45th of a series which, under the title "Das Wissen der Gegenwart," is published at Leipzig. The series embraces works on Astronomy, Geology, Physics, Biology, as well as treatises on History, Geography, Philosophy, and Art, all of which are issued at the extremely low price of one mark each. The present work consists of two parts, each of about 220 pages, with illustrations, and treats of the mechanics of the animal machine. The first part is concerned with the Vertebrates—where the construction is more complex—and in eight chapters we have the first principles of mechanics, so far as they relate to animals in general, discussed, and then the actions involved in locomotion, prehension, &c., are treated of in detail. The second part glances at the same facts, so far as they are found manifested in the lower animals, more especially in the Arthropods, Mollusca, and Worms. Many of the woodcut illustrations are from original drawings, and of these those representing the muscles engaged in prehension and mastication are very good.

Animal Life on the Farm. By Prof. G. T. Brown, Agricultural Department, Privy Council. (London: Bradbury and Agnew.)

THIS is the last of a series of eight convenient handbooks covering the whole field of agricultural study. Dr. Masters's "Plant Life on the Farm" is ably followed by the excellent little book from the pen of Prof. Brown; and what may at first appear in the light of omissions in a treatise upon animal life as seen upon farms is at once corrected by the previously-published account of the live stock of the farm. Thus, while the subject of crops of the farm and live stock of the farm were ably treated, there was still room for more purely scientific writers, such as Dr. Masters and Prof. Brown, to treat of life more as biologists than as practical farmers. Accordingly, what is true of life on the farm is in many respects true of life in the forest and life in the city; but this does not detract from the value of facts about life wherever it may be found. It was probably an agreeable task to the writer to put this little volume together. It is full of matter with which he is very familiar, and which he is able to present with that admirable clearness and precision which has always characterised both his oral and written teaching. Commencing with the two opposite conditions of life, and death, as abstractions, we are pleasantly led to the consideration of the beginnings of life in the egg, and by a natural progress to a popular, but at the same time accurate, description of tissues, organs, and functions, which carry the reader through about two-thirds of the book. The remaining third is devoted to the peculiarities of domesticated animals, and in fact becomes more thoroughly specialised upon the farm. The variability, the precocity, the delicacy, the plasticity of domesticated animals are each dealt with by a master hand, and illustrated by examples taken from the experience of breeders and our great agricultural societies.

LETTERS TO THE EDITOR

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

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

Iridescent Clouds

IN a letter published in NATURE for January 7 (p. 220), I tried to describe the appearance of the iridescent clouds as seen here on the afternoon of December 28. The phenomenon was repeated on December 29 and 31. On December 30, and again on January 1, the sky was overcast, but since then, though I have looked for them at different times of the day, and especially about sunrise and sunset, I have seen no further trace of iridescent clouds.

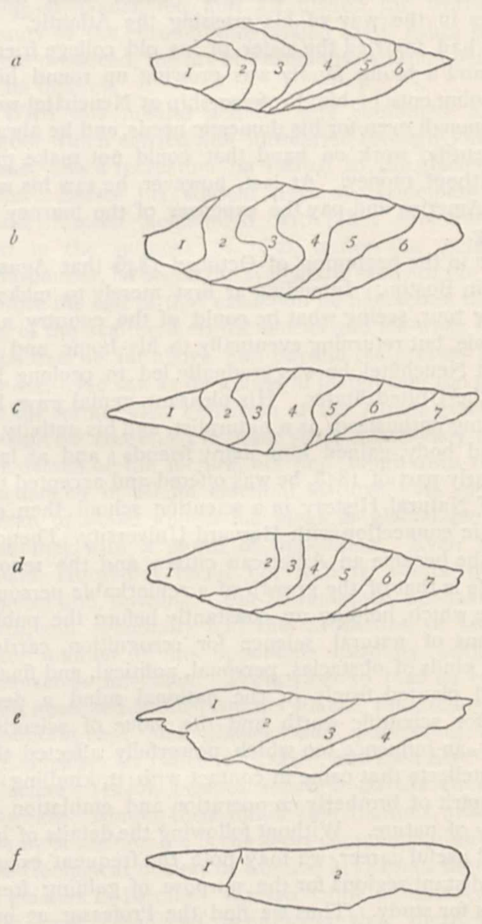
What struck me as most remarkable about them was, not the prevalent colour which they have been said to possess (see pp. 199, 219), for I cannot point out any as being peculiar to them, but the changes of colour undergone, often rapidly, by each individual cloud. As a record of these changes in the few instances I am able to give may perhaps help to throw some light on the nature and origin of these clouds, I trust I may be excused for occupying so much of your space.

December 29.—3.15 p.m., the sun a few degrees from setting, light cloud partly covering the sky, heavy snow-clouds near the horizon. At about 10° north of the sun and at an altitude of about 25°, there was a small cloud, 5° in length, consisting of four or five narrow bands nearly parallel to the horizon, all of a faint, but beautiful, violet colour. Soon after this, it was hidden by snow-clouds.

3.44.—This cloud was again visible, showing iridescent colours, no longer consisting of bands, but oval in form and slightly inclined to the north. Half a minute later, a branch of the same form and size, but rather more inclined to the north, appeared on the right, very faint, but increasing rapidly in brightness, until it equalled that of the original cloud. The new branch was at first violet, but in part tinged with rose-colour. The original cloud soon, however, began to fade, and by 3.47 had disappeared, the remainder being then green, except the upper edge slightly tinged with pink.

3.50.—The colours almost gone, but I believe the cloud was at this time covered by a thin haze. At 3.52 the cloud was very faint, and white.

Fig. 1.



3.55.—The colours again appeared, in three bands, blue on the left (nearest the sun), green in the middle, and on the right pink. But, immediately, the colours began to change, the blue and pink to fade, the green band becoming wider and brighter, until, in a few seconds, the whole cloud was green. It grew brighter and brighter until, at 3.57, it shone out a pure beautiful green almost of rainbow-brightness. But, at this moment, the snow-clouds, which had been rising rapidly, passed over it, and heavy driving snow began to fall.

At 4.18 the snow-storm was over, and in nearly the same place as the cloud just described were two small clouds, each about 5° long, at altitudes of about 20° and 25° respectively. They were faint, and had a slight trace of indefinite colouring. By 4.26 they had both disappeared.

4.28.—The two clouds again visible, the lower green, and the upper rose-coloured. But the clouds began to fade at once, and a minute later both had disappeared finally, the sky being now, and continuing, quite clear.

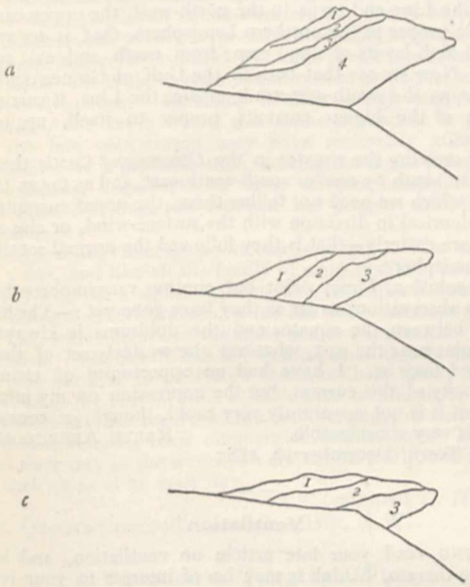
Besides these there were a few other small clouds, white, and of unusual character and brightness, but at no time did I detect in them any certain trace of colouring.

December 31.—At about 10 a.m., and for some time after, I noticed a small coloured cloud, above, but a little to the west of, the sun, and at an altitude of about 30°. The lower edge was blue, immediately above this a narrow band of green, the rest of the cloud being faint, almost colourless, but occasionally showing a slight yellowish tinge, and at the upper edge a touch of red.

At sunset there was the most wonderful display. At 4 p.m. in all parts of the sky were bands of light cirrus cloud, flushed with crimson by the setting sun. In the west, higher than the cirrus, and shining through them and in the intervals between, were splendid iridescent clouds, set off against a background of blue. I have never yet seen anything to equal the glory of this sky. It is impossible to describe it, the colours were so varied and their changes so rapid. I confined my attention, therefore, to the two largest and most beautiful clouds, and the following is a record of the colours and their variations, so far as I was able to observe them.

(1) One of these clouds is shown in Fig. 1. It was situated a few degrees south of west, about 20° above the horizon, and was about 15° in length and 5° in greatest breadth. During the whole time it seemed stationary, though changing slightly in

Fig. 2.



form. It was crossed by beautiful bands of colour, separated by fairly sharp lines. Sometimes, when the stripes of colour were narrow, I have included them in one band, to save time in drawing; the order being then given from left to right.

4.5 p.m.—Fig. 1, *a*. The right end of the cloud hazy. (1) Green, (2) yellow, orange, red; (3) blue, green, yellow, red; (4) red, with a tinge of purple; (5) bright purple; (6) red, green.

4.11.—Fig. 1, *b*. Both ends hazy. (1) Pink in the haze, blue; (2) yellow, green, orange; (3) green; (4) red; (5) blue; (6) red, ending in green in the haze.

4.18.—Fig. 1, *c*. The cloud rather longer and narrower than before. (1) Green; (2) green; (3) yellow, orange; (4) green; (5) red; (6) green; (7) red.

4.21.—The orange band 3 beginning to invade the green band 2.

4.22.—The red band 5 growing brighter.

4.25.—The red and orange bands, 3 and 5, widening, and becoming the predominant colours of the cloud.

4.27.—Fig. 1, *d*. (1) Light haze; (2) hazy; (3) red; (4) green; (5) bright red; (6) greenish; (7) orange red. The general hue of the cloud was at this time reddish orange, the red and orange bands being much brighter than the rest.

4.30.—Fig. 1, *e*. The outline hazy. (1) Haze; (2) red: (3) reddish orange; (4) red.

4.32.—Fig. 1, *f*. (1) Thin haze; (2) not quite so bright as before, but all of a deep rose-colour.

4.34.—The rose-coloured part had a slight tinge of purple, which, two minutes later, had become more marked, but rising clouds now stopped further observation.

(2) The other cloud was in a west-south-west direction, about 10° above the horizon, and partly hidden by a bank, which served, however, to show how slightly the cloud altered its position.

4.7 p.m.—Fig. 2, *a*. (1) Green; (2) orange red; (3) light green; (4) violet. All these colours very bright.

4.13.—The colours had changed, so that the general hue of the cloud was blue.

4.14.—Fig. 2, *b*. (1) Orange; (2) bright blue; (3) violet. The right edge hazy.

4.16.—The left side blue, the right violet, with a narrow pink band on the lower edge.

4.17.—The greater part of the cloud a very bright light blue, violet on the right, pink on the upper edge towards the left.

4.22.—Very faint and bluish.

4.25.—The cloud smaller, and bluish-green, but still faint.

4.26.—Green, and brighter.

4.29.—Fig. 2, *c*. The whole cloud much brighter, though not so bright as when first seen. (1) Reddish; (2) green; (3) reddish.

4.34.—The cloud the same shape as at 4.29, and the whole of it orange-coloured. After this moment it was hidden by heavy clouds.

Beside the two clouds above described, and several other smaller ones similar to them, there was visible in the west, at 4.26, a long narrow band of cloud (about 20° long and 3° or 4° broad), parallel to the horizon, and of a distinctly violet colour throughout. CHARLES DAVISON

Sunderland, January 12

Parallel Roads in Norway

IN Mr. Hansen's account of the terrace formation of Central Norway he discards the sea theory of their origin, as well as the detrital dam, the local glacier theory, and also that of Prof. Prestwich, of landslips. The cause he ascribes to rests in the passage of the inland ice seawards, allowing lakes to form in the watershed while ice remained in the valleys seaward. Does this idea not reverse the order of Nature? Would it not be far simpler, more reasonable, and more in accordance with the laws of Nature to conclude that ice would remain in the highest valleys of the country longest, and that the parallel roads or terraces are the ice margins or lateral moraines where the ice rested after the most intense glaciation ceased, while the surplus passed over the cols, and the passage seaward was more or less retarded by the configuration of the country? The Lochaber roads are mostly composed of the usual glacial stuff of the district, it is neither washed as lake margins or sea beaches. The only water-washed material seems to have run down from the hills above, before glaciation ceased, and vegetation covered the surface. The roads are neither strictly parallel or horizontal, and just what might be expected to be formed by ice lying for a long time in a valley when the growth did not greatly exceed the waste and the motion was slow. JAMES MELVIN

Edinburgh

Dew

HAVING read with interest the abstract in NATURE of January 14 (p. 256) of Mr. Aitken's observations on dew, I noted attentively during a walk this morning the behaviour of the hoar-frost as deposited on different objects. The morning was fine and frosty after a clear cold night. There was a copious deposit of hoar-frost upon the grass, upon the upper side of wooden rails, and upon the topmost twigs of the bushes in the tall hedges (6 to 8 feet high), but the lower twigs in the hedges had little or none. On stones in the road, as Mr. Aitken observes, there was little hoar-frost on the upper surface, only lines of ice crystals along the salient angles, but their under surfaces were thickly covered. With the loose heaps of broken stones by the road-sides the case was different: here the uppermost stones were thickly coated with frost on their upper surface, but had little on their lower surface; the stones underneath the uppermost layer, on the contrary, were coated with hoar-frost on their under, but not on their upper, surfaces. The hollow "cat's ice" on the road-side puddles, where previously unbroken, was copiously coated with ice crystals above, but only scantily underneath; but where the ice had been broken so that the cavity beneath it had communicated freely with the open air, the crop of ice crystals was equally copious on both sides. A large hollow iron roller, 24 inches in diameter, had a copious crop of ice crystals on the upper surface, but little on the sides. Underneath, however, it had a coating of ice which extended about an inch from the point at which it rested on the earth, and then ended abruptly.

These observations seem to show that for the formation of hoar-frost, and inferentially also of dew, upon solid bodies, two factors are necessary, viz. (1) a sufficient cooling of the bodies by radiation below the temperature of the surrounding air; and (2) a supply of watery vapour in the air; and that within certain limits an excess of one of these factors may compensate for a deficiency of the other. Thus upon the top twigs, on the uppermost stones in the heaps, and on the upper surface of the iron roller—all these bodies being freely exposed to radiation, and not directly connected with the warm earth—a copious deposit of hoar-frost took place; and this deposit, it is to be remarked, must have been condensed from the vapour diffused in the layers of air in contact with those bodies, and not from that issuing from the earth. Vapour from the ground could not pass through the impervious iron roller to reach the upper surface; it may indeed be supposed to have passed round the circumference, but the sides of the roller were, as I have said, comparatively free from hoar-frost. On the other hand, the under sides of the stones, and of the roller, though to a considerable extent protected from radiation, had on them a deposit of ice, seemingly condensed, as Mr. Aitken supposes, from the vapour exhaled from the comparatively warm ground beneath them.

The scantier deposit of hoar-frost upon the under surface of the "cat's ice" when unbroken than when broken is, I presume, due to the more rapid cooling of the ice when the space beneath it communicates with the open air, than when closed. H. F. P.

January 19

Clouds and Upper Wind-Currents over the Atlantic Doldrums

THE first of the two following weather sections across the Atlantic doldrums was taken in June and July last on board the s.s. *Tongariro*, during her voyage from Rio Janeiro to Teneriffe.

Practically clouds in these latitudes may be taken as belonging to three levels: a small cumulus, low down; a middle layer of some stratiform cloud; and a high-level cirrus. Any one of these may appear by itself, or all may be present simultaneously. The depth of the various air-currents which drive these clouds, I take to be of great importance in any general theory of the circulation of the atmosphere in the equatorial regions.

Space will not permit me to give here the details of each day's observations, but the results may be briefly stated thus: South of the equator, the low or middle clouds over the south-east trade, which we picked up in 10° S. lat., invariably came from some point to the right of the surface-wind, when you stood with your back to it, *i.e.* if the surface-wind was south-east the clouds would drive from about east-south-east. This is the usual rotation of upper currents in the southern hemisphere.

But, north of the Line, when for reasons which cannot be discussed here, the south-east trade did not turn to south-west, as might have been expected, the upper currents continued to follow the rotation of the southern, and not that of the northern hemisphere, that is to say, the upper currents over the south-east surface-wind continued to come from some more easterly point. In the "doldrums," also, which extended from about 8° to 13° N., the same rule obtained, and the middle cloud-layer over some "cat's-paws" of south-east wind drove from the east.

In the north-east trade I only got one unsatisfactory observation in 22° N., 19° W., which gave a middle layer of north-north-east wind over an east-north-east surface trade. This is contrary to what might have been expected.

The second section was taken in December last on board the s.s. *Drummond Castle*, during part of her voyage between Lisbon and Cape Town, with much better appliances for observing clouds than on my former voyage.

In the north-east trade, from 30° N. lat. down to the doldrums in 5° N., the upper layers of cloud invariably came from some point to the left of the surface-wind. When you stood with your back to it, *i.e.* if the surface-wind was from north-east, the higher clouds would come from east, or south-east, or even south by west. This is the usual rotation of upper wind-currents in the northern hemisphere. As far north as 20° N. the middle clouds came from south by west, and in 10° N. this current had descended to the level of the low cumulus, and the middle clouds drove from west.

But as we touched the doldrums in 5° N., a totally different wind-system became apparent. Over the oily calm of that district I could just detect, through the universal haze and gloom, a middle current from the east; and when, in a few hours, we picked up the south-west monsoon of the Gulf of Guinea, here coming from south by west, the low clouds drove from south-east. This continued till we reached the Line, and the single observation which I got of high cirrus in 1° N. lat. showed an easterly current at that level. Thus, for 8° N. of the equator the rotation of the upper winds was that proper to the southern hemisphere, for south-east and east were over a south-west surface-wind instead of west or north-west, as might have been expected. This is the more curious, because the surface-wind has the south-west set proper to the northern hemisphere.

But the greatest interest of this last observation is to be found in the extraordinary analogy which the wind-system over the Gulf of Guinea presents to the wind-system over the north-west monsoon in the Indian Ocean, which I discovered last spring, and described in a letter to NATURE of October 29, 1885 (p. 624). In that region I found that as the north-east monsoon crosses the Line and turns to the north-west, the upper currents are those proper to the northern hemisphere, that is to say the low and high layers of cloud come from north and east respectively. Now we see that both in the Gulf of Guinea and mid-Atlantic, as the south-east trade crosses the Line, it carries the rotation of the higher currents, proper to itself, up to the doldrums.

After crossing the equator in the *Drummond Castle* the wind turned to south by east or south-south-east, and as far as 18° S., beyond which we need not follow them, the upper currents were either identical in direction with the surface-wind, or else a very little more easterly—that is, they followed the normal rotation of their hemisphere.

In conclusion, I may point out another very important result of these observations as far as they have gone yet:—The highest current between the equator and the doldrums is always from some point near the east, whatever the westerly set of the surface-wind may be. I have had no opportunity of estimating the velocity of this current, but the impression on my mind has been that it is not apparently very rapid, though, of course, the height is very considerable. RALPH ABERCROMBY

Cape Town, December 18, 1885

Ventilation

HAVING read your late article on ventilation, and letters referring thereto, I think it may be of interest to your readers to know something of what we have done in this quarter. Since the year 1877 we have had in Dundee a number of schools and other buildings ventilated and heated by propelling large volumes of heated air into the rooms with a small-power engine.

The system, as now generally introduced, is as follows:—Rotary air-pumps, or a Blackman air-propeller, driven by a small gas-engine, are placed in the basement floor. The air is conducted thither by flues from an altitude of 30 feet, so as to be as free from dust and other impurities as possible. This cold air is discharged into large wooden flues under the ground floor, which are painted with asbestos paint. Running parallel to these flues are others containing hot-water high-pressure pipes, about 1⅜ inches in diameter. These hot flues are divided into air-tight sections, suitable for the heating of the different rooms. The air from the cold flue passes into the different sections of the hot flue, from which again it passes out, heated, into the different rooms, about 5 feet from the floor, by long and narrow flues, so that it may be well diffused. Each room has its own exhaust-flue or flues, reaching within 1½ feet of the floor, and passing into the space between the upper-floor ceiling and the roof. This space is made into a large flue, into which all the foul air from the different rooms passes. On the roof there are constructed one or more square shafts, with fixed louvre boards on each of the four sides. Inside the louvres are fixed valve-frames covered with a large number of light waterproof cloth valves, which prevent the air passing inwards. There are always one or more sides on which the wind does not blow, allowing the foul air free egress from within out. Some of the school buildings where this system has been introduced are having as much air passed through them as will refill the rooms every 10 or 15 minutes.

This system, as explained, can be seen in operation at the chemical laboratory of the Dundee University College, the Harris Academy, Dundee, and at the Dundee High Schools, the directors of which are introducing the system into another large new school for girls, which is to be opened in a few months. WILLIAM CUNNINGHAM

Dundee, January 12

A Family of Rare Java Snakes

AT the Zoological Gardens, on Saturday, the 9th inst., a rather rare "Green-Tree Snake" (*Dryiophis prasina*), from Java, produced eight snakelings under circumstances which tend to confirm recent observations regarding the uncertain period of gestation in snakes, otherwise the voluntary retention or deposition of their eggs or even their young. The mother was brought to the Reptilium five months ago (August 15), and allowing two months for her transportation from Java, it must be at least seven months since she was captured and separated from her mate. The normal period of gestation in a snake of this size may be about three months, but incubation, which begins at once, would in all snakes seem to depend a good deal on temperature and on other propitious circumstances; nor can it be positively asserted that such or such a species is invariably oviparous or viviparous, as in several instances the same snake has been known to be both—*i.e.* under certain conditions an oviparous snake has become viviparous. In sunny weather a high temperature is obtained in the cages where this snake is; and it is probable that the late cold season may have materially affected this *Dryiophis*. It is probable that, lacking the dense foliage of her native forests, together with these adverse conditions of her small glass dwelling, she retained her progeny until the latest moment.

The snakelings average 20 inches in length. The mother is over 5 feet, and like all the family of whip-snakes is exceedingly slender, with the long tail tapering to a cord-like fineness. She is of a bright emerald green, while the little ones are of a dull ashy hue, with tongues of the same colour; the mother's tongue is pinkish. The parent has fed well on small lizards during her captivity, but it is to be feared that the little family will fare badly, as at the present time suitable food is difficult to procure. They were at once removed into another cage, or their mother might have reduced their numbers at dinner-time. They soon found their way to the water-pan and drank freely, and began to cast their skins at an early day.

CATHERINE C. HOPLEY

15, Queen's Crescent, Haverstock Hill, N.W.

Vibration of Telegraph-Wires

I NOTICED to-day a curious vibration of telegraph-wires near here, and perhaps some reader of NATURE may be able to explain it. Each wire was vibrating rapidly, but instead of the nodes being only at each post, there were several in each span (of about 88 yards). The number of nodes varied in each span; I counted seven in one, nor did the wires vibrate together as a rule. In some spans four out of five wires were vibrating, and in others only one. The total amplitude of vibration did got exceed 1½ inches, I should think. I noticed this peculiar action in some five or six contiguous spans only. There was a very hard frost at the time, and the wires were coated with snow which had fallen some thirty-six hours previously. There was no wind, and the sun was just breaking through a fog. The wire was galvanised iron, No. 8 B.W.G.

E. DE M. MALAN

Howden, East Yorkshire, January 19

HEREDITARY STATURE [1]

IT will perhaps be recollected that, at the meeting last autumn of the British Association in Aberdeen, I chose for my Presidential Address to the Anthropological Section a portion of the wide subject of "Hereditary Stature." My inquiries were at that time advanced only to a certain stage, but they have since been completed up to a well-defined resting-place, and it is to their principal net results that I shall ask your attention to-night.

I am, happily, released from any necessity of fatiguing you with details, or of imposing on myself the almost impossible task of explaining a great deal of technical work in popular language, because all these details have just been laid before the Royal Society, and will in due course appear in their *Proceedings*. They deal with ideas that are perfectly simple in themselves, but many of which are new and most are unfamiliar, and therefore difficult to apprehend at once. My work also required to be tested and cross-tested by mathematical processes of a very technical kind, dependent in part on new problems, for the solution of which I have been greatly indebted to the friendly aid of Mr. J. D. Hamilton Dickson, Fellow and Tutor of St. Peter's College, Cambridge. I shall therefore quite disembarrass myself on the present occasion from the sense of any necessity of going far into explanations, referring those who wish thoroughly to understand the grounds upon which my results are based, to the forthcoming memoir in the *Proceedings* of the Royal Society, and to that amplified and illustrated extract from my Address at Aberdeen, accompanied by tabular data, which appeared among the "Miscellanea" of the *Journal* of this Institute last November.

The main problem I had in view was to solve the following question. Given a group of men, all of the same stature, whatever that stature may be,—it is required to be able to predict two facts regarding their brothers, their sons, their nephews, and their grandchildren, respectively, namely, *first*, what will be their average height; *secondly*, what will be the percentage of those kinsmen whose statures will range between any two heights we may please to specify;—as between 6 feet and 6 feet 1 inch, 6 feet 1 inch and 6 feet 2 inches, &c.?

The same problem admits of another rendering, because whatever is statistically *certain* in a large number is the *most probable* occurrence in a small one, so we may phrase it thus: Given a man of known stature, and ignoring every other fact, what will be the most probable average height of his brothers, sons, nephews, grandchildren, &c., respectively, and what proportion of them will most probably range between any two heights we may please to specify?

I have solved this problem with completeness in a practical sense. No doubt my formulæ admit of extension to include influences of a minor kind, which I am content to disregard, and that more exact and copious observations may slightly correct the values of the constants I use; but I believe that for the general purposes of understanding the nearness of kinship in stature that subsists between relations in different degrees, the problem is solved.

It is needless to say that I look upon this inquiry into stature as a representative one. The peculiarities of stature are that the paternal and maternal contributions blend freely, and that selection, whether under the aspect of marriage selection or of the survival of the fittest, takes little account of it. My results are presumably true, with a few further reservations, of all qualities or faculties that possess these characteristics.

Average Statures.—The solution of the problem as regards the average height of the kinsmen proves to be almost absurdly simple, and not only so, but it is explained most easily by a working model that altogether supersedes the trouble of calculation. I exhibit one of these: it is a large card ruled with horizontal lines 1 inch apart, and numbered consecutively in feet and inches, the value of 5 feet 8 inches lying about half way up. A pin-hole is bored near the left-hand margin at a height corresponding to 5 feet 8¼ inches. A thread secured at

[1] Extracts from Mr. F. Galton's Presidential Address to the Anthropological Institute, January 26.

the back of the card is passed through the hole; when it is stretched it serves as a pointer, moving in a circle with the pin-hole as a centre. Five vertical lines are drawn down the card at the following distances, measured horizontally from the pin-hole: 1 inch, 2 inches, 3 inches, 6 inches, and 9 inches. For brevity I will call these lines I., II., III., VI., and IX. respectively. This completes the instrument. To use it: Hold the stretched thread so that it cuts IX. at the point where the reading of the horizontal lines corresponds to the stature of the given group. Then the point where the string cuts VI. will show the average height of all their brothers; where it cuts III. will be the average height of the sons; where it cuts II. will be the average height of the nephews; and where it cuts I. will be the average height of the grandchildren. These same divisions will serve for the converse kinships; VI., obviously so; III., son to a parent; II., nephew to an uncle; I., grandson to a grandfather. Another kinship can be got from VI., namely, that between "mid-parent" and son. By "mid-parental" height I mean the average of the two statures: (*a*) the height of the father, (*b*) the transmuted height of the mother. This process, I may say, is fully justified by the tables already printed in our *Journal*, to which I have referred. It is a rather curious fact that the kinship between a given mid-parent and a son should appear from my statistics to be of exactly the same degree of nearness as that between a given man and his brother. Lastly, if we transmute the stature of kinswomen to their male equivalents by multiplying them after they are reduced to inches, by 1·08, or say, very roughly, by adding at the rate of 1 inch for every foot, the instrument will deal with them also.

You will notice that the construction of this instrument is based on the existence of what I call "regression" towards the level of mediocrity (which is 5 feet 8¼ inches), not only in the particular relationship of mid-parent to son, and which was the topic of my Address at Aberdeen, but in every other degree of kinship as well. For every unit that the stature of any group of men of the same height deviates upwards or downwards from the level of mediocrity as above, their brothers will on the average deviate only two-thirds of a unit, their sons one-third, their nephews two-ninths, and their grandsons one-ninth. In remote degrees of kinship, the deviation will become zero; in other words, the distant kinsmen of the group will bear no closer likeness to them than is borne by any group of the general population taken at random.

The *rationale* of the regression from father to son is due (as was fully explained in the Address) to the double source of the child's heritage. It comes partly from a remote and numerous ancestry, who are on the whole like any other sample of the past population, and therefore mediocre, and it comes partly only from the person of the parent. Hence the parental peculiarities are transmitted in a diluted form, and the child tends to resemble, not his parents, but an ideal ancestor who is always more mediocre than they. The *rationale* of the regression from a known man to his unknown brother is due to a compromise between two conflicting probabilities; the one that the unknown brother should differ little from the known man, the other that he should differ little from the mean of his race. The result can be mathematically shown to be a ratio of regression that is constant for all statures. The results of observation accord with, and are therefore confirmed by, this calculation.

Variability above and below the Mean Stature.—Here the net result of a great deal of laborious work proves, as in the previous case, to be extremely simple, and to be very easily expressed by a working model. A set of five scales can be constructed, such as I exhibit, one appropriate to each of the lines I., II., III., and VI., and suitable for any position on these lines. They are so divided that when the centres of the scales are brought opposite to the points crossed by the thread, in the way already explained, we shall see from the divisions on the scales what are the limits of stature between which successive batches of the kinsmen, each batch containing 10 per cent. of their whole number, will be included. Smaller divisions indicate the 5 per cent. limits. The extreme upper and extreme lower limits are perforce left indefinite. Each of the scales I give deals completely with nine-tenths of the observations, but the upper and lower 5 per cent. of the group, or the remaining one-tenth, have only their inner limits defined.

The divisions on the movable scales that are appropriate to the several lines VI., III., II. and I., are given in the table, where they are carried one long step further than I care to recommend in use.

Per-cents. of included statures	Divisions, upwards and downwards, from centres of the scales; in inches		
	VI.	III.	II. and I.
10	0·5	0·6	0·6
20	1·0	1·3	1·3
30	1·6	2·0	2·1
40	2·4	3·0	3·1
45	3·1	3·9	4·0
49·5	4·8	6·1	6·3

The divisions are supposed to be drawn at the distances there given, both upwards and downwards from the centres of the several scales, which have to be adjusted, by the help of the thread, to the average height of the kinsmen indicated in the several lines. The percentage of statures that will then fall between the centre of each scale and the several divisions in it is given in the first column of the table. Example:—In line VI. 40 per cent. will fall between the centre and a point 2·4 inches above it, and 40 per cent. will fall between the centre and a point 2·4 inches below it; in other words 80 per cent. will fall within a distance of 2·4 inches from the centre. Similarly we see that 2 × 49·5, or 99 per cent. will fall within 4·8 inches of the centre.

In respect to the principle on which these scales are constructed, observation has proved that every one of the many series with which I have dealt in my inquiry conforms with satisfactory closeness to the "law of error." I have been able to avail myself of the peculiar properties of that law and of the well-known "probability integral" table, in making my calculations. A very large amount of cross-testing has been gone through, by comparing secondary data obtained through calculation with those given by direct observation, and the results have fully justified this course. It is impossible for me to explain what I allude to more minutely now, but much of this work is given, and more is indicated, in the forthcoming memoir to which I have referred.[1]

I know of scarcely anything so apt to impress the imagination as the wonderful form of cosmic order expressed by the "law of error." A savage, if he could understand it, would worship it as a god. It reigns with serenity in complete self-effacement amidst the wildest confusion. The huger the mob and the greater the apparent

[1] The following will be of help to those who desire a somewhat closer idea of the reasoning than I can give in a popular Address.

m = mean height of race = 68·25 inches.

$m \pm x$ = height of a known individual.

$m \pm x'$ = the probable height of an unknown kinsman in any given degree.

$\frac{x'}{x}$ (which I designate by w) = the ratio of mean regression: it is shown by direct observation to = ⅔ both in the case of mid-parent to son, and of man to brother; it is inferred to be ⅓ in the case of parent to son. It is upon these primary kinships that the rest depend.

The "probable" deviations ("errors") from the mean values of their respective systems are—

p = that of the general population = 1·70 inch.

b = that of any large family of brothers = 1·0 inch.

f = that of kinsmen from the mean value of $m \pm x'$.

Since a group of kinsmen in any degree may be considered as statistically identical with a sample of the general population, we get a general equation that connects f with w, namely, $w^2p^2 + f^2 = p^2$.

The ratio of regression in respect to brothers can be shown to depend on the equation $w = \frac{p^2 - b^2}{p^2} = \frac{2}{3}$ nearly.

anarchy the more perfect is its sway. Let a large sample of chaotic elements be taken and marshaled in order of their magnitudes, and then, however wildly irregular they appeared, an unsuspected and most beautiful form of regularity proves to have been present all along. Arrange the statures side by side in order of their magnitudes, and the tops of the marshaled row will form a beautifully flowing curve of invariable proportions; each man will find, as it were, a preordained niche, just at the right height to fit him, and if the class-places and statures of any two men in the row are known, the stature that will be found at every other class-place, except towards the extreme ends, can be predicted with much precision.

It will be seen from the large values of the ratios of regression how speedily all peculiarities that are possessed by any single individual to an exceptional extent, and which blend freely together with those of his or her spouse, tend to disappear. A breed of exceptional animals, rigorously selected and carefully isolated from admixture with others of the same race would become shattered by even a brief period of opportunity to marry freely. It is only those breeds that blend imperfectly with others, and especially such of these as are at the same time prepotent, in the sense of being more frequently transmitted than their competitors, that seem to have a chance of maintaining themselves when marriages are not rigorously controlled—as indeed they never are, except by professional breeders. It is on these grounds that I hail the appearance of every new and valuable type as a fortunate and most necessary occurrence in the forward progress of evolution. The precise way in which a new type comes into existence is untraced, but we may well suppose that the different possibilities in the groupings of some such elements as those to which the theory of pangenesis refers, under the action of a multitude of petty causes that have no teleological significance, may always result in a slightly altered, and sometimes in a distinctly new and fairly stable, position of equilibrium, and which, like every other peculiarity, admits of hereditary transmission. The general idea of this process is easy enough to grasp, and is analogous to many that we are familiar with, though the precise procedure is beyond our ken. As a matter of fact, we have experience of frequent instances of "sports," useful, harmful, and indifferent, and therefore presumably without teleological intent. They are also of various degrees of heritable stability. These form fresh centres, towards which some at least of the offspring have an evident tendency to revert. By refusing to blend freely with other forms, the most peculiar "sports" admit of being transmitted almost in their entirety, with no less frequency than if they were not exceptional. Thus a grandchild, as we have seen, regresses on the average one-ninth. Suppose the grandfather's peculiarity refused to blend with those of the other grandparents, then the chance of his grandson inheriting that peculiarity in its entirety would be as one to nine; and, so far as the new type might be prepotent over the other possible heritages, so far would the chance of its reappearance be increased. On the other hand, if the peculiarity did not refuse to blend, and if it was exceptional in magnitude, the chance of inheriting it to its full extent would be extremely small. The probability (easily to be calculated for any given instance by the "probability integral" tables) might even be many thousand times smaller. I will give for an example a by no means extreme case. Suppose a large group of men, all of 6 feet 5 inches in height, the statures of whose wives are haphazard, then it can be shown that out of every thousand of the sons not more than one on an average will rival or surpass the height of his father. This consideration is extremely important in its bearing on the origin of species. I feel the greatest difficulty in accounting for the establishment of a new breed in a state of freedom by slight selective influences, unless there has been one or more abrupt changes of type, leading step by step to the new form.

It will be of interest to trace the connection between what has been said about hereditary stature and its application to hereditary ability. Considerable differences have to be taken into account and allowed for. *First*, after making large allowances for the occasional glaring cases of inferiority on the part of the wife to her eminent husband, I adhere to the view I expressed long since as the result of much inquiry, historical and otherwise, that able men select those women for their wives who on the average are not mediocre women, and still less inferior women, but those who are decidedly above mediocrity. Therefore, so far as this point is concerned, the average regression in the son of an able man would be less than one-third. *Secondly*, very gifted men are usually of marked individuality, and consequently of a special type. Whenever this type is a stable one, it does not blend easily, but is transmitted almost unchanged, so that specimens of very distinct intellectual heredity frequently occur. *Thirdly*, there is the fact that men who leave their mark on the world are very often those who, being gifted and full of nervous power, are at the same time haunted and driven by a dominant idea, and are therefore within a measurable distance of lunacy. This weakness will probably betray itself in disadvantageous forms among their descendants. Some will be eccentric, others feeble-minded, others nervous, and some may be downright mad.

It will clear our views about hereditary ability if we apply the knowledge gained by our inquiry to solve some hypothetical problem. It is on that ground that I offer the following one. Suppose that in some new country it is desired to institute an Upper House of Legislature consisting of life-peers, in which the hereditary principle shall be largely represented. The principle of insuring this being that two-thirds of the members shall be elected out of a class who possess specified hereditary qualifications, the question is, What reasonable plan can be suggested of determining what those qualifications should be?

In framing an answer, we have to keep the following principles steadily in view:—(1) The hereditary qualifications derived from a single ancestor should not be transmitted to an indefinite succession of generations, but should lapse after, say, the grandchildren. (2) All sons and daughters should be considered as standing on an equal footing as regards the transmission of hereditary qualifications. (3) It is not only the sons and grandsons of ennobled persons who should be deemed to have hereditary qualifications, but also their brothers and sisters, and the children of these. (4) Men who earn distinction of a high but subordinate rank to that of the nobility, and whose wives had hereditary qualifications, should transmit those qualifications to their children. I calculate roughly and very doubtfully, because many things have to be considered, that there would be about twelve times as many persons hereditarily qualified to be candidates for election as there would be seats to fill. A considerable proportion of these would be nephews, whom I should be very sorry to omit, as they are twice as near in kinship as grandsons. One in twelve seems a reasonably severe election, quite enough to draft off the eccentric and incompetent, and not too severe to discourage the ambition of the rest. I have not the slightest doubt that such a selection out of a class of men who would be so rich in hereditary gifts of ability, would produce a body of men at least as highly gifted by nature as could be derived by ordinary parliamentary election from the whole of the rest of the nation. They would be reared in family traditions of high public services. Their ambitions, shaped by the conditions under which hereditary qualifications could be secured, would be such as to encourage alliances with the gifted classes. They would be widely and closely connected with the people, and they would to all appearance—but who can speak with certainty of the effects of any paper constitution—form a vigorous and effective aristocracy.

DEPOSITS OF THE NILE DELTA

IN a previous communication I referred to the probability that the lower portion of the Delta borings belongs to the Pleistocene and Isthmian deposit which underlies the modern Nile mud, and which has been recognised as an important formation by nearly all geologists who have studied the Nile Valley. I now propose to state shortly some objections to the generalisations of the Report on the Nile borings with reference to the causes assigned for the comparative purity of the waters of the Nile, and the character of its sediment, viz. that the former is due to its flowing through a rainless country, and that the latter is derived from the decay of rocks in this rainless area, and this decay produced not by "chemical agencies," but by "mechanical forces," namely, the "unequal expansion" of the constituent minerals under the influence of heat and cold, aided by "the force of the wind."

It is scarcely necessary to premise that neither the water nor the mud of the Nile can be derived from the rainless district through which the river flows, but from the well-watered regions of interior Africa. The White Nile, which carries scarcely any sediment, is a somewhat constant stream, draining a country of lakes, swamps, and forests. The Blue or Dark Nile and the Atbara drain the mountainous country of Abyssinia, deluged with rain in the wet season, and it is these streams, swollen by violent inundations, that supply the Nile with its sediment, the quantity of fresh material carried into the river below the confluence of the Atbara being very small, as the results of the microscopic study of the sediment sufficiently proves, and I can testify from my own examinations of the Nile mud, that its composition, as stated by Prof. Judd, is essentially the same along the course of the Nile as in the upper layers of the Delta borings, though with some local differences in the fineness of the sand and the proportion of argillaceous matter. Thus both the water of the inundations and the material of the alluvial deposit come from a region of copious rains, and where decay of rocks may be supposed to proceed under the ordinary conditions.

What then is the cause of the freedom of the Nile water from saline matter? Simply its derivation from a country of siliceous and crystalline rocks. If, instead of comparing it with the water of the Thames and other streams draining sedimentary districts, it had been compared with that of the lakes and streams of the Scottish Highlands (by no means rainless districts) this would have been apparent. Dr. Sterry Hunt has described and referred to its true cause a fact of the same kind in the case of the Ottawa and St. Lawrence. The former, rising in a region of crystalline rocks, has little more than one-third of the saline matter in solution that is found in the latter, which drains principally a sedimentary country. The proportions in 10,000 parts are, for the Ottawa, only 0·6116, and for the St. Lawrence, 1·6055.[1]

But it may be asked, Why in that case is the Nile mud so deficient in kaolin? The answer is, that the current of the river is sufficiently strong to wash out all the more finely comminuted argillaceous matter and to carry it in its turbid waters to the sea. In connection with this, every voyager on the falling Nile must have observed how the mud-banks are constantly falling as they are undermined by the river, and their material carried down to be redeposited. This work goes on even more energetically in the time of the inundations. Thus any given quantity of sediment on its way from Abyssinia to the Delta is lixiviated thousands of times, and necessarily deprived of its lighter and finer constituents.

¹ Logan's ' Geology of Canada," 1865, p. 565.

But the quantity of kaolin need not originally have been large. The older gneisses and schists do not kaolinise after the manner of Cornish granites, but, when decomposed so as readily to crumble into sand, they still contain much of their more refracting felspar in a perfect state.

These facts are farther illustrated by the agricultural qualities of the Nile alluvium, as they have been explained by Schweinfurth and others. If the alluvial soil were a stiff clay, it would be practically incapable of cultivation in the circumstances of Egypt. If it were mere quartzose sand, it would be hopelessly barren. It is, in fact, an impalpable sand, highly absorbent of water, crumbling readily when moistened, and containing not merely quartz but particles of various silicates and of apatite and dolomite, which, though unaltered when under water, are gradually dissolved by the carbonic acid present in the cultivated soil, yielding alkalies, phosphates, &c., to the crops. In connection with this, recent microscopic examinations by Dr. Bonney of the old crystalline rocks of Assouan, which are probably similar to those farther north, show that, like those of Canada and Norway, they contain numerous crystals of apatite.

As to the mechanical action of the heat of the sun on crystalline rocks, any one who examines the polished surfaces still retained by monuments which in Upper Egypt have been exposed to this influence for thousands of years, must be convinced that no disintegration of this kind occurs. The only evidence of such actions that I have been able to find is the chipping of little circular disks from the exposed sides of nodules of flint on the surface of the desert. Granitic rocks decay, however, in Egypt, as elsewhere, where they are exposed to moisture from the soil, or where, as at Alexandria, they are subjected to the influence of frequent rains and of saline particles carried from the sea. In this connection I may add that Hague, in a paper in *Science* on the decay of the New York obelisk, shows that it had probably suffered (as, according to Wigner, that in London has also done) from atmospheric action before its removal from Alexandria, and that this decay has been greatly increased by the alternations of moisture and frost to which it is subjected in New York.[1]

At Assouan, in a climate at present rainless, or nearly so, I was surprised to find that the surface of the gneiss and crystalline schists was in many places decayed to the depth of several feet, so that it was impossible to obtain fresh specimens except from the railway cuttings. This may be due to the action of water and carbon dioxide oozing through the ground, but is more probably a result of more humid climatal conditions in former ages.

I hope at a future date to pursue these interesting questions farther; but in the meantime I shall be content if it has been shown that Egypt owes the advantage of pure, sweet water to the fact that it drinks of mountain streams which the rainless character of its own climate merely preserves from pollution by the drainage of the Cretaceous and Tertiary beds, and that its rich alluvial soil has not been produced by any mechanical action of an exceptional nature, but by the ordinary atmospheric agencies of denudation.

These conclusions, as well as those stated in my previous letter, respecting the depth of the modern alluvium and its relation to the well-known Pleistocene formation which underlies it, could be confirmed by the testimony of most geologists who have studied the valley of the Nile, and more especially of Lartet, Fraas, and Schweinfurth. I hope that as now stated, however imperfectly, they may suffice to induce the Committee materially to modify its Report, or to postpone its publi-

¹ The freezing of water in the pores of rocks is undoubtedly an important cause of destruction in the colder climates.

cation until those members of the Royal Society who have studied the geology of Egypt can have opportunity to discuss it fully. J. WILLIAM DAWSON

December 28, 1885

NOTES ON THE "MUIR GLACIER" OF ALASKA

IN a recent number of NATURE (vol. xxxii. p. 162) an abstract is made of a San Francisco newspaper account of the "Great Glacier" of Alaska. This account is not very accurate, and as I spent a few hours on this glacier during a flying visit to Alaska in the summer of 1884, I think my observations may be worth recording. I have heard that some descriptions by American observers have already been published, but have not been able to procure them. However, as there are one or two features to which it may be useful to draw the attention of future explorers in this region, I will give my observations just as I made them, and apologise beforehand if they should be found to overlap those of others.

On August 1, 1884, I took passage from Victoria, Vancouver Island, on the steamer—on this occasion the *Ancon*—which carries the monthly mail from ports on Puget Sound to Sitka, Alaska, and eight days later we steamed up the long fiord known as "Glacier Bay," which opens into the Chilcoot Inlet, being then not far from latitude 59° N. and longitude 136° W. of Greenwich.

On either side of us high snow-capped mountains bordered the fiord, and in their recesses we could see glaciers of all sizes. One large mass filled a deep valley on our left, and reached nearly down to the sea, being apparently only separated from it by a ridge of moraine; and everywhere little patches of blue rested in all the *coulées* near the mountain-tops, and showed by their trail of bare striated rocks and long strings of moraine how much further they must recently have extended.

Here and there a small island rose above the waters of the fiord, and, by its bare rounded outline and *moutonnéed* surface, gave evidence that it, too, had once been overspread by the ice. The Indians say that one of these islands which is now above a mile distant from the Great Glacier, was embedded in the ice during their recollection, and I was told that early Russian charts of the coast do not show this fiord at all, but make note of a line of ice cliffs near its present entrance; but though the fiord has undoubtedly been at one time filled with ice, I cannot think that the period was so recent as this would indicate.

All round us the waters of the bay were strewn with masses of floating ice of beautiful colour and fantastic outline, but none were large. Right ahead, a gleaming wall of ice rose up out of the water and completely blocked the fiord, extending with a slight outward bulge from shore to shore. This was the "Great Glacier," or the "Muir Glacier," of Alaska.

In the account in NATURE it is stated that the height of the ice-wall is 500 feet, but I think this is an exaggeration. The master of our steamer thought its highest point might reach 450 feet; my own estimate would place it much lower even than this. Where I stood beneath it on the eastern shore I do not think it was more than 240 feet high, judging from the better-known height of an abutting cliff of sand and gravel presently to be described; but as the upper surface of the glacier appeared to be slightly domed, so as to be highest in the centre of the bay and lowest near the mountains, I should say that near the middle of the fiord the cliffs might be nearly 100 feet higher than where I stood; but in my opinion they nowhere exceeded 350 feet.

The breadth of this ice-wall was about three miles. Huge masses were constantly splitting from it and sliding down into the sea with a loud dull roar. As they slid they raised a white dust-like cloud, and when they fell into the water great waves leaped in upon them and dashed high up the ice cliff, rebounding and causing every now and again a broad deep ground-swell which we could watch as it rapidly swept towards us.

The water through which we passed had changed when we first entered the fiord from the deep dark blue of the outer channel to a beautiful pale green, and now became quite clouded and of a milky greenish-white; and when we came nearer the glacier strong springs were observable, bursting up through the sea-water so as to rise slightly above its level. These were some little distance from the ice-cliff, which must have projected forward under water.

After having failed in an attempt to make fast to a grounded mass of ice—the largest near us—which rose up in pinnacles to the height of our somewhat stunted topmasts, we anchored near the right, or eastern, shore. Our party was then put ashore on a fine beach of washed sand and shingle, about half a mile from the foot of the glacier.

This beach is formed by the action of the waves on a mass of morainic material which is piled up irregularly between the shore and the bare mountain-side, and, where we landed, sloped back almost insensibly into the glacial gravels. But nearer the glacier the moraine had been cut back so as to form a low cliff, which increased in height as it approached the ice.

This cliff exhibited a clear and very interesting section, of which I made a sketch on the spot, shown in Fig. 1.

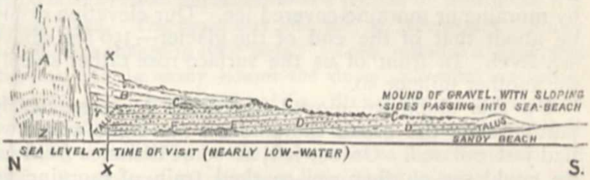


FIG. 1.—Sketch Section of Cliff at the head of Glacier Bay, Alaska, on the eastern shore, adjoining the glacier, Aug. 9, 1884. Length of section about 400 yards; height at X about 100 feet.

A, Eastern end of terminal precipice of Muir Glacier, a nearly vertical wall of very clear blue ice, without stones: the ice shows lines of bedding towards the base, which are strongly curved over a dome-shaped cave (Z) from which issues a strong current of muddy water; this cave is filled by the sea at high tide; full height of ice wall, which is about 240 feet here, is not shown.

B, Flange of very stony, dirty ice, apparently descending and flowing forward from the main mass of the glacier at a point some distance behind the line of section: about 60 feet thick at *X....X*: this passes over the sands and gravels D, and covers them for some distance, but rapidly diminishes in thickness, and seems to fade away into the *remainder-bed* C.

C, Rubble of angular and water-worn boulders and pebbles mixed with sand and clay; derived from the melting of the stony ice, B, whose lower layers are scarcely distinguishable from this bed.

D, Steep cliff of evenly-bedded sand and gravel; pebbles small and water-worn; shows signs of erosion at junction with C, but the bedding is not disturbed: height at *X....X* 40 feet.

E, A small boss of stony, bluish-gray clay resembling till, outcropping below the sands and gravels: full of small water-worn pebbles.

F, Similar boss of fine gray clay without stones: no observable bedding.

NOTES.—In the above figure that part of the section marked A is not on the same plane as the rest, which recedes about 20 yards—the width of the sea-beach.

A narrow gully (*y*) had been excavated between A and D by water derived from the melting ice, and the lower part of the section was here obscured by talus: C crossed the head of this gully and joined the main mass of the glacier, but it was difficult to study this junction, as the ice of C overhung the gully, and was constantly shedding masses into it.

The size of the patches of clay marked E and F is somewhat exaggerated in the section to make them apparent. I saw only a small surface of each rising above the beach in the cliff-foot; but from the manner of their outcrop I think they may form part of a clayey base on which the gravels rest.

I was not able to give much time to the study of this remarkable section, but was able to satisfy myself on the following points:—That a considerable thickness of *evenly-bedded*, water-worn gravel and sand was in close proximity to an almost vertical wall of ice, if not actually abutting on it. That this bedded gravel and sand was covered for some distance by a mass of dirty ice, full of stones, which was connected in some way with the main mass of the glacier. That the bedding of this deposit was in no way disturbed by either of these masses of ice. That a loose unstratified deposit containing both angular and water-worn pebbles and a little clay and sand, evidently the remainder-beds from the melting of the dirty and stony ice, overlay the bedded gravels. And that fine grey clay, in one place with stones, in another without, resembling glacial clays with which I am well acquainted, occurred below the bedded gravels.

A gentleman on board the steamer, Captain H. E. Morgan, of Port Townsend, W.T., with whom I had become acquainted during the voyage, had made several previous visits to the glacier; and we agreed to set out together for its upper surface as soon as we landed, and go as far along it as we could in the time allowed us.

We therefore struck out at once for the top, and, skirting the heaps of moraine which fill a large hollow space caused by the shrinking of the glacier from the mountain-side, we soon commenced to ascend, passing diagonally along steep slopes of what looked like rough gravel, but was really stony ice covered with a thick crust of loose stones, as some dark water-pools and narrow crevasses soon showed.

Along these slopes we rose rapidly for some distance, the rubbly covering becoming thinner and thinner, till we emerged on a tolerably even plane of clear dark ice, with a rough and evidently rapidly-wasting surface which afforded excellent foothold.

I should think we were now at least half a mile from the mountain-side, and this space was altogether occupied by moraine or moraine-covered ice. Our elevation would be about that of the end of the glacier—350 feet above sea-level. In front of us the surface rose rather steeply for another mile or so.

Up this slope we moved, following a course nearly parallel with the broad moraine on our right, which we had just crossed. On our left, at some distance from us, we could see another well-marked train of moraine, in which were many blocks of large size. The ice we were now passing over was very clear and unencumbered with debris, and of a magnificent pale blue tint. It was fissured transversely by deep crevasses, which, however, were not very wide, so that we could generally find a place to cross without diverging far from our course, though they seemed to widen as they left the margin of the glacier.

We went on in the same direction till we reached the crest of the slope. Up to this point I do not think the glacier anywhere exceeded a width of three miles, but now in front of us there lay a great expanse of ice which spread out like a lake, having a width which we estimated to be from six to eight miles. It seemed to me that from where we stood we looked slightly downward upon this basin. Numerous feeders poured into it on either side, one very large tributary coming in from a deep valley on our right about three miles distant, but its main gathering grounds were on some mountains at the head of the valley, which we estimated were about forty miles distant, our estimate being based on their appearance as compared with that of those off the mouth of the inlet, whose distance was known.

This basin discharged itself into the fiord by the steep slope we had just passed, which no doubt represented a similarly narrowed and increased slope in the buried valley beneath it. Our elevation here was probably not far short of 1000 feet. About three miles ahead of us an island of whitish rock cropped high up above the surface of the ice. This seemed to cause an eddy, as it were, in the current, there being a swerving of the ridges of ice on either side and a depression under its lee.

After passing the crest we found that the crevasses were no longer open, their sides coming together at a short distance below the surface, so as to form deep V-shaped troughs, or wells, which were filled with water of brilliant purity. The exquisite tints of blue deepening with the depth of the water exhibited by these ice pools made them a most beautiful spectacle. At the same time the surface of the glacier became very hummocky, so as to resemble a short cross-sea suddenly frozen, but as the decaying upper layer still afforded excellent foothold, and as there were now no black, open gulfs to startle one, travelling, though laborious, was quite practicable in any direction. We therefore changed our course and, striking out diagonally, soon crossed the narrow moraine on our left. This, which would be about a mile from the edge of the ice, we found to consist chiefly of blocks of gray granite of all sizes, mixed with much sand formed by the decomposition of the small boulders which had often crumbled away into little heaps of grit. Beyond this there did not seem to be any rocky debris on the ice nearer than the moraines of the opposite shore, and the glacier consisted entirely of clear massive ice cut up into grooves and ridges. I noticed here and there amongst this clear ice, however, patches of small extent through which a muddy yellow stain was suffused. Seeking a cause for this, I found in the midst of one of these patches a pasty-looking mass of gritty matter of the colour of rusted iron, forming a centre from which the stain had evidently diffused itself through the ice.

As this was not only far away from the moraine, but was also widely different from anything I had seen there, and as it did not in any way resemble an organic growth, I concluded that it might be of meteoric origin, and brought part of the mass away with me.

With the kind assistance of Mr. G. Carr-Robinson, F.R.S.E., F.C.S., I have lately been able to make a rough qualitative analysis of this substance, which has shown it to consist in great part of iron oxide, with a trace of nickel, and my suspicion that it may be a decomposed meteorite has thus been considerably strengthened. A more complete analysis will shortly be made. I hope that some future visitor to the locality will more thoroughly investigate this point, and carefully examine any stained ice which he may meet with in the body of the glacier. I took hasty notice of several instances, but only found this substance in the one case mentioned. A melting glacier of great age is certainly a likely place to reveal meteorites.

Capt. Morgan told me that once before when he was on the glacier he had come across the weathered bones of a bear protruding from the ice; he afterwards showed me one of the teeth which he had brought away with him.

After going a little further we found it was high time to return to the ship. There was now nearly two miles of ice and moraine between us and the mountain-side which bounded the glacier on our right, whilst on our left the ice still rose before us in broken hummocky ridges, with deep pools between. I pressed on alone to the crest of one of the ridges ahead of us, which promised a more extended view. Looking forward from this point, the surface seemed to become more and more broken, but I still could not see any open crevasses, and think it might have been possible to cross the glacier.

I then hurriedly retraced my steps, but instead of going directly back to the beach, swerved to the left, and passed down into the hollow between the glacier and the mountain-side to which I have already referred, wherein was heaped a great mass of moraine. This consisted chiefly of sand and gravel piled up in long ridges running roughly parallel with the flank of the glacier and with each other, with here and there a dangerous slough of soft tenacious mud between them, deposited by waters welling up from below. These ridges, of which there were three or four between the glacier and the mountain, were from 30 to 100 feet high, and were steeper on one side than the other; they seemed to contain both water-worn and angular pebbles, with a thin scattering of large blocks. I crossed two of them, but had not time to go further. To all appearance they were made up altogether of morainic matter, but in ascending the steep side of one of them I was surprised to find that my feet, after sinking through a few inches of loose stone, struck upon a hard surface of ice, and that the bulk of the ridge was made up of stony ice.

Seeing also that muddy water was welling out in the depression between this ridge and the next, I came to think that a buried portion of the glacier probably still underlay all this ground, perhaps even reaching down to the beach. Then, observing huge piles of similar material on the mountain-side, I concluded that a portion of the ice might remain hidden there also.

If this were so, then the downward pressure of this mass on the one hand against the sloping and partially-buried flank of the glacier on the other would readily explain the presence of these ridges.

This view of their origin is illustrated in the following diagram (Fig. 2), which I drew just after leaving the glacier; it would account for the mixture of water-worn and angular debris in the ridges, the former resulting from the watercourses between the glacier and the mountain, and the latter from the melting of stony ice.

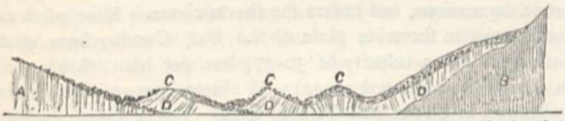


FIG. 2.—Ideal Section across the Moraine on the eastern flank of the Muir Glacier.

A, Eastern slope of the glacier: stony ice covered with a deep layer of loose stones.

B, Solid rock of the mountain-side.

C C C, Ridges apparently consisting of water-worn gravel and sand, with some angular debris, but probably hiding a core of stony ice, D D.

D D D, Buried portion of the glacier, supposed to exist below the moraine at C C C, and also on the mountain-side, which has been pressed up into ridges.

The ridges at the time of my visit were about half a mile in length, but may of course grow much longer as the glacier shrinks back. Though more or less regular, they were here and there interrupted and confused so as to form hollows surrounded by mounds, and in one case I noticed that the drainage of a gully had been dammed back so as to form a pond, in which the muddy water deposited much of its fine rock-flour, and issued out comparatively clear at the other side of the obstruction.

The boulders and pebbles of the moraine were chiefly of gray granite, but I noticed also quartzite, gneiss, a few fragments of slaty shale, and a mass of ancient-looking conglomerate—the last-named on the beach. During the day I saw only one scratched block; this was low down on the moraine near the beach.

We were now obliged to join the boat, which was waiting to take us back to the ship, and very much did I regret that circumstances would not permit me to stay longer.

Before leaving the ice-cliffs we fired a shot or two from our small signal cannon, to try to bring about an avalanche, but it had no perceptible effect, and the avalanches continued to choose their own time to fall.

This whole region forms a magnificent field for the study of glacial phenomena, and to any geologist who may follow I would especially say—examine the hollow between the ice and the mountains; go to the foot of the ice-cliff at low water; and, wherever there is stained ice on the top of the glacier, trace out the source of the discolouration. G. W. LAMPLUGH

NOTES

THE honour of knighthood was conferred upon Prof. Robert Stawell Ball, LL.D., Astronomer-Royal for Ireland, at the *levée* of the Lord-Lieutenant, on January 25.

LORD IDDESLEIGH has selected Mr. D. Morris, Director of the Public Gardens, Jamaica, for the appointment of Assistant Director of the Royal Botanic Gardens at Kew.

DR. RILEY, Entomologist to the United States Agricultural Department, has presented his collection of insects to the United States. It is said to contain 115,000 specimens of 20,000 species or varieties of insects.

THE Committee of the François Arago centenary have appointed M. Mouchez, Director of the Observatory, President; M. Floquet, President of the Chamber of Deputies, has been appointed Honorary President. The principal part of the celebration will take place at the Observatory.

M. PAUL BERT will not leave Paris so soon as was expected for Tonquin; the delay is occasioned by the organisation of the scientific part of his mission.

THE late M. Bertillon has bequeathed a sum of 4000 francs to the Paris Anthropological Society, to found a biennial prize to be awarded for the best work on some anthropological subject.

A SHOCK of earthquake was felt at about 7 o'clock on the morning of January 20 at St. Austell and in the neighbourhood. It appeared as if an explosion had taken place, so great was the noise, and the sound was immediately followed by the shaking of the ground. Persons felt their beds moving under them, and many others had an impression that a portion of their house was falling down. The shock was also felt at Mevagissey. Many people were shaken in their beds. In one instance a clock was stopped, and in many houses the doors and windows shook violently. The inhabitants of St. Blazey and neighbourhood were greatly startled, about a quarter past 7, by hearing a loud rumbling noise and by houses being shaken from foundation to roof. It appeared to come from a northerly direction, and the vibration lasted about 4 or 5 seconds. Persons coming in from the outlying districts and giving an account of the shock being more or less severe all agree as to the time of its taking place.

A TELEGRAM from Mexico states that there was a renewed eruption on January 16 from the Colima volcano. Enormous stones were thrown out, and great streams of lava appeared. The eruption was accompanied by earthquakes.

MR. J. FRANCIS COLE, writing from Sutton, Surrey, informs us that he was a spectator of the remarkable meteor alluded to in our columns of the 21st inst. (p. 278). As seen by him, the meteor appeared to explode or extinguish itself at a point about midway between the horizon and Capella, and was of a form like a well-shaped pear. It seemed so near that he felt he could have hit it with a stone. At the moment of exploding it opened in the centre of the lower part with a well-defined slit, and then widening, showed a light of the character of a hydrogen flame. The direction of the meteor was clearly from west to east, and at the same time the wind was blowing strongly from the west.

AMONGST the objects of interest at the forthcoming Colonial and Indian Exhibition will be a rare collection of indigenous Australian grasses. The specimens are named to correspond with the nomenclature used in the "Flora Australiensis," and there is in addition much practical information about each, derived from general sources.

WE have received Prof. Baird's last Report on the work of the Smithsonian Institution, which deals only with the half year ending June 30 last, in consequence of a resolution of the Board of Regents directing that the fiscal year, instead of extending from January to December, shall, like the Government fiscal year, extend from July 1 to June 30 in future. Amongst the publications promised by the Institution we notice the scientific writings of Prof. Joseph Henry, which will consist altogether of 1050 printed pages, and which are due now; also a work by Prof. Cope, of Philadelphia, on the reptiles and batrachians of North America. A compact manual on this subject was wanting, although numerous monographs on reptiles have been published, and when this has been completed, the entire field of the vertebrates of North America will have been covered by convenient and effective text-books prepared under the direction of the Institution. The various departments of the museum are treated, as usual, in successive paragraphs describing their work for the year. Under the head of "Explorations" we notice that Mr. Thomas Wilson, United States Consul at Nantes, and afterwards at Nice, has presented a very large collection of the remains of prehistoric man around these two places. It is believed that this collection, filling a large number of boxes, will prove to be one of the richest and most complete ever sent to the United States.

THE idea of an International Exhibition at Geneva has been abandoned, and it is now intended to hold only a national Swiss Exhibition.

A SOUTH AMERICAN Exhibition will be held at Berlin by the Central Verein für Handelsgeographie during May, June, and July, in which Brazilian products will be specially represented.

IN Germany an unusual number of white varieties of animals are noticed this winter. A white chamois was shot in the Totengebirge, a white fish otter was caught near Luxemburg, white partridges were shot near Brunswick, and a white fox was killed in Hessen.

THE recently-formed Central-Swiss Geographico-Commercial Society at Aarau is collecting funds for the erection of an ethnological museum.

IN the new number (No. 15) of the *Journal* of the Straits Branch of the Royal Asiatic Society, Mr. Wheatley, in a paper on the rainfall of Singapore, urges that the Straits Settlements are almost the wealthiest of the British colonies, and that it is not too soon to provide for an Observatory under an astronomer and meteorologist. The equatorial position of Singapore, he adds, would give to the astronomer a more interesting field for observation than can be obtained at higher or lower latitudes. Meanwhile, private observers are doing their best to study the meteorological features of the Straits, and Mr. Wheatley publishes tables of mean annual rainfall and number of rainy days from 1869 to 1884. Mr. Dodd, whose name is given to a conspicuous mountain-range in Northern Formosa, and who has already written on the "aborigines" of that island, describes the hill-tribes in the north, occupying the savage forest-clad mountains to the south-east and south of the town of Banka. These appear to have no negro features whatever; the hair is lank, not curly or frizzled, their lips are not so thick even as those of Malays, and the high noses possessed by many approach often the European type. The complexion, too, of the younger men who had not undergone much hardship or exposure is as light and fair as that of the Japanese. The paper is not finished in this number. The other papers are mainly geographical.

IN a recent paper to the *Archiv für Anthropologie* on the capacity and chief diameters of the skull in different nations, Herr Welcker considers that nine-tenths of all the figures of capacity given in literature are incorrect, most of them being excessive. After discussing different modes of measurement, he gives the following results of his own observations:—In the Germanic peoples the average internal capacity varies between 1400 and 1550 c.cm. In Celts, Romans, and Greeks we find 1400 to 1500; in the Slavs the width of variation is about the same as in the Germans (but less exactly determined). Quite out of the series are the peoples of Hindostan; the narrow range of 1260 to 1370 includes all the members of this group. Individual examples of the Semitic and Hamitic peoples (of which the author had but few to examine) differ widely; but the Jews and Arabians here take a good position—1450 to 1470 c.cm. The Mongolians range from about 1320 (but mostly 1400) to 1500; 1350 to 1450 seems the proper range of the capacity of the Malays, and only very isolated stocks exceed these limits on both sides. The Papuans and Australians show the averages 1370 and 1320 respectively. The negroes vary between 1300 and 1400. A much lower figure appears for the Bushmen (1244). The Americans, finally, have a wide range; while they are normally between 1300 and 1400, they reach in some of their artificially deformed members a mean value of 1200 and even less. Sexual dimorphism (female skull smaller and flatter) is most pronounced in all civilised peoples.

FROM a study of 650 thunderstorms that occurred in Italy in 1881, Signor Ferrari concludes that every thunderstorm is connected with a barometric, hygrometric, and thermic depression; it is behind the two former, and in front of the last. All three depressions, but especially the two latter, are associated with maxima, which are situated behind the barometric and hygrometric depressions, but before the thermic one. Most of those storms arose in the wide plain of the Po. Coming from west-north-west with a velocity of 30–37½ km. per hour, they passed (in case of their greatest range) with slackening speed over the Apennines in Upper and Middle Italy. For a given moment the thunderstorm has the form of a long narrow band, advancing, with numerous bends outwards and inwards, parallel to itself, and having its various characteristic phenomena most intense along the middle line. The *isohyetes*, or curves of equal rainfall, often take the form of ellipses, whose longer axes coincide with the direction of the storm. The dominant wind-direction is generally parallel to that of propagation of the storm.

THE Penny Science Lectures at the Royal Victoria Hall are about to recommence after the Christmas interval. Lectures hove been promised as follows:—Tuesday, February 2, Mr. W. P. Bloxam, "Fire, Fuel, and Illumination"; February 9, Mr. J. M. Thomson, "Dirty Water and how to Cleanse it"; February 16, Prof. George Forbes, "Shooting-Stars and Comets"; February 23, Mr. Wm. Lant Carpenter; March 2, Mr. T. Cunningham Porter, "English Cathedrals"; March 9, Dr. J. A. Fleming, "Niagara."

DR. ALFRED DANIELL'S "Text-book of the Principles of Physics" has been adopted, in Polish translation, by the University of Cracôw.

A FOURTH edition of Prof. Tyndall's "Six Lectures on Light, delivered in the United States in 1872–73," has been issued by Messrs. Longmans and Co.

THE Council of the City and Guilds of London Institute have received an application from the Board of Technical Education of New South Wales requesting them to forward examination papers in technology to the colony, and award certificates and prizes on the results. This application has been referred to the special committee of the Institute on technological examinations.

AT the forthcoming Indian and Colonial Exhibition the Canadian Government intend to demonstrate the manner in which fish culture is prosecuted in the Dominion, and the various methods adopted in regard thereto will be practically illustrated to the public, and shown together with live specimens of Salmonidæ indigenous to native waters. Canada now possesses about twenty hatcheries, most of which have been constructed since 1873, and worked with the greatest success, whitefish being the chief source of reproduction. Preparations are already being made for the reception of the Canadian exhibits, which will be very numerous, and replete with interest.

LARGE consignments of whitefish and trout ova have arrived at the South Kensington Aquarium from America as a presentation from the Commissioners of that country. In consequence of the success attending the introduction of the first-named fish into this country last year, special attention is to be given to their culture during the present season with a view to their distribution in some of our chief lakes. The National Fish Culture Association have extended their hatchery, and, in order to secure healthy embryos, have adopted the new method, viz. the "underflow" system, which has been found to incubate the ova at a less rate of mortality than the "overflow" system.

DR. SAMUEL TENNY, the indefatigable investigator of Roman antiquities on and around the Lake of Constance, has now at last succeeded in laying bare the forum of the old Roman city of Brigantium (Bregentz), the so-called "Rhätische Pompeii." It consists of an area on the "Oelrain" inclosed by a wall furnished with roofed halls. There are also the remains of a building with stairs and eight columns, evidently a portico of imposing proportions, besides two gates leading to streets. The remains are unfortunately in a very dilapidated condition, and their total destruction is imminent.

IN the eleven years from 1873 to 1884 the number of lions killed in Algeria was 202, for which a premium of 400*l.* has been paid by the Government. The number of panthers destroyed in the same period is 1214, and the money paid by the Government 720*l.* About 400*l.* has been paid for 1882 hyænas, and 1600*l.* for 27,000 jackals. The large felidæ are almost extirpated principally in the western provinces, and the lion of the desert is fast becoming a myth.

IN the *Transactions* of the Verein für Erdkunde at Halle a writer describes certain cave-dwellings in the province of Saxony. These are occasionally found in loess formations in the Balkan Peninsula (in the Lom Palanka region, for instance), but it is somewhat startling to find them used now in such a cultivated place as Saxony. They are in the neighbourhood of Halberstadt, quite close to the village of Langenstein. Here in a sandstone hill, about a dozen caves have been dug, which are used as dwellings. They have different rooms, light and dark, as well as chimneys, windows, and doors, and are said to be very dry and habitable. The writer of the account, a physician, says that he found the inhabitants quite comfortable, and that some of them had lived there for more than thirty years without suffering from any evil effects to their health.

WE have on our table the following new books:—"Zoological Record," vol. xxi. 1884 ("Zoological Record" Association); "The Definitions of Euclid," by R. Webb (Geo. Bell and Sons); "Organic Chemistry," by H. F. Morley (Churchill); "Elementary Algebra," by Chas. Smith (Macmillan and Co.); "Eminent Naturalists," by Thos. Greenwood (Simpkin and Co.).

THE additions to the Zoological Society's Gardens during the past week include a Macaque Monkey (*Macacus cynomolgus*) from India, deposited; two White-billed Parrakeets (*Tanygnathus albirostris*) from Celebes, a Bearded Lizard (*Amphibolurus barbatus*) from Australia, purchased; a Common Otter (*Lutra vulgaris*), British, received in exchange.

OUR ASTRONOMICAL COLUMN

THE DENSITY OF SATURN'S RING.—M. Poincaré supplies a short note on the stability of Saturn's ring in the November number of the *Bulletin Astronomique.* Laplace had shown that the ring could only be stable if it were divided into several concentric rings revolving at different speeds. M. Tisserand had confirmed this result, and had recognised that a single ring must, in order to exist, possess a much higher density than the planet, and had calculated the maximum breadth of each elementary ring in terms of its density and mean radius. M. Poincaré has carried this investigation a step further, and shown that if the density of a ring be less than a certain amount, it will, under the influence of the slightest perturbation, no longer break up into a number of narrower rings, but into a great number of satellites, and that if the rings be fluid and turn each as a single piece, the density of the inner ring must be at least 1/5, and of the outer ring 1/16 that of the planet. For a ring of very small satellites (not for a fluid-ring, as M. Poincaré erroneously states), Maxwell has shown the condition to be that the density should not *exceed* 1/300 part of that of Saturn.

We do not at present know the actual density of the ring from observation sufficiently accurately to make therefrom any certain inference as to its physical condition. Bessel's determination from the movement of the peri-saturnium of the orbit of Titan gave the reciprocal of the mass of the ring as compared with that of Saturn as 118, which, since the volume of the ring—adopting Bond's value of 40 miles for its thickness—is about 1/400 that of the planet, would make its density about 3·4 times greater than the planet's. Bessel's value is, however, clearly too great, as he neglected the influence of the equatorial protuberance of Saturn on the movement of the apsides. Meyer's determination of the secular variation of the line of apsides of Titan, viz. $d\pi = 1726''\cdot5$, gives the reciprocal of the mass of the ring as 26700, but from all the six brighter satellites as 1960; the latter value closely agreeing with Tisserand's. It does not, however, seem to have been noticed that even the smallest value for the mass considerably exceeds the highest permissible in accordance with Maxwell's result, since that would make the mass of the rings only 1/120,000 part of the planet's, an amount we cannot hope to detect with our present resources.

THE ORBIT OF TETHYS.—Herr Karl Bohlin has recently communicated to the Swedish Academy of Sciences an interesting discussion of the elements of the orbit of Tethys. The observations discussed are those of Sir Wm. Herschel, 1789, reduced by Lamont, Lamont, 1836, Sir J. Herschel, 1835–7, the Bonds, 1848–52, Secchi, 1856, Capt. Jacob, 1857–8, Newcomb and Holden, 1874–5, and Meyer, 1880–1. The elements are calculated for each period of observation, without taking account of perturbations. Herr Bohlin, then specially treating the mean longitude of the epoch, and adopting $190^\circ\cdot69812$ as the value of the mean motion, draws up tables of the differences between observation and calculation, and attempts to represent them by an empirical formula. The corrected value of the mean motion is $190^\circ\cdot698169$, almost identical with that found previously by M. Baillaud. Herr Bohlin finds that the annual motion of the peri-saturnium amounts to 33°. M. Baillaud's results and M. Tisserand's investigations had given the value as 70°. The excentricity is found as $0\cdot00803 \pm 0\cdot00077$.

THE ORBIT OF IAPETUS.—Prof. Asaph Hall has published a memoir containing a very full discussion of all the observations of Iapetus made at Washington from the mounting of the 26-inch refractor until February 29, 1884. His finally-adopted elements are deduced from his own observations made between June 10, 1875, and the above-mentioned date. And in deducing them he has taken account of the perturbations produced by the sun, Iapetus being so distant from its primary that, notwithstanding the distance of Saturn from the sun, these perturbations cannot be neglected. The periodic time of the satellite was found, from a comparison of Herschel's observations in 1789 with the conjunctions observed in 1880 and 1881, to be 79·3310152 mean solar days. The adopted mean distance determined by two different methods of observing—one by differences of R.A. and declination, and the other by angles of position and distances, which give very accordant results, is $515''\cdot5195 \pm 0''\cdot02645$. The corresponding reciprocal of the mass of Saturn (including the planet, its ring, and its satellites) is $3481\cdot3 \pm 0\cdot54$, closely agreeing with that found by Meyer from his observations of the six brightest satellites, viz. $3482\cdot93 \pm 5\cdot50$.

A NEW METHOD OF DETERMINING THE AMOUNT OF ASTRONOMICAL REFRACTION.—M. Lœwy proposes to determine refraction by placing a glass prism with silvered faces, forming a double mirror, in front of the object-glass of an equatorial. By means of this arrangement the images of two stars—one at the zenith, and the other near the horizon—can be simultaneously viewed in the field and their distance measured. This distance will be affected by the maximum amount of refraction.

If after an interval of three or four hours, when the stars have equal zenith distances (and therefore are relatively but little displaced by refraction), the observation be repeated, the comparison of the two measures gives the means of determining the amount of refraction with great accuracy. For the success of the method it is, of course, essential that the measured distance should be absolutely independent of every possible displacement of the various parts of the apparatus in the interval between the observations. This result is attained, M. Lœwy considers, by placing the double mirror in such a position that the planes of reflection for the two stars coincide, as he finds that under these circumstances, whatever small displacements the prism may undergo, the distance in the field of the telescope measured in the plane of reflection or the projection of this distance on the trace of the plane of reflection in the field remains invariable.

ASTRONOMICAL PHENOMENA FOR THE WEEK 1886 *JANUARY* 31—*FEBRUARY* 6

(For the reckoning of time the civil day, commencing at Greenwich mean midnight, counting the hours on to 24, is here employed.)

At Greenwich on January 31

Sun rises, 7h. 42m.; souths, 12h. 13m. 42·5s.; sets, 16h. 46m.; decl. on meridian, 17° 19′ S.: Sidereal Time at Sunset, 1h. 29m.

Moon (New on February 4) rises, 4h. 54m.; souths, 9h. 21m.; sets, 13h. 47m.; decl. on meridian, 18° 25′ S.

Planet	Rises	Souths	Sets	Decl. on meridian
	h. m.	h. m.	h. m.	° ′
Mercury	7 8	11 8	15 8	22 23 S.
Venus	8 2	13 48	19 34	3 30 S.
Mars	20 36*	3 7	9 38	5 23 N.
Jupiter	21 44*	3 43	9 42	0 59 S.
Saturn	13 15	21 26	5 37*	22 40 N.

* Indicates that the rising is that of the preceding evening and the setting that of the following morning.

Phenomena of Jupiter's Satellites

Jan.	h. m		Feb.	h. m.	
31	1 21	I. occ. reap.	5	1 7	II. ecl. disap.
31	22 30	I. tr. egr.	5	5 32	I. ecl. disap.
Feb.			5	5 47	II. occ. reap.
2	22 19	III. ecl. disap.	6	3 36	I. tr. ing.
3	1 14	III. ecl. reap.	6	5 51	I. tr. egr.
3	2 19	III. occ. disap.	6	21 53	II. tr. ing.
3	5 1	III. occ. reap.			

The Phenomena of Jupiter's Satellites are such as are visible at Greenwich.

Feb. h.
6 ... 9 ... Venus at least distance from the Sun.

Variab!e-Stars

Star	R.A.	Decl.			
	h. m.	° ′		h. m.	
U Cephei	0 52·2	81 16 N.	Feb.	1, 23 0	*m*
			,,	6, 22 39	*m*
Algol	3 0·8	40 31 N.	,,	3, 4 4	*m*
			,,	6, 0 53	*m*
λ Tauri	3 54·4	12 10 N.	,,	3, 2 6	*m*
ζ Geminorum	6 57·4	20 44 N.	,,	2, 9 30	*M*
U Monocerotis	7 25·4	9 32 S.	,,	3,	*M*
δ Libræ	14 54·9	8 4 S.	,,	5, 0 20	*m*
U Coronæ	15 13·6	32 4 N.	,,	6, 5 23	*m*
U Ophiuchi	17 10·8	1 20 N.	,,	1, 0 51	*m*
		and at intervals of		20 8	
R Scuti	18 41·4	5 50 S.	Feb.	5,	*m*
β Lyræ	18 45·9	33 14 N.	,,	1, 17 0	*m*
δ Cephei	22 24·9	57 50 N.	,,	4, 2 30	*M*

M signifies maximum; *m* minimum.

Meteors

The *Virginids*, R.A. 175°, Decl. 14° N., form the principal February shower. Fireballs may be looked for on February 2.

GEOGRAPHICAL NOTES

The *Izvestia* (1885, v.) contain another letter from M. Potanin, describing his interesting journey to the Upper Hoang-ho. Leaving Si-nin (Tsin-ning) on May 2, the Expedition visited the Humbum Monastery—a trading-place for Russian goods brought from Urga and transported further to Thibet—and crossed a high ridge of mountains, the pass having an altitude of no less than 12,000 feet above the sea. Following the valley of the Lan-chou (Dun-ho-tsian on Prjevalsky's map), they ascended to the plateau of Rchandza-tan, about 10,000 feet above the sea, leaving to the north the snow-clad mountains of Naryn-jamba, where Prjevalsky spent the winter of 1880. Only Tanguts inhabit this elevated table-land, and a few lamas who occupy several monasteries. Descending from the plateau into a deep valley, Naryn-jamba, which joins that of the Urung-vu River, they were soon compelled to climb another plateau of the same height, the Ganja-tan, also peopled by Tanguts. The Amni-Tunglyng Mountains raise their snow-covered summits towards the north. On May 16 the Expedition reached the Labran Monastery, situated at an altitude of 10,000 feet, and still containing several hundred well-built houses, some of them with two and three stories. The Gue-guen—a religious chief, who is also chief of the neighbouring Tanguts—resides at this rich monastery. From Labran, MM. Potanin and Skassi again climbed a high plateau, and followed it until they arrived at the Renu-kika Pass. A high snow-covered ridge extending west and east on the left bank of the Tao-ho, was seen to the north; it is inhabited by a tribe of Tangut robbers—the Tebu. The Tao-ho flows along a valley more than half a mile wide, between picturesque craggy mountains, the slopes of which are thickly wooded. The town Ming-cheu, situated in the same valley, could thus soon be reached. Leaving it on June 16, the Expedition easily reached also the Yali-san Mountain, which is the watershed between the tributaries of the Tao-ho and the Yang-tse-kiang, the ascent to the watershed offering no difficulties. The further journey to Si-gu-sian was made in an alpine country, intersected by deep and narrow valleys, which have a flora offering some notable differences from that of the Si-nin and Min-cheu region. The town Si-gu-sian is situated in the region of the monsoons. The further intentions of the Expedition were to go to Niang-pin, leaving M. Berezowski at Si-gu-sian to make collections of mammals and birds.

An extraordinary meeting of the Geographical Society of Paris was held on the 21st inst. to receive M. de Brazza on his return from his latest expedition to that part of Western Africa which is now described as the French Congo. M. de Brazza gave an account of his journey undertaken in the summer of 1883, on a subsidy from the Government of 1,250,000 francs (50,000*l.*). In the beginning of June he and his party had reached Franceville on the Ogowai. At this place he concluded new treaties with the chiefs of the tracts adjoining the river, and opened warehouses for carrying on trade. After instructing in their duties the Europeans who were to remain at Franceville, M. de Brazza crossed the elevated tract which separates the basins of Ogowai and Alima to join Dr. Ballay, who was conducting negotiations with the Bapfourous, a tribe settled near the junction of the Alima with the Congo. Dr. Ballay had a steamer on the latter river, the first French vessel of the kind which had penetrated so far into these regions. M. de Brazza then narrated his adventures in the two years and nine months during which he was engaged in exploring the banks of the Ogowai, the Alima, and the Congo, in laying the foundation of eight stations.

The *Calcutta Englishman* states that Mr. Needham, of the Assam Police, and Capt. Molesworth, of the Bengal Staff Corps, who left Sadiya on December 12 for Rima, in Thibet, have returned to Dibrugarh. They reached Rima, but were unable to enter the place, owing to the hostility of the Thibetans. Having followed the course of the Brahmaputra the whole way from Sadiya to Rima, they are able to state authoritatively that the river corresponding in size to the "Sanpo," as described by the explorer "A. K.," falls into it; and that the identity of the "Sanpo" with the Dijong may be deemed to be finally settled.

The Government of the Congo State has commissioned several geographers to execute maps of the entire State. Lieut. Massari is surveying the right bank of the Congo between the Alima and Mobangi Rivers. The topographical party under Lieut. Junghers has surveyed Banana completely, and is now engaged, in two divisions, in surveying the districts between Banana and Boma, and between Boma and Vivi. The Swedish geographer Herr Hakanson has drawn a map of the district between the village of Mvinda, above Vivi, and the Issanghali Station.

Advices received in Berlin contradict the statement of the death of the German traveller, Dr. Büttner, who is now alleged to have escaped all the dangers that beset him in the Congo region, and to be on his way back to Europe.

WITH the beginning of next month a party organised by the German New Guinea Association will start from Hamburg. The command of the expedition has been intrusted to Dr. Schraber, one of the staff of the Hamburg Observatory, who was chief of the scientific expedition sent in 1882 to the southern hemisphere. The preparations are almost completed. Six experienced foresters have been already sent on in advance. Fifteen block-houses have been constructed, some at Hamburg, some in Norway, to be put together at chosen points in New Guinea. Forty Malays have been hired in Java to act as bearers and servants, and five persons trained in various branches of natural science will form the staff of the party. Their explorations will be confined to the portion of the island which is under the German protectorate, and will, it is expected, occupy about three years.

THE Milan Society for the commercial exploration of Africa is preparing a new expedition to Zeila and the neighbouring districts. It will be led by Count Peter Porro.

THE census returns of the provinces of Bosnia and Herzegovina for 1885 show an increase of 15 per cent. in the population since the previous returns for 1879, the respective figures being 1,158,440 and 1,336,101. Nearly all the inhabitants are of South Slavonic (Servo-Croatian) stock and speech, and, according to religions, they were distributed in 1885 as follows:—Mussulmans, 492,710; Orthodox Greeks, 571,250; Roman Catholics (Greek and Latin rites), 265,788; Jews, 5805; Miscellaneous, 548.

THE Viennese firm of Hartleben has begun the publication of Dr. F. Umlauft's important work on the Alps, entitled "Manual of Alpine Sciences." It will be issued in fifteen parts.

FATHER LEO M. ALISHAN, of the Armenian Mekhitarist Congregation of St. Lazarus near Venice, has recently published a sumptuous work entitled "Sissûan," the term applied by the Armenians to the province of Kilikia at the end of the twelfth century, when it was governed by Leo the Magnificent. The work deals with the physical geography, history, and literature of this region of Asia Minor, and contains numerous maps, fac-similes, and illustrations, besides several valuable unedited documents.

THE *Bollettino* of the Italian Geographical Society for December has a short obituary notice of the distinguished geographer and geologist, Prof. Giuseppe Ponzi, who was born in Rome in 1805, and died there on November 30, 1885. He filled the Chair of Geology in the Roman University since the year 1866, and on his careful surveys of the basin of the Tiber were based the first geological maps of that district.

THE same *Bollettino* contains some particulars of the Capucci-Cicognani Expedition, which arrived at the capital of the Anfari (Sultan) of Aussa at the end of August. Here it was detained by the Anfari, who demanded 3000 dollars for the right of passage, and after tedious negotiations Capucci returned to Assab in order to procure this sum, and thus obtain permission to pass on to the kingdom of Shoa in Southern Abyssinia. On his return he induced the Anfari to accept less than half the amount claimed, on payment of which the Expedition continued its journey through Gafra for Shoa.

To the *Bollettino* Count A. Salimbeni sends a description, with illustration, of the bridge he has now completed over the Temcha, a river in Gojam, which flows through the Birr to the Abai (Bahr-el-Azrag, or Blue Nile). The bridge, the first constructed in Abyssinia since the time of the Portuguese, spans the river with three arches of 8·50 metres each, is 4 metres wide, and has a total length of 38 metres. The work, which was begun in December 1884 and finished the following March, is looked on as a marvel by the natives, and has given great satisfaction to King John.

THE BENEFITS WHICH SOCIETY DERIVES FROM UNIVERSITIES[1]

NEXT, I mention as the subject for university study, Psychology, the nature of man's soul, the characteristics of his mental and moral activity. This science has lately made great progress, —it has improved its methods and enlarged its scope. Those who are devoted to it appreciate the inherited experiences of the human race and are not indifferent to the lessons which may proceed from intuition and introspection; they study all the manifestations of intellectual and spiritual life; but, on the other hand, they are not afraid to inquire, and they know how to inquire, into the physical conditions under which the mind works; they watch the spontaneous, unconventional actions of children; they investigate the laws of heredity; they examine with curious gaze the eccentricities of genius, and with discerning, often with remedial eye, the alienation of human powers, and they believe that by a combination of these and other methods of research, among which experiment has its legitimate place, the conduct of the human understanding and the laws of progressive morality will be better understood, so that more wholesome methods of education will be employed in schools of every grade. They acknowledge the superiority of the soul to the body, and they stand in awe before the mysteries which are as impenetrable to modern investigators as they were to Leibnitz and Spinoza, to Abelard and Aquinas, to Aristotle and Plato, the mysteries of man's conscious responsibility, his intimations of immortality, his relations to the Infinite.

I do not know whether philosophy is on a "return to Kant," or to common sense, but I believe that standing firm on the postulates, God, Soul, and Immortality, it will in years to come disentangle many perplexities, brush away heaps of verbal accumulations, and lead the mind to purer and nobler conceptions of righteousness and duty. I go even farther, and, as I believe that one truth is never in conflict with another truth, so I believe that the ethics of the New Testament will be accepted by the scientific as well as the religious faculties of man; to the former, as Law; to the latter, as Gospel.

In confirmation of these views, let me quote to you the language of that one among us who is best qualified to speak upon this subject.

"The new psychology, which brings simply a new method and a new standpoint to philosophy, is, I believe, Christian to its root and centre; and its final mission in the world is not merely to trace petty harmonies and small adjustments between science and religion, but to flood and transfuse the new and vaster conceptions of the universe and of man's place in it—now slowly taking form and giving to reason a new cosmos and involving momentous and far-reaching practical and social consequences—with the old scriptural sense of unity, rationality, and love beneath and above all, with all its wide consequences. The Bible is being slowly re-revealed as man's great text-book in psychology, dealing with him as a whole, his body, mind, and will, in all the larger relations to nature and society, which has been so misappreciated simply because it is so deeply divine. That something may be done here to aid this development," continues the lecturer, "is my strongest hope and belief."

The study of Society engages the earnest interest of another set of men, and the apparatus of their laboratory includes archæological and historical memorials of the activity of the race. The domain of history and political science has never been cultivated as it is in modern times. The discovery of primæval monuments and the interpretation of long hidden inscriptions, the publication of ancient documents once hidden in monasteries and governmental archives, the inquiry into primitive forms of social organisation, the development of improved modes of research, the scientific collection and classification of facts which illustrate the condition of ancient and modern communities and especially the interest awakened in the growth of institutions and constitutions, give to this oldest of studies the freshest interest. Papers which have lately been printed on rudimentary society among boys, on the laws of the mining camp, on the foundations of a socialist community, on the differences between parliamentary and congressional government, on the derivation of modern customs from the ancient beginnings of the Aryan people, on the nature of communism and many more such themes, afford illustrations of the mode in which the historical student among us, following the lines of Stubbs, Maine, Freeman, Seeley, Bluntschli, Roscher, and other celebrated workers, are advancing historical science, and developing the true historical spirit. The aim of all these inquiries is to help on the progress of modern society by showing how the fetters which now bind us were forged, by what patient filing they must be severed, and at the same time to work out the ideal of a society in which Liberty is everywhere, but "Liberty sustained by Law."

Languages and Literature have always received attention in universities, and will always be dominant for reasons which are

[1] An Address by D. C. Gilman, President of the Johns Hopkins University. Continued from p. 283.

as enduring as language itself. We study tongues that we may know the men of other climes and other days; we study literature to enjoy it. As an aid to intercourse with people of other nations and for the purpose of keeping up with the record of modern science, nobody doubts that the modern languages are to be encouraged; but if we really would own the inheritance which is our birthright, if we wish to appreciate the masterpieces of literature, if it is well to put ourselves in sympathy with mankind, to laugh with those who have laughed, and weep with those who have wept, we must not be restricted to the writings of to-day. In science, it has been said, read the newest and latest; not so in literature—but the best. Isaiah and John, Homer and Æschylus, Cicero and Virgil, the "Nibelungen Lied" and Chaucer, Dante and Petrarch, are as full of life, beauty, instruction, and entertainment to us as to former generations. But from the classical standard of excellence this busy world would soon depart, were it not that in every university there are scholars keeping bright the altar fires, and warming us with the glow of their enthusiasm, whenever we come under their influence—sharpening too our wits by their critical acumen.

It is not uncommon, nowadays, to hear objections to classical education, usually from those who have never had it, and declamations against dead languages, usually from those who have never learned them. But the Humanists may unquestionably leave it to the Geologists to fight the battle for antiquity. The latter assure us that the older the fossils the more instructive their lessons; indeed, so much importance is attached to ancient animal life that the national government, with great liberality, encourages its study by promoting explorations, museums, and costly publications. Be it so; but let not the nation which does this forget that men are of "more value than many sparrows"; that the oldest literature is not old or dead, but fresh and living in comparison with the bones of the cave-dwellers; and that though a Megatherium is wonderfully instructive, an ancient epic or a drama is not unworthy of attention.

Jebb, in his life of Bentley, asserts that probably "the study of classical antiquity, in the largest sense, has never been more really vigorous than it is at the present day." We might add that classical poetry has never been so popular—else why these innumerable editions and translations? Why, after Worsley, Butcher, Bryant, and their predecessors, are we reading aloud and smiling over the immortal Odyssey as it is given to us in the rhythmical prose of Palmer? This is a good sign; only it is well to remember that reading translations is not reading Greek, and, as Jebb goes on to say, we must not forget the difference between "the knowledge at second hand," which the intelligent public can possess, and "the knowledge at first hand" which it is the business of the libraries and professorships of a university to perpetuate.

If the defenders of classical study would confine their argument to the line which was lately followed by Butcher, they would silence their opponents. "To Greece," he says, "we owe the love of science, the love of art, the love of freedom—not science alone, art alone, or freedom alone, but these vitally correlated with one another and brought into organic union. . . . The Greek genius is the European genius in its first and brightest bloom. From a vivifying contact with the Greek spirit, Europe derived that new and mighty impulse which we call progress."

But I must not pass from the subject without a word upon the study of language in general, that faculty of the human race which was never half understood until the universities of Germany entered upon the study of comparative philology, by the introduction of Sanscrit study. With this new torch they have thrown a flood of light upon the nature of speech, the history of our race, the brotherhood of nations, and the development of ideas which lie at the basis of all Indo-European civilisation.

The Shemitic tongues have long been subjects of university study, especially Hebrew and Arabic—the former so much esteemed as the language of the Old Testament that it used to be spoken of as the language of Paradise, and the latter being regarded as a key to the ideas and religion, the ancient literature and science, of one of the largest families of men. Of late years the domain of Shemitic study has been widened; libraries long hidden have been exhumed on the sites of ancient Babylon and Nineveh; records, the very existence of which was unknown at the beginning of this century, written in characters to which there was then but the slightest clue, are now read and printed and studied as a part of the history of mankind. Assyrian becomes a language of university study—not, indeed, for many scholars, but for a few, and the bearing of their discoveries is so important upon the language and history of the Hebrews that one of the most learned of English theologians has recently said that, in respect to certain of the obscurer passages of the Old Testament, the world must wait for the light which would come from Assyriology.

Certainly, if the history of mankind is worth studying, if the lessons of the past are of value, language and literature, the ancient, the modern, the primitive, and the cultivated, will never be neglected among the studies of an enlightened community.

When we turn from Man to his environment, we soon perceive that mathematics lies at the basis of all our knowledge of this world. To count, to measure, and to weigh, are steps in civilisation, and as we extend our powers in these directions, we find that even the distance and mass of the planets, the form of the earth, the velocity of light, the mechanical equivalent of heat, and the unit of electrical resistance may be accurately ascertained, and the results, with many of the ideas which they involve, may become a part of the intellectual possessions of every educated person. Yet when we reflect that hardly any branch of knowledge is so depreciated by the average man as the modern advancement of pure mathematics, we must believe that its influence upon civilisation is not sufficiently considered.

Prof. Cayley, in a recent address, alluded to the connection of mathematics with common life, on the one hand, and with the deepest questions of philosophy, for example, the metaphysical ideas of time and space, on the other. As to its utility, he declared that he would defend this science as Socrates defended justice, quite irrespective of worldly advantages,—and then he proceeds to show the relations of mathematics to the certainty of knowledge, and to emphasise the idea that mathematical science is not built upon experience but upon certain fundamental assumptions—which are indeed found to be in conformity with experience. I wish that every student, however remote his studies may be from mathematical text-books, would turn to the opening passages of this discourse, and steady his own mental equilibrium by the assurance that the science which is most exact, and most satisfactory in its reasonings, is based upon fundamental postulates which are assumed and not proved by experiment. "In the theory of numbers," he says, "there are very remarkable instances of propositions observed to hold good for very long series of numbers—and which are nevertheless untrue."

If you persist in taking the utilitarian view, and ask me what is the good of Mr. Glaisher's determination of the least factors of the missing three out of the first nine million numbers, the volume containing the sixth million having lately been published;—or if you put a much more comprehensive question, what is the use of the Abelian functions, I shall be forced to say, I do not know; and if you press me harder I shall be obliged to express my conviction that nobody knows; but I know, and you know, and everybody may know, who will take the pains to inquire, that the progress of mathematics underlies and sustains all progress in exact knowledge.

Whewell, the author of the "History of Inductive Sciences," has brought out very clearly the fact that "the opening of Greek civilisation was marked by the production of geometry, the idea of space was brought to a scientific precision; and likewise the opening of modern European civilisation was distinguished by the production of a new science, Mechanics, which soon led to the mechanics of the heavens, and this step, like the former, depended on men arriving at a properly distinct fundamental idea, the idea of force." Henry Smith, arguing for the value of his favourite study to mankind, points out the injury which would come to the intellectual strength of any nation "whose notions of the world and of the things in it, were not braced and girt together with a strong frame-work of mathematical reasoning. It is something," he continues, "for men to learn what proof is and what it is not." The work in mathematics at Alexandria or Syracuse two thousand years ago is as perfect in its kind and as direct and unerring in its appeal to our intelligence, as if it had been done yesterday at Berlin or Göttingen by one of our own contemporaries. In kindred language, Cayley, working forward as well as backward, and not unmindful, let us hope, of the Sylvestrian school upon this side of the Atlantic, in which he had been a master and a guest, thus concluded the address from which I have already quoted:—

"Mathematics has steadily advanced from the time of the Greek geometers. Nothing is lost or wasted; the achievements of Euclid, Archimedes, and Apollonius are as admirable now as they were in their own days. Descartes' method of co-ordinates is a possession for ever. But mathematics has never been cultivated more zealously and diligently, or with greater success than in this century—in the last half of it or at the present time; the advances made have been enormous, the actual field is boundless, the future full of hope. In regard to pure mathematics we may most confidently say,

"'Yet I doubt not thro' the ages one increasing purpose runs,
And the thoughts of men are widened with the process of the suns.'"

Many who hesitate to assent to these views of the relation of pure mathematics to civilisation, have no hesitation whatever in lauding applied mathematics, especially astronomy and physics; and no wonder, for within the memory of this generation, the world has gained these five results of physical science, steam locomotion, telegraphy, telephony, photography, and electric lighting. The first three, it may be said, have revolutionised the methods of human intercourse; the fourth has multiplied infinitely the means of communicating knowledge to the brain by what Sir William Thomson, following John Bunyan, has termed the Eye-gate; and the fifth, still in its dawn, includes possibilities of illumination, which we are not likely to exaggerate. But I have no time to eulogise these recent gains of civilisation; every word I can spare must be given to emphasise the fact, which is most likely to be forgotten, that these wonderful inventions are the direct fruit of university studies. I do not undervalue the work of practical men when I say that the most brilliant inventor who ever lived has been dependent upon an unseen company of scholars, the discoverers and the formulators of laws which he has been able to apply to methods and instruments. Nor do I forget that Faraday, like Shakespeare, was not a university man. But I mean to say that the manifold applications of science, about which everybody is talking, are only possible because of the abstract studies which universities promote. The electro-magnetic inventions which are now so multiform are only possible because scores of the greatest intellects of the century, one after another, have applied their powers of absolute reasoning to the interpretation of phenomena which could have been elucidated in any part of the world, and at any epoch of the past, if only the right methods had been employed. As long as universities held aloof from experimental sciences, these discoveries were not made, but when laboratories for investigation were established, an alliance was formed by mathematics and physics, and a new type of intellectual workers was produced, men whose hands were as cunning to construct and make use of instruments, as their brains were cunning to develop the formulas of mathematics. Take the splendid list of leaders who have followed Franklin and Rumford. They may be called the school of Sir Isaac Newton, so much of their inspiration is due to him. Not all were trained in academic walls; but not one failed to derive help from the advantages which universities provide and perpetuate.

One of the greatest of these men, Sir William Thomson, has lately been here. He was invited to come because it was believed that he, more than any other foreigner, could give an impulse to the study of physics in this country. His lectures were on a subject so remote from ordinary thought that I do not suppose its announcement conveys to those who are unfamiliar with the present position of physical inquiries, the least idea of what the lecturer was to talk about. Nevertheless, so great was the attraction of his powers, that a large company, two or three from England, one from Japan, several from beyond the Alleghanies, and many from this neighbourhood, most of them teachers and professors of physics, here assembled daily for a month to catch what they could of his learning and his enthusiasm. His words were taken down and have been given to the public in the form of lecture notes, and have thus reached already the principal seats of learning abroad and at home, but the chief results of his visit will be seen as the years go on in the increased devotion of his followers to their science, and in their emulation of his enthusiasm and concentration. Could I give you a more interesting example of the way in which a university may encourage physical science?

Notwithstanding all the progress in physics and astronomy which has been made during a century, those who know the most about these subjects will assure us that they are but at the alphabet of their science. Read the address of the Astronomer of Princeton, on a recent occasion, in which he enumerates the impending problems of astronomy; or that of one of our own staff, when he reviews the condition of electrical science, and declares that "as the region of the unknown is infinitely greater than the known—there is no fear of there not being work for the whole world for centuries to come;" and he adds (to please, I suppose, the practical men) that in the applications of science, "the telephone, the telegraph, and electric lighting, are but as child's play to what the world will see."

Chemistry is the child of the nineteenth century. The atomic theory, which lies at the foundation of all modern investigations, was announced by Dalton,—(that English Friend after whom it would not be amiss to name our chemical laboratory "Dalton Hall," as a tribute alike to his eminence and to the society in which our founder was also trained),—Dalton's law, I say, was announced between 1804 and 1808, so that we can trace more distinctly than in most sciences the exact influences under which chemistry has grown up. Alchemy, the search for gold or for the philosopher's stone, never became a science, and contributed very little to the good of man; but when the universities of Europe, with their trained observers, their methods of accurate work, their habit of publication, and especially their traditional principles of co-operative study, directed their attention to the fundamental laws of atomic combination, the science of chemistry grew with rapidity, and with benefits to mankind which can never be enumerated. To no man were its early days more indebted than to Liebig—"of organic chemistry the very source and fountain-head"—good as a thinker, good as an investigator, good as a lecturer, but better still, as one of his most illustrious pupils has informed us, "in the peripatetic teaching of his laboratory."

"It was at the small University of Giessen," says Hofmann, from whom I have just quoted, that "Liebig organised the first educational laboratory that was ever founded. This school forms an epoch in chemical science. It was here that experimental instruction such as now prevails in our laboratories received its earliest form and fashion, and if we are proud of the magnificent temples raised to experimental science in all our schools and universities, let it never be forgotten that they all owe their origin to the prototype set up by Liebig, half a century ago." The world appreciates the results which have proceeded from these laboratories—let it also be remembered that they were the creation not of industrial fabrics, not of mercantile corporations, not even of private enterprise, but of universities, and that the motive which inspired their founders and directors was not the acquisition of wealth, but the ascertainment of fundamental law.

The science which began with the century is going forward more rapidly than ever. Yet, if we examine a recent exposition of the principles of theoretical chemistry, we may discover that here, as in mathematics and in physics, the most expert perceive that the field which is open to investigation is much vaster than that which has been surveyed. Here, as everywhere else, the higher one ascends the greater his horizon. What good is to come to men from these researches it would not be wise to predict; but we may reflect on what has recently occurred. Within the last few months a boon has been conferred on humanity so great that all the cost of all the laboratories of all the lands in Christendom would have been a small price to pay for so precious a pearl. It came into the world never again to leave it, unheralded, unexpected, from the laboratory of science, to deaden for a few moments and then restore to life the organs of the sight, so that operations on the eye, hitherto dreaded, may be performed without the slightest pain. The chemists may modestly say that this discovery was an accident not to be compared in significance with the discovery of Avogadro's law. That may be so, yet this sort of accident does not happen in Africa or the Fiji Islands,—it "happens" where there are universities and laboratories, and trained men able and ready to observe, discover, and apply.

The hour has passed, and I have hardly introduced a theme which would be more appropriate for a volume than for a discourse. I have not spoken of the study of the structure of the earth, the physics of the globe, the laws of storms, the constituent rocks and minerals of the earth, the record of life hidden in ancient strata, the living kingdoms of animals and plants, the distribution of the races of men, the progress of archæology—or of innumerable subdivisions in the great branches of human knowledge. Such a task would be beyond my powers; I have only attempted to suggest what each one of you may study for the rest of your lives, as you watch the growth of universities and the progress of knowledge. I have purposely left for another occasion all questions pertaining to professional and technical education.

A few miles east of one of my former homes—the settlement of Berkeley, in California—there is an isolated peak of moderate height, from the top of which you may survey an area equal to that of the State of New York. From Mount Shasta on the north to Mount Whitney on the south, you may trace the jagged, often snow-white, crest which bears the name of Sierra Nevada. Here and there a peak rises a little higher than its neighbours, and can be identified from the look-out; but human vision cannot see the chains beyond the chains, nor the marvellous valley Yosemite and the beautiful Lake Tahoe which are sheltered within the nearest range of hills. All that the eye can distinguish on the horizon are a few of the loftiest summits as it turns toward the east, and a glimpse of the Farallone Islands as it turns toward the west. So to-day, from a hill not very high, we have looked upon a broad area, distinguishing only the chief features of the landscape,—but we have seen the mountains and the sea.

A NEW ISLAND IN THE SOUTH SEAS

According to the *Melbourne Argus* of December 10, further news respecting the volcanic outbreak which recently occurred in the Friendly Group has been received from Fiji, *viâ* Auckland. Intelligence concerning it first arrived there by the schooner *Midge*, from Tonga. Before the vessel arrived, however, the eruption had already reported itself to the eastern portion of the Fiji Group, and the *Argus* Correspondent furnishes the following account of it:—

"At Ogea, one of the island outposts lying nearest to the point of eruption, and distant from it about 175 miles in a south-west direction, heavy discharges as of siege artillery were heard on October 14, and continued at short intervals up till the 17th. It is to be noted in connection with this that the outbreak occurred, or was first noticed, in Tonga on the 12th, and that mention is made of 'a low rumbling noise at intervals during the night.' During the continuance of these heavy discharges, Ogea was frequently and very violently shaken by earthquakes, so that the people were in a state of great consternation. At night-time a lurid glare, as from a great fire, was visible in the direction of Tonga, and these phenomena culminated in a terrific roar on the morning of the 17th, such as might be produced by thousands of big guns being discharged simultaneously. Next day a small vessel which had been working the open sea between the Fijian and Friendly Groups, called in to Ogea and reported having passed through vast fields of pumice. This served to confirm the idea generally prevailing that a terrible calamity in the form of a volcanic outbreak had befallen and had overwhelmed Tonga."

The Tonga Correspondent of the *Fiji Times*, who was an eye-witness of the eruption, has communicated the following account of it to that journal:—

"On the night of Sunday, October 11, 1885, more than one slight shock of an earthquake was felt, and lightning was seen at intervals at different quarters. Several persons noticed a low rumbling noise at intervals during the night. At sunrise on Monday morning, October 12, the natives reported that a steamer was coming in. The Tongan Government was induced to send out the schooner *Sandfly*, and about noon on the day the outbreak was first seen Dr. Buckland, accompanied by the Premier and various officials, started to see the volcanic eruption which it was evident was going on. The *Sandfly* returned on the 16th inst. and reported having reached the scene of the eruption on the 13th, but too late to see much: that on the following morning a small island became for the first time visible, and that the vessel had approached within about a mile of the shore, but a strong current prevented nearer approach. On October 17 a number of residents chartered Tugi's schooner, and started for the spot, and on the succeeding morning witnesed a spectacle of such surpassing magnificence as men have seldom been permitted to view. An island of, I believe, not less than nine miles superficial area was seen by us, which had been upheaved, presuming the *Sandfly's* observations to be correct, within four days. On its shore a submarine volcano was belching out a fearful quantity of what I believe to be steam and salt water, throwing it upwards in a column for a distance, I was told by a competent gentleman, of a mile. To give an accurate description in detail of the column and eruption generally is impossible. It is indescribable. The shapes assumed by the steam clouds, after the greatest height had been reached, were inexpressibly beautiful, and were fantastic to a degree. While these clouds were still wreathing and curling, another and another column, with well-defined lines, would shoot upwards, and the downpour of liquid and the wreathing and curling were again and again renewed. The island, named by many 'Fakaogo fei lagi,' or Takaogo Island, is situated about 16 or 20 miles to the north-west of Honga Hapai. I have not a chart to refer to, but believe it is on the site of the Culdibras (?) Reef, marked on the chart, and which is some distance south of Tonga and Kao. Vessels coming here from Fiji will be able to visit the island without going much from their course. At night time flashes of light are seen, but whether proceeding from flames of volcanic fire or from the electricity generated during the condensation of the volumes of steam, will be best known to scientific people. Many and various are the conjectures as to how the island has been formed, and conjectures alone can be made until the island is visited. The whole matter is likely to create great interest, and will afford an opportunity to scientific people to ascertain, with a tolerable amount of certainty, the exact manner in which these islands of the Pacific have in past ages been produced. The height of the island on the occasion of the visit of the *Sandfly* was from 20 to 30 feet, and when we saw it on Saturday it appeared to be from 200 to 300 feet."

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

Oxford.—Whatever be the fate of the new Moderations Scheme now being considered by a Committee of Congregation, the present academic year will be remarkable for the vigorous onslaught made by the younger Faculties on the time-honoured requirement at Pass Moderations of "a little Latin and less Greek." The waste of a year over classical work having no direct bearing on the final school chosen by the student had become so great a tax on time and patience that, when a blow was at last struck at the evil, but little opposition was expressed in quarters where small sympathy with modern studies was thought to dwell. If the Committee can agree on a working scheme, a great relief will be afforded to students in Natural Science in Oxford.

It is with much pleasure that we notice, after long interval, two Colleges offering Fellowships in Pure Science. Merton offers a Fellowship in Physics, and Lincoln in Biology. Besides these Fellowships, Pembroke has a vacant Medical Fellowship.

The nomination of Examiners in the Honour School of Natural Science (now conducted by a Committee of the Faculty) took place this week. Prof. Burdon-Sanderson succeeds Dr. Gamgee in Physiology, Mr. H. B. Dixon succeeds Mr. Vernon Harcourt in Chemistry, and Mr. J. Walker succeeds Mr. Hayes in Physics.

The following courses of lectures and practical classes will be held during the present term:—

In the Physical Department of the Museum, Prof. Clifton lectures on Electricity, Mr. Walker on Polarised Light, and practical instruction is given by the Professor, Mr. Walker, and Mr. Selby. At Christchurch Mr. Baynes lectures on Thermodynamics, and gives practical instruction in Electrical Measurements. At Balliol Mr. Dixon lectures on Elementary Heat and Light.

In the Chemical Department of the Museum Prof. Odling lectures on the Phenic Compounds; Mr. Fisher continues his course on Inorganic Chemistry, and Dr. Watts continues his course on Organic Chemistry. Practical instruction is given by Messrs. Fisher, Watts, Marsh, and Baker. Practical instruction is also given in the Christchurch and Balliol Laboratories.

In the Morphological Department Prof. Moseley lectures on the Anatomy of the Vertebrata; Mr. Spenser has a course on Elementary Animal Morphology; and Mr. Barclay Thompson, on the Osteology and Distribution of the Amphibia and Reptilia. Mr. Arthur Thomson lectures on Human Myology, and has a class for Practical Anatomy. Practical instruction in Comparative Anatomy is given by the Professor, and Messrs. Robertson and Spenser.

In the Physiological Department Prof. Burdon-Sanderson lectures on the Physiology of the Nervous System, and will also give twelve elementary lectures during the present and next term on the Vital Phenomena of men and animals. Mr. Dixey lectures and has a class for Practical Histology; Dr. Gotch has a class for Practical Physiology; and Mr. Poulton lectures on the Physiology and Histology of the Special Senses.

In the Geological Department Prof. Prestwich lectures on the Palæozoic series; Prof. Story-Maskelyne on Crystallographic Symmetry; and Dr. Tylor on Mankind, their Distribution, Antiquity, and Early Condition.

At the Botanical Garden, Prof. Bayley Balfour lectures and gives practical instruction in Vegetable Morphology and Physiology. Prof. Gilbert lectures on Field Experiments.

Scholarships in Natural Science are offered this term by Magdalen and Jesus Colleges, and next term by Queen's College.

The next examination for a Radcliffe Travelling Fellowship will commence on Monday, February 8.

CAMBRIDGE.—Mr. J. H. Randell, M.A., who has been elected to a Fellowship at Pembroke College, was 5th Wrangler in 1882, first class in the Natural Sciences Tripos, Part II., 1883, and is now additional Demonstrator of Experimental Physics.

It is proposed by the Council that the appointments of University Lecturers shall be tenable "for such a term of years, not exceeding five, as the General Board shall prescribe," the statutable provision for cancellation remaining still in force for extraordinary occasion.

A Shuttleworth Scholarship at Gonville and Caius College is vacant, and an examination for it will commence on March 19 next. The subjects are Botany and Comparative Anatomy in its most general sense (including Zootomy and Comparative Physiology), and there will be practical work in all these subjects. Candidates must be registered medical students of Cambridge University, and at least of eight terms' standing. The Scholarship is of the value of 60*l.* per annum, and tenable for three years. A Foundation Scholarship may be awarded to the successful candidate in addition.

In the scheme of Entrance Scholarship Examinations at Girton College recently issued no Natural Science subject is included in the optional subjects. One Gilchrist Scholarship, tenable at Newnham or Girton, will be awarded, among other groups, for proficiency in Physical and Natural Science at the next Cambridge Higher Local Examination.

OWENS COLLEGE, MANCHESTER.—The following appointments have recently been made:—To the Brackenbury Professorship of Physiology, William Stirling, M.D., D.Sc., Regius Professor of the Institutes of Medicine in the University of Aberdeen; to the Lectureship in Medical Jurisprudence, John Dixon Mann, M.D., M.R.C.P.

SCIENTIFIC SERIALS

Journal of the Franklin Institute, No. 717, September 1885.—J. Sartain, on the ancient art of painting in encaustic.—Dr. P. H. Van der Weyde, on the new system of telegraphy to and from moving trains. This paper describes Phelps's method of communicating by induction.—A. E. Outerbridge, a lecture on matter.—S. W. Holman, friction of leather belts on iron pulleys; an experimental study of the slip, and coefficients of sliding friction.—A. S. Greene, on the jacketing of working cylinders of steam-engines.—Otto Luthy, on Florida sugar.—Pedro G. Salom, on the metallurgy of steel; an essay on Bessemer and other modern processes.

No. 718, October 1885.—E. A. Gieseler, on tidal theory and tidal prediction.—Chief-Engineer Isherwood, an account of experiments on a condensing compound engine.—C. L. Gateley and A. P. Kletzsch, cylinder condensation in steam-engines. Gives first part of some researches made on a large engine by two students of Stevens Institute.—W. Curtis Taylor, three new portraits of Washington. A study in composite photography.—F. Lynwood Garrison, the microscopic structure of iron and steel. Accompanying this paper are several photolithographed plates, one of which shows the transition in structure of a "burned-out" fire-grate bar of cast-iron into steel by the action of the fire.

No. 719, November 1885.—E. A. Gieseler, on tidal theory and tidal prediction (conclusion).—C. L. Gateley and A. P. Kletzsch, cylinder condensation (continued).—Pedro G. Salom, recent improvements in the manufacture of iron and steel. Describes the "Clapp-Griffiths," the "Davy," the "Gordon," and the "Avesta" processes.—Prof. E. J. Houston, glimpses of the International Electrical Exhibition, No. 8. Reis's articulating telephone. An exhaustive examination of Reis's various suggestions and instruments.—S. H. Needles, a translation of a note of M. Blavier on the influence of electric storms on subterranean telegraph wires.

Wiedemann's Annalen, Band xxvi. No. 10, October 1885.—Fr. Kohlrausch, on the conductivity of certain electrolytes in extremely dilute aqueous solutions. This paper contains an historical summary of methods and results; a discussion of the method of working with alternate currents; accounts of various new experimental researches.—E. Pfeiffer, on the electric conductivity of mixtures of ethyl-alcohol and ethyl-ether. The author believes that both pure alcohol and pure ether possess metallic conductivity, though both are extremely bad conductors.—G. C. Foster, on a modified form of Wheatstone's Bridge and a method of measurement of small resistances. This is a reprint of Prof. Foster's paper of 1872 in the *Journal* of the Society of Telegraph Engineers, which appears to be unknown outside England.—A. Oberbeck, on a phenomenon of electric oscillations similar to resonance. This refers to the effect of condensers on alternate currents recently investigated by Hopkinson.—K. Angström, on the diffusion of radiant heat from plane surfaces. The research was made by an apparatus called a "galvanic differential thermometer," resembling Langley's "bolometer." Results are given for a number of substances at different angles of incidence.—A. Schleiermacher, on the dependence of heat-radiation upon temperature and the law of Stefan. These researches confirm the accuracy of Stefan's law for perfectly black bodies.—M. Thiesen, on the law of the resistance of air.—E. Dorn, experimental confirmation, for pyro-electricity, of the law that the two kinds of electricity are generated in equal quantity.—E. Dorn, some lecture experiments. These relate to Leslie's apparatus, interference of sounds, vortex-rings, Puluj's apparatus for Joule's equivalent, and cooling of wire by sudden extension.—P. Brühl, on forked lightning.

No. 11, November.—E. Gumlich, theory of Newton's Rings in transmitted light. The author concludes that the effect of multiple reflection in the air-film is to render the dark rings incompletely dark in the transmitted set, and the bright rings incompletely bright in the reflected set.—Leonhard Weber, measurement of intensity of diffused daylight. The quantities and qualities of daylight at Breslau were measured against those of standard flames from December 1884 to July 1885, with the following mean relative figures:—December, red 3834, green 11,514; January, red 6875, green 20,447; June, red 51,803, green 151,233; July, red 37,309, green 105,230.—W. von Bezold, on formation of the triangle of colours by true colour mixture. Three shaded triangles of red, blue, and green are optically superposed.—W. Müller-Erzbach, dissociation of salts containing water.—F. Kohlrausch, on the inconstancy of the damping-function of a galvanometer, and its influence on the determination of absolute resistance by means of the earth-inductor.—R. Colley, on some new methods for observing electric oscillations, and some applications of them. To measure electric oscillations the author has applied (1) a telephone receiver, (2) a mirror-oscillometer, and (3) a gas-flame oscillometer; descriptions of these are given, with drawings.—A. Koepsel, determination of the constants of electro-magnetic rotation of the plane of polarisation of sodium light in bisulphide of carbon. The apparatus was a modified Lippich's half-shadow polarimeter. The result gave for the absolute unit of rotation at 18° C., $0{\cdot}0419913' \pm 0{\cdot}0000078'$; in close agreement with Lord Rayleigh's value, $0{\cdot}042002'$.

Journal de Physique, t. iv., September 1885.—H. Dufet, experimental researches on the variation of the indices of refraction under the influence of temperature. The points comprised are: (1) variation of ordinary and extraordinary indices of quartz; (2) variation of index of water by prism method and by method of Talbot's fringes with aid of a lamina of quartz; (3) variation of indices of fluor and of beryl by the same method; (4) variations of indices of bisulphide of carbon, of monobromnaphthaline, turpentine, and alcohol by means of a lamina of quartz immersed in these liquids. The extraordinary index of quartz varies about seven times as much as the ordinary index, with variations of temperature.—MM. Bouty and Foussereau, on the employment of alternating currents for measuring liquid resistances. They criticise Kohlrausch's methods, in which a bridge and a receiving telephone are used, and show that ordinary resistance coils cannot be relied upon as having no self-induction. They describe a liquid rheostat, without polarisation, capable of giving resistances from 24 to 62,000 ohms.—M. Bourbouze, new models of hygrometers. In these instruments, which are modifications of the dew-point hygrometer, the formation of the first film of dew is observed by causing the deposit to be made on thin glasses which form the sides of the ether-chamber, when, on viewing a candle or other luminous point through the glass, coloured halos are visible.

SOCIETIES AND ACADEMIES

London

Royal Society, December 10, 1885.—"On the Relation of the Reptiliferous Sandstone of Elgin to the Upper Old Red Sandstone." By Prof. John W. Judd, F.R.S., Sec.G.S.

The question of the geological age of the yellow sandstones of the district lying to the north of the city of Elgin has been, as is well known, the subject of very animated discussions among geologists. Some have even gone so far as to assert that the evidence on the question, which has been adduced by stratigraphists, is absolutely incapable of reconciliation with that relied upon by palæontologists.

After detailing the successive discoveries of fossils in these beds from 1844 to 1877, in which latter year Prof. Huxley published his well-known monograph on *Stagonolepis*, the author proceeds :—

In the year 1884 I saw in the Elgin Museum the cast of a skeleton which had recently been obtained from the new quarry near Elgin, to be more particularly referred to in the sequel. This fossil appeared to me to be so different from all the remains hitherto found in the formation, that I obtained an impression of it and submitted it to Prof. Huxley, who recognised in it certain characters distinctive of the Dinosauria. From the same quarry a skeleton apparently belonging to another lizard, distinct both from *Telerpeton* and *Hyperodapedon*, with portions of the skeleton of the last-named genus, were also obtained.

Returning to Elgin in the autumn of the present year, I was told by my friend Dr. Gordon that another reptilian specimen, including the skull and some other parts of the skeleton, had been found in the same quarry. On examining this specimen I at once saw that it exhibited the characteristic features of *Dicynodon*, and my opinion on the subject was confirmed by my friend Dr. Traquair, F.R.S., of Edinburgh, who, at my request, proceeded to examine the specimen. A second example of the same genus has since been discovered, and I trust that ere long a full account of this interesting form will be given by Dr. Traquair.

In addition to these facts, I may add that casts of teeth, undistinguishable from those of *Ceratodus*, were some time ago obtained from the Spynie quarries.

The present state of the palæontological evidence concerning the age of the beds then is as follows. The strata have yielded the remains of no less than *four* orders of reptiles, all of them belonging to forms very different from any which have been found in Palæozoic rocks. The Lacertilia are represented by *Telerpeton*, *Hyperodapedon*, and an undescribed form ; Crocodilia by *Stagonolepis ;* Dinosauria by an undescribed skeleton, and possibly by *Dasygnathus ;* and Dicynodontia by two individuals of the type genus. In addition to these we have a great number of footprints differing so greatly in form or size that they must probably have been made by creatures of very different proportions and organisation.

It will be seen from this summary that the palæontological evidence in favour of the Triassic age of the Elgin sandstones is now absolutely overwhelming. Besides the remains of *Hyperodapedon* and *Dicynodon*, genera which appear to be confined to Triassic strata, in districts so widely separated as South Africa, India, the Ural Mountains, and the British Islands, we have *Stagonolepis*, a crocodile with Mesozoic affinities, the highly organised lizard *Telerpeton*, and Dinosaurs ; the last-mentioned having never been found in any rocks older than Trias. *Ceratodus*, too, has usually been regarded as having commenced in the Trias, though it must be admitted that difficulty may exist in separating the cast found at Spynie from *Ctenodus*, which occurs in the Carboniferous, or *Dipterus*, which occurs in the Devonian.

Let us now inquire what is the nature of the stratigraphical evidence which has been regarded as opposed to the palæontological arguments in favour of the Triassic age of this formation. At the outset it is necessary to bear in mind two very important circumstances. First. The exposures of the Reptiliferous Sandstone and of the Upper Old Red in the district are more or less isolated, the greater part of the country being thickly covered by drift and other superficial deposits. Secondly. The whole of the rocks in the district exhibit evidence of having undergone great disturbance ; this is shown by their steep inclinations, and by the foldings and fractures which can often be recognised in the quarries opened in them.

The Reptiliferous Sandstone makes its appearance at the surface in two parallel ridges, ranging from north-east to south-west for a distance of about nine miles. The most northerly of these ridges extends from Brandenburgh to Burghead. Although the rocks are well exhibited both in sea-cliffs and in reefs on the shore, the only fossils obtained from them are the footprints of the Cummingston and Hopeman quarries, near the south-western extremity of the ridge, and the remains of *Stagonolepis*, *Telerpeton*, and *Hyperodapedon*, found in a single bed at Lossiemouth, at its north-eastern end. A tract of about three miles wide, thickly covered by superficial deposits, completely isolates the northern or coast ridge from the southern one, which is known as the Quarrywood ridge. In this Quarrywood ridge the Reptiliferous Sandstone is only found along its northern face for a distance of about three miles. The southern slope is composed of the ordinary rocks of the Upper Old Red Sandstone, containing *Holoptychius nobilissimus*, Ag., with species of *Glyptopomus* and *Pterichthys*. There is no evidence of the occurrence of Triassic strata, either along the southern slopes of the Quarrywood ridge or in the district lying still further south about the city of Elgin. The localities in which the sandstone containing reptiles has been found along the northern slope of the Quarrywood ridge are as follows :—At Spynie, which may be regarded as a north-eastern prolongation of the Quarrywood ridge, the deep quarries have yielded *Telerpeton*, *Hyperodapedon*, and *Ceratodus*. At Findrassie Wood, a mile and a half further to the south-west, a quarry, now abandoned, has yielded *Stagonolepis* and *Dasygnathus*. Lastly, the quarry near the top of the ridge, above New Spynie Church, and a mile and a half still further to the south-west than Findrassie, has yielded *Hyperodapedon* and another lizard with a Dinosaur and a Dicynodont.

In both the coast ridge and the Quarrywood ridge, as was well pointed out by Dr. Gordon, the Reptiliferous Sandstone is seen to be covered by a very peculiar and easily-recognisable deposit, known as the "Cherty rock of Stotfield." It has been frequently suggested that the preservation of these two sandstone ridges, and thus of the whole peninsula between Burghead Bay and Spey Bay, was in all probability due to the presence of this remarkable rock, which offers such resistance to the ordinary agents of denudation.[1] The rock consists of a more or less intimate admixture of siliceous and calcareous materials, including also crystallised patches of galena, blende, and pyrites ; it has yielded no trace of organic remains. Sir Roderick Murchison compared the "Cherty rock of Stotfield" with the Cornstones of the Old Red series, with which, however, they have but little in common ; and some confusion appears to have arisen from bands of true Cornstone, which occur in Upper Old Red Sandstone to the south of Elgin, with the Cherty rock of the Trias.

Prof. Harkness in 1864 was able to show that the positions in which the Cherty rock and the Reptiliferous Sandstone occur in the neighbourhood of Elgin are such as can only be explained by the existence of great faults. At a later date I showed how numerous are the indications of disturbance in the district—evidence of tilting of the beds, of actual contortion, and of fracture occurring in many of the quarries. On the north of the coast-ridge I have shown that beds of Inferior Oolite are found faulted against the Trias at Stotfield,[2] and probably also at Burghead. In the great "Scars," or reefs, which lie off this coast red sandstones are seen, and I have been assured that scales of *Holoptychius* occur in them. The presence of these great lines of dislocation is unquestionable, and in the paper referred to I have endeavoured by means of dotted lines to indicate the approximate position of some of them. It must be remembered, however, that in a country so deeply covered by drift as Northern Morayshire, the working out of the relations of the rock-masses by tracing their outcrops at the surface is an almost hopeless task.

As throwing an entirely new light on the age and relations of

[1] *Quart. Journ. Geol. Soc.* vol. xx. (1864), p. 424.
[2] *Ibid.* vol. xxix. (1873), p. 128, &c.

the Reptiliferous Sandstone of Elgin, I was able to show in the year 1873 that strata identical in character with that deposit and with the Cherty rock of Stotfield occur on the northern as well as on the southern side of the Moray Firth. At Dunrobin, in Sutherland, the yellow sandstones are seen covered by the Cherty rock, and this in turn is overlain in apparently conformable sequence by the various members of the Lias and Oolite. The whole of the Mesozoic strata of Sutherland are seen to be thrown by a great fault against the Lower Old Red and the crystalline rocks of the Highlands.

Although it is certain, however, that some of the cases of juxtaposition between the Old Red and the Triassic strata must be due to faulting, yet there were reasons for believing that the latter strata lie directly and unconformably upon the former. But, as was remarked by Dr. Gordon in 1877, "the district is so covered by drift that no junction of the Holoptychian and the Reptiliferous strata has been laid bare."

It was therefore with the greatest interest that in the summer of 1884 I learned from that veteran geologist, whose important services to science have extended over a period of more than half a century, that the bones of reptiles had at last been detected in the same quarry with the remains of *Holoptychius*. On repairing to Elgin, I found evidence that a somewhat coarse variety of the Reptiliferous Sandstone is seen passing downwards into a bed of conglomerate from three to four feet thick, which is known to the workmen as the "pebbly-post."

It was also found that the "pebbly-post," which in its lower portion becomes more perfectly conglomeratic, and contains pebbles of white and purple quartz up to the size of the fist, rests on beds of pink and red sandstones, very finely laminated, and exhibiting evidence of much false-bedding. These beds are strikingly different in character from the coarse-grained white sandstones lying above the "pebbly-post," in which the bedding is usually indistinct and imperfect. The stone lying below the conglomerate was found to be unsuited for building purposes, and the trial shaft, after being carried to the depth of thirteen feet in the bottom-rock, was abandoned; very fortunately, however, the last blast which was fired in it revealed a remarkably fine specimen of *Holoptychius*, which has been identified by Dr. Traquair as *H. nobilissimus*, Ag., and is now in the Elgin Museum.

These facts all point to the conclusion that the Reptiliferous Sandstone of Elgin passes downwards into a bed of conglomerate, which rests unconformably upon the strata of the Upper Old Red.

The Royal Society long ago testified its sense of the importance of determining the age and relations of the remarkable strata of Elgin, by appointing a Committee and making a grant from the Donation Fund to aid in securing new specimens of the fossils. Seeing, then, that an opportunity offered itself for determining the exact relations of the Reptiliferous to the Holoptychian beds, I preferred a request to the Council of this Society for a grant to be applied in excavations directed to uncovering the line of junction between the two beds.

My request having been granted, I had the great advantage of the aid and judicious counsel of Prof. T. G. Bonney, F.R.S., President of the Geological Society, in examining the section laid bare, and he permits me to state that he fully concurs in the following statement.

We were able to observe that, while the conglomerate of the "pebbly-post" graduates insensibly into the overlying Reptiliferous Sandstone, it is sharply divided from the red sandstones below. It was unfortunately found that, owing to the imperfect bedding of the upper series and the prevalence of oblique lamination in the lower one, it was impossible to obtain decisive evidence of a discordance of dip between them. But the line of junction between the two sets of strata showed every appearance of being an eroded one. We came to the conclusion that while the upper series having the "pebbly-post" for its base, is certainly perfectly distinct from the lower one, there can scarcely be the smallest doubt that the former rests unconformably upon the latter; in other words, the evidence points to the conclusion that during the vast periods of the Carboniferous and Permian, the Upper Old Red Sandstone of the Elgin area was upheaved and denuded, and the Upper-Trias beds were deposited unconformably upon their eroded surface.

The paper concludes with a *résumé* of all that is known of this formation, which has proved of such interest both to geologists and to biologists, and a comparison with the strata of the same age in other parts of Scotland and in Scandinavia.

Zoological Society, Jan. 19.—Prof. W. H. Flower, V.P.R.S., President, in the chair.—A letter was read from Dr. C. S. Minot (25, Mount Vernon Street, Boston, U.S.A.), calling attention to the Elizabeth Thompson Science Fund for the advancement and prosecution of scientific research, and inviting applications for assistance from it.—A communication was read from the Rev. T. R. R. Stebbing, containing descriptions of some new Amphipodous Crustaceans from Singapore and New Zealand.—Mr. Howard Saunders exhibited an adult specimen of the Sooty Tern (*Sterna fuliginosa*), caught alive near Bath, October 1885, and pointed out that only two examples of this species had as yet occurred in Great Britain.—Mr. H. J. Elwes read a paper on the butterflies of the genus *Parnassius*, having special relation to the development, functions, and structure of the horny pouch found in the females of this genus. He described the habits, distribution, and variations of twenty-three species which he recognised in the genus; and illustrated his remarks by the exhibition of a very complete collection of specimens and drawings. The paper was supplemented by Prof. Howes's remarks on his examination of the anatomy of the *Parnassius apollo*, and by Mr. Thomson's notes on the habits of the insects as bred in the Society's Gardens in 1885.—Mr. Oldfield Thomas, F.Z.S., read a paper containing a list of the specimens of mammals collected in various parts of India and presented to the British Museum by Mr. A. O. Hume, C.B. The series consisted of about 400 specimens, nearly all in excellent condition and with accurate localities attached to them. A new mouse from Tenasserim was proposed to be called *Mus humii*. A new Flying Squirrel from the Malay Peninsula was named *Sciuropterus davisoni*.—A communication was read from the Rev. Canon Tristram, containing the description of an apparently new species of duck (*Dafila*) from Sidney Island of the Phœnix group in the Central Pacific, which he proposed to name, from its extreme simplicity of plumage, *Dafila modesta*.—A communication was read from Mr. A. G. Butler, containing a description of the larva, pupa, and imago of a butterfly (*Aporia hippia*) from specimens bred in the Society's Gardens.

PARIS

Academy of Sciences, January 18.—M. Jurien de la Gravière, President, in the chair.—Memoir on M. de Saint-Venant and his scientific work, by M. Ed. Phillips.—On a new mercurial bath intended to deaden the vibrations of the ground, by M. Mouchez. This contrivance, at once simple and practical, has been invented by M. Gautier for the purpose of diminishing the vibrations of the ground at the Paris Observatory, caused by passing traffic. A cylindrical cast-metal basin containing the supply of quicksilver, has attached to the centre a wormed axis, to which is riveted a second and somewhat smaller basin furnished with a corresponding female-screw. The latter is pierced with a small aperture, through which the layer of quicksilver enters. This layer then becomes insensible to the vibrations, provided the screw be neither too tight nor too loose. The appliance has already yielded excellent results, for the first time enabling regular observations of the nadir to be taken at the Paris Observatory.—Remarks on MM. Paul and Prosper Henry's astronomical photographs, presented to the Academy by M. Mouchez. Since the proofs obtained of the Milky Way last June, MM. Henry have continued their labours with a success that has surpassed all hopes. The results already secured have been pronounced by competent judges the very perfection of astronomical photography, full of promise for the future of astronomy. Perfectly distinct images of several thousand stars down to the sixteenth and even the seventeenth magnitude have been obtained, as well as the nebula near Maia in the Pleiades and other objects absolutely invisible to the most powerful telescopes. Amongst other photographs presented are forty-two proofs of the Milky Way and various regions of the heavens; the neighbourhood of ϵ Lyræ showing some stars far smaller than the *debilissima* of Herschel, and below the sixteenth magnitude; the neighbourhood of Vega, with stars even feebler still than the foregoing, some of which have certainly never before been seen; the groups of Hercules, Sobieski, Ophiuchus, and Perseus, and over 600 images of double or multiple stars; a very successful photograph of the nebula of Orion and of several of the planets.—Note on the irreducible pure reciprocants of the fourth order, by Prof. Sylvester.—Note on an electric spectrum peculiar to the rare earths of the terbic group, by M. Lecoq de Boisbaudran.—Collection of plans or designs of ancient and modern vessels, with the elements necessary for their construction; third instalment, presented to the Academy by Admiral Paris.—Considerations relative to the illumination of lighthouses by means of electricity, by M. Félix Lucas. It is shown that the voltaic arc presents two decided advantages over mineral oil: greater brilliancy and less expense. The only drawback is the somewhat capricious instability of its light, a defect so inherent in the nature of the voltaic arc, that at present it seems impossible completely to remove it.—Note on the solar statistics of the year 1885, by M. Rod. Wolf. The tabulated results of solar observations made at the Zurich Observatory, and of magnetic observations made at Milan, shows that the relative number and magnetic variation have both considerably diminished at about the same rate since the year 1884.—On hitherto unrecognised wave-lengths, by M. Langley. From his protracted researches the author concludes with some reserve that the radiations, whose lower limit was determined by Newton at 0·0007 mm., have now been extended to 0·0150 mm., that is to say, to over twenty times Newton's limit. Thus the great gap that existed between the lowest known vibration of light and the highest of sounds, has been partly filled up.—On the velocity of the flow of liquids, by M. Th. Vautier.—On the secondary or persistent luminous impressions, second note, by M. F. P. Le Roux. The author concludes for the present that the seat of the phenomenon, to which these persistent images are due, lies about the back part of the eyeball, and that probably one or more fluids play an important part in its production.—Action of the sulphur of antimony on the sulphur of potassium, by M. A. Ditte.—Note on a new synthesis of an inactive borneol, $C_{20}H_{16}(H_2O_2)$, by MM. G. Bouchardat and J. Lafont.—Action of high pressure on the animal tissues, by M. P. Regnard.—Influence of the anæsthesia produced by the inhalation of the protoxide of pure nitrogen on various functions of the animal system, by M. M. Laffont. This species of anæsthesia is not only more or less injurious in itself, but constantly causes functional disturbances, which may give rise to serious dangers, especially in certain physiological conditions.—Researches on the physiological and therapeutic action of acetophenone, by MM. Mairet and Combemale. From their experiments the authors conclude that acetophenone, which acts chiefly on the nervous system, is not a sedative, while its healing virtues appear to be very doubtful.—On the histogenesis of the elements contained in the ovaries of insects, by M. J. Perez.—A contribution to the study of the Eocene palms of West France, by M. Louis Crié.—Note on the Jurassic and Lower Cretaceous formations of the provinces of Grenada and Malaga, by MM. Marcel, Bertrand, and W. Kilian. These Andalusian formations appear to be of an essentially Alpine character, their composition resembling those of Sicily and South Tyrol. The upper layers also show strong analogies with the Balearic Islands, the Apennines and Alps of Lombardy.—Note on the photography of speech and its reproduction by oxhydric projection, by M. Léon Esquile. The author claims to have succeeded, by means of the photophone, in fixing on a photographic plate the modulations of the voice, afterwards reproducing the words by the telephone, projecting in oxyhydric light the positive image of the plate on Mercadier's selenium receiver.—The election was announced of M. Boussinesq as member of the Section for Mechanics, in place of the late M. Rolland.—The Academy was informed by the Mayor of Chamounix that the commune of Chamounix intended celebrating the centenary of the first ascent of Mont Blanc by de Saussure in the month of August 1887, when a monument erected to his memory will be unveiled. Subscriptions for the monument will be received by the Secretary of the Institute.

BERLIN

Physical Society, November 20, 1885.—Dr. Gerstmann having given a report on the "Molecular Physics" of Herr Wittwer, Prof. Schwalbe delivered an address on wind-holes and ground-temperatures, a theme on which he has frequently before made communications to the Society. Notwithstanding that he had been engaged for years in the study of ice-cavities and wind-holes, the speaker had yet arrived at no conclusive judgment respecting the cause of them. Having been prevented in 1884 from instituting observations of his own, he had collected the literature of the subject, and had ascertained that ice-cavities and wind-holes were very widely diffused, but had not yet excited general interest to such a degree as to have become the subject of continuous observations. In the summer of 1885 Prof. Schwalbe made a searching investigation into the cold cavities and wind-holes in the neighbourhood of Questenberg, in the Southern Hartz. The gypsum here constituting the main mass of the soil showed very many cavities and wind-holes. The ice-cavity he had described on a former occasion, with its entrance by a smooth gypsum wall, was found by him this year entirely free of ice, and the temperature of the air in it was, on three different visits, always between 4° and 5° C. On the other side of the gypsum mountain he found a hole which, on former visits, was almost entirely filled with water, but was on this occasion quite dry, so that it could be examined to the interior extremity. Here, too, he found a low and uncommonly constant temperature of 5° in the proximity of the mouth, and of 4° at the far end. A large number of more or less small holes, whence cold air issued, was found on the same side of the mountain, which was almost bare, except for a few fruit-trees. Occasionally these holes were very close to the surface illumined by the sun, and yet their temperature, in all kinds of weather, was perfectly constant and low, mostly from 4° to 5°,—in one case 0°. Although, too, most of these cavities communicated by broader or narrower crevices with the interior of the gypsum mountain, yet nowhere in them could there be demonstrated any stronger current of air that might be claimed as the cause of a more powerful evaporation and cooling. Prof. Schwalbe, in conclusion, drew attention to two interesting phenomena he had observed in the gypsum strata of the Southern Hartz. These were the sinking of rivers, often accompanied by loud uproar, and the occurrence of intermittent lakes. The so-called "Bauerngraben" (peasants' ditch), near Rosslau, was, even in the last century, as the old contracts between the two neighbouring villages proved, sometimes a lake serving the one village for fishing purposes, and sometimes dry land, which was then tilled by the other village. Several channels at the bottom of the lake led to the interior of the gypsum rock, nevertheless the water, when it gathered here, stood for several years at a depth of from 10 to 15 metres, suddenly to disappear again. In the years 1876, 1877, and 1878 the "Bauerngraben" was filled with water, and since this last date it had been dry land. The meteorological conditions appeared to exercise no influence on this phenomenon. The cause of the sudden accumulation of water, and the just as sudden desiccation, was yet wholly unknown.

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