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WEATHER CHARTS AND STORM WARNINGS

Weather Charts and Storm Warnings. By Robert H. Scott, M.A., F.R.S., Director of the Meteorological Office. With numerous Illustrations. (London: Henry S. King and Co., 1876.)

"DO you understand these *Isobars* on the weather charts?" we asked an amateur meteorologist who was showing us the curves which represented his own barometrical observations. "Well, I cannot say I do," he replied; "they are very interesting and curious, twisting one day one way, next day another way, and the third day turning all round." It is this not uncommon ignorance which the Director of the Meteorological Office seeks to dispel. His object is "to explain to the reader what he can learn from a careful study of the information published in the newspapers or in the daily weather reports," and for this end he has "attempted to give to the public an account of the actual state of our knowledge at present." He then exposes to public gaze all the mysteries of the Weather Office; he draws aside the curtain, and shows us

> *His* "copper-plate, with almanacks
> Engraved upon 't, and other knacks;
> *His* moondial, with Napier's bones,
> And other constellation stones."

The following are among the most important of these talismans:—The cyclonic law of the northern hemisphere—that if we turn our backs to the wind the higher barometer will be on our right hand, the lower barometer on the left; that the force of the wind is connected with the closeness of the isobars to a considerable extent; that we never have a storm unless the difference of pressure at two stations in the British Isles is less than half an inch of mercury. That cyclones proceed, in general, eastwards, their approach being frequently heralded by a tendency of the isobars to form closed curves; and that this is first seen in most instances towards the west coast of Ireland. These conclusions differ little from those which Dr. Lloyd deduced in 1854 from his study of atmospheric variations in Ireland. Anti-cyclones which have their greatest pressure at the centre are most frequently connected with light winds and fine weather.

All the deductions are illustrated by charts and curves from self-registering instruments, which enhance the value of this useful little volume.

Nothing, however, is more interesting than to see how the theories of meteorological writers for the last half century stand the test when confronted with the daily observation and practical application of facts. We cannot open a work on meteorology without finding all the great phenomena of varying atmospheric pressure ascribed to the action of the sun's heat in producing vapour and expanding the atmospheric gases. Thus the barometer is said to fall in a country because it is warmer there than in neighbouring countries, the more expanded air overflowing (thus causing a wind in the upper regions) towards the colder country, where the barometer rises; on the other hand, a surface wind is generated from the colder to the hotter region. But the most important of all movements admitted by every one were the polar and equatorial currents. The chief of the Meteorological Office treats the views of the great authorities to whom we have referred, in the following manner:—

"For many years it has been the fashion to say that all cold winds flowed from the poles to the equator, forming the so-called polar currents, and becoming the trade winds when they approached the tropics, while the warm winds flowed from the equator to the pole, forming the equatorial currents or anti-trades" (p. 20).

It is very like heresy to speak of "the fashion" and the "so-called polar currents," when their existence has been an article of faith accepted everywhere. It is true no one could say he had observed these currents; and we, who have sought for them in our own latitudes and within the tropics, have insisted that they were neither to be seen nor felt where their effects were supposed to be the greatest. No doubt one of our greatest writers on this subject put the equatorial atmosphere into one cylinder, surrounded by warm water, and the polar atmosphere into another, with an ice-cold jacket, and showed that if the stopcocks preventing communication at the top and bottom of the two cylinders, that is, the upper and lower passages from the equator to the pole, were opened, the currents referred to could be made visible. This, we think, is an illustration of what Mr. Scott, immediately after the passage quoted above, refers to as "right in principle." The atmosphere has also been supposed to have an upper surface like a lake, down which the expanded gases slide. Every condition in nature—density, distance, temperature, viscosity (besides those unknown to us) have been under-estimated, exaggerated, or neglected.

The author's conclusions, from his long watch of atmospheric variations, are somewhat different. He says:—

"The motions of the atmosphere are found to be mainly regulated by the distribution of barometrical pressure over the globe, the particles moving from the regions where the pressure is high to those where it is low," &c. (p. 21).

"Wind is always connected with some disturbance of the pressure of the atmosphere, and it will be at once understood that its existence is due to the tendency of an elastic fluid like air to regain the condition of equilibrium from whence it has by any means been disturbed," &c. (p. 27).

These conclusions are just the reverse of those usually entertained, especially with reference to tropical cyclones where the diminution of central pressure is attributed to the winds, and the movement in which is illustrated by a whirlpool caused by the difference of velocities, or opposite directions of motion of contiguous currents of water. In the cyclones of these latitudes we must suppose Mr. Scott to give, as the result of his experience, that the winds *follow* and do not *precede* the diminished central pressure.

In whatever way the subject is considered there will always remain many facts to some of which the author alludes, which cannot easily be explained by the action of cyclonic winds as causes of diminished pressure; and in these cases the question arises, what is the cause of the latter? This is no mere idle question, it is connected with the whole subject of weather prediction.

Thus, we may ask, with a fluid so mobile as the air, why are there atmospheric basins at the centre of which during months the mean pressure is half an inch of mercury below that in neighbouring regions? Why, in all the disquisitions on fluid equilibrium, are the constant low pressures in the antarctic regions south of 60° neglected? How shall we account for the permanent barometric depression in the neighbourhood of Iceland referred to by the author (p. 74)? And to come to our own country, how will cyclonic winds explain the fact that the pressure of the atmosphere diminishes on the average of the whole year at the rate of one-tenth of an inch of mercury for 4° of latitude as we proceed northwards, and increases at the same rate as we move southwards?

There are evidently atmospheric conditions with which we are unacquainted and for which no parallel can be found by experiments with air shut up in a box, in which it has been "the fashion" of some meteorologists to travesty our atmosphere. The variations of temperature and vapour tension which have been employed to explain everything occupy a very subsidiary place in weather predictions. Yet the effects of varying temperature on our atmosphere are to a great extent unknown to us; the only action taken into consideration has been that connected with expansion; but even expansion may affect properties of the atmosphere which have not as yet been investigated. Thus we know that the magnet which is expanded by heat loses magnetism, but of the way in which heat may affect the magnetism, the electricity, and the viscosity of the atmosphere we know nothing, and we are equally ignorant to what extent the pressure of the atmosphere may be affected by its varying electric state through humidity or otherwise. The satisfaction with which insufficient hypotheses have been received has retarded the progress of research for other causes; and it is a good sign of future advancement that a practical meteorologist like the author has left boldly the beaten track and given indications that we must try elsewhere.

Returning to the practical view, Mr. Scott says:—

"Various theories have been propounded to account for storms . . . but none of them have met with general acceptance as yet. We must, therefore, only take things as we find them, and endeavour to make the best of them" (p. 28).

This, in all senses, philosophic view of the subject, is also that of necessity—to make the best of what we know. To do this the author points out the importance of having more stations and more telegrams. As the great mass of storms approach us from the west, more stations are required, especially on the west coast of Ireland; stations also are required in the interior for the purpose of ascertaining the rate of progress of any threatening signal. This demand, there can be no doubt, will be granted, together with the means to procure any telegrams which particular cases may seem to require.

When we remember the great advantage of these storm warnings, not only to ourselves, but, as Mr. Scott has shown, especially to the ports on the western littoral of Europe (where our sailors and ships are also to be found), we trust every means will be given to make them more certain.

Though the Director of the Meteorological Office is forced to employ the knowledge he now has, he does not seem to feel less the necessity of obtaining more. In spite of the large proportion of successful warnings, he says, in the conclusion of his work, that weather telegraphy is "a branch of investigation which can hardly be said to have got out of the leading strings of infancy as yet" (p. 146). Although the infant stumbles little, all things considered, yet some astonishment has been expressed that it has not grown more rapidly.[1] This astonishment, we believe, has been due in part to an underestimate of the labour and difficulties connected with meteorological research. Every one considers he can commence as master in this subject, if he has only the observations or the instruments to make them with. This error is not confined to those ignorant of all science; it is partaken by many men eminent in other departments, who would smile if their own subjects were treated in a similar way by any tyro, whatever his knowledge otherwise. The low view thus taken of the qualifications necessary for successful inquiry in this branch of science has certainly not been supported by the results of importance which should have been so easily obtained, although meteorologists have counted in their ranks some of the most eminent mathematical physicists.

One of the great causes of the slow growth of meteorology is to be found in the long, laborious, and, not unfrequently, unfruitful calculations necessary in seeking laws from great masses of observations. The results obtained, if the inquiry has been successful, may be expressed in a few figures, which may not appear to have the slightest practical value. Few men qualified to direct the lines, and to devise the methods, of investigation have the time to devote to such ungrateful, and to a great extent mechanical, work. Hence the readiness with which speculative views, chamber theories, have been proposed instead, and these, when supported by men of talent, have made research to appear unnecessary or have thrown it into false channels.

Meteorology, it appears to us, will be best advanced by neglecting at present all theories, unless as far as they indicate new objects of investigation; and by the devotion of qualified workers, each searching in his own way. Also it should not be forgotten that it may not be possible to tell, *à priori*, in what direction the laws are to be sought, on which satisfactory weather predictions may be founded. It may be in some connection between the variations of the earth's magnetism and those of our atmosphere that warnings which will outrun the telegraph may be found; or it may be in some apparently insignificant fact discovered in a neglected corner. All the knowledge we now possess in meteorology would be practically valueless for storm warnings but for the useless-looking experiment of Oersted with a magnetic needle and an electrical current.

We should notice a few cases in which, it appears to us, some slight changes may be made with advantage in a second edition of the work before us. In his desire to be brief, the author has not been quite exact in his remarks on the dry and wet thermometers; thus, p. 5:—

"Suffice it to say, the greater the difference between the readings of the two thermometers, the drier the air,

[1] Mr. Scott gives a table showing that in 1873 and 1874 warnings were justified by subsequent gales 45·3 times in a hundred, and by subsequent strong winds 33·4 times per cent., or in all nearly four times in five (p. 139).

and when the two thermometers read alike, the atmosphere is exceedingly damp."

This statement is not likely to give any very definite idea of the conclusions which may be drawn from the readings of the thermometers, and the difference may be less at one time than another, and yet the air be "drier."

In cyclonic systems, the author says, "the air circulates more rapidly [than in anti-cyclonic], causing strong winds, and appears to flow in towards the centre, so that it must naturally be supplied from below and ascend in the centre." Here the rapid circulation of the air is said to be the cause of the wind. It is also said elsewhere that it is calm in the centre. Is it meant as a result of observation that the air flows towards the centre? and is it a result of observation that the air (naturally or not) rises in the centre?

We have already alluded to the little use of the tension of vapour in "storm warnings." With reference to one case, we find: "The absence of rain is very noticeable during the early period of the gale; the reason for this absence can be seen from the fact of the great distance [on the curves given] between the wet and dry thermometers." The difference is about 3° with the dry thermometer near 50°, and the wind blew "pretty steadily from S.S.W. for twenty hours" (p. 68). If the fact that it did not rain was an unusual one under the circumstances, and if that depended on the difference of the thermometers, the question seems to us only changed to what was the reason of the difference?

We do not always read the curves as the author has done, nor always agree with his reasoning from them; and in some cases, as p. 72, where one cyclone has passed eastwards, north of a station, leaving a N.W. wind, and is followed by another also passing north, the author has not made it very clear why the wind should back to S.W., to S., and S.E., through the action of the S.E. wind of the second cyclone meeting the N.W. of the first.

These queries and suggestions do not affect the general character of the book, which we can recommend as a useful and instructive companion in the study of weather charts, and for the comprehension of storm-warnings as they are issued from the Meteorological Office. It is much to be desired for the many who will not read this work, yet cast a curious eye on the isobars in the newspapers, that some condensed statement of the general rules should occasionally accompany them.

JOHN ALLAN BROUN

GEIKIE'S GEOLOGICAL MAP OF SCOTLAND

Geological Map of Scotland. By Archibald Geikie, LL.D., F.R.S., Director of the Geological Survey of Scotland; Murchison Professor of Geology and Mineralogy in the University of Edinburgh. (Edinburgh and London: W. and A. K. Johnston, 1876.)

SINCE the publication of the last edition of the sketch-map by Sir R. I. Murchison and Prof. Geikie, no general geological map of Scotland has, so far as we are aware, been issued, while those older than the sketch-map rather served as guides to localities where minerals and rocks were to be found, than afforded any clue to the subdivisions of geological time represented by our ancient formations. During the last twelve years, however, materials have been accumulating which have daily rendered the sketch-map more and more inadequate to the purposes for which it was originally designed, and it had obviously become necessary either to issue a new edition, or to "reform it altogether." Considering all things, and especially that he could no longer avail himself of the co-operation of his late colleague, Prof. Geikie has, wisely we think, decided on the latter course. The comparatively large scale adopted (ten miles to the inch), gives room for a number of details which had to be omitted from previous maps.

The publication, for the greater part of the south of Scotland, of the Geological Survey Maps on the scale of one-inch and six-inches, reduces to some extent the operations of the compiler to the selection of as much of the details as his map gives him room to insert. At the same time there are many points regarding the relations of distant deposits which can be better seen on reviewing the work as a whole than during the progress of detailed mapping, and on some of these, as we shall presently point out, Prof. Geikie takes up an independent position.

The northern half of Scotland is in a very different state as regards our knowledge of its geology. Here and there, it is true, competent observers have selected choice bits, and have worked them out with a thoroughness that leaves little to be desired. But a great part of the Highlands is still unknown to geologists, or only known in so far as concerns its comparatively simple glacial phenomena. For this region we have to consult "geognostic travels" of the beginning of the century, and put the best construction on them that we can. It is not, therefore, to be wondered at that this portion of the map is somewhat vague. The metamorphic rocks of the Highlands offer difficult problems to the chemist and physicist, as well as to the geologist; and whoever attempts to unravel their structure as a whole, must probably be content to work for some years in the dark, and with the consciousness that he may not see the issue of his own labours.

Till recently the Southern Uplands were pretty much in the same state as the Highlands, but the detailed work of the geological survey, and a few private observers, has filled up this great blank and rendered possible a comparison of the structure of the Silurian rocks there with those of England and Ireland. On the map now before us, are laid down, for the first time, all the more important graptolite bands which for a hundred miles, at least, appear at intervals among the upturned Lower Silurian strata between the Rhinns of Galloway and the Tweed, while a marginal section explains how the Llandeilo beds, after folding over and over, are unconformably succeeded near the northern edge of the uplands by Caradoc basins, and on the south by rocks supposed to be Upper Silurian. It thus appears that on the southern side of Murchison's "axial beds" only a small part of the northern series is repeated, the place of the Moffat shales not being reached at the point where the Upper Silurian rocks begin.

North of the Uplands a notable feature of the new map is the rearrangement of the Old Red and Carboniferous boundary-line. The identity of the bright-red, sharp, siliceous sandstones below the cement-stone series of the

Lower Carboniferous group with the sandstones answering to the same description that rest unconformably on the Lower Old Red of Forfarshire is regarded as established notwithstanding the occurrence in their associated limestones (in Nithsdale and elsewhere) of carboniferous limestone fossils. This bold course may be taken as a protest, on Prof. Geikie's part, that such questions are not to be settled on palæontological grounds alone.

Along the southern edge of the Grampians the present map shows that the fault which for a long distance separates the Silurian slates from the Old Red Sandstones and conglomerates, runs all the way from Strathearn to Glen Esk (a distance of about fifty miles), within the old red area. Here then we have a noble exposure of the base of that formation abutting against its Silurian shores; and we learn from its interbedded igneous rocks and trappean conglomerates, that even thus early, volcanic activity had set in on the margin of the Highlands. As far north as the Orkney Isles, the sub-divisions of the old red have been re-arranged, Prof. Geikie having himself observed the unconformability of the red sandstones (Upper Old Red) on the Caithness Flags on the west coast of Hoy.

In the Silurian Highlands many of the chief folds and variations of the metamorphic rocks are clearly indicated, and old mineralogical observations are corrected, largely through Prof. Geikie's own frequent traverses. The Laurentian and Cambrian rocks of the north-west coasts and islands seem to have suffered no changes since the publication of the sketch-map, except slight rectifications of boundaries required by the larger scale.

Much light has been thrown within the last few years on the mesozoic and tertiary rocks of the Moray Firth, Skye, Mull, and Arran, and this new information has been skilfully embodied in the map. Besides his own work in this department Prof. Geikie justly acknowledges his obligations to Ramsay, Judd, Bryce, and Zirkel.

It has been found possible to indicate at least two phases of the Glacial epoch, that of the main extension of the ice-sheet, and that of the later local glaciers. Of the direction of the ice-flow during the former phase an idea may be gathered from the arrows denoting observed glacial striæ, while the moraines of the later period are shown by a neat system of stippling. Both in the Highlands and the Southern Uplands the number of valleys containing glaciers seems to have been very great. Scotland must have been a magnificent country for tourists in these pre-historic times.

In conclusion, we need only say that geological students have now in their hands a portable map that will supply them with much valuable information, and with suggestions equally valuable with regard to problems awaiting solution. Prof. Geikie is to be congratulated on the successful completion of a task for which he was peculiarly qualified, both by his position as Director of the Survey and by his thorough acquaintance with the minutest details of Scottish geology. R. L. J.

OUR BOOK SHELF

Botanical Reminiscences in British Guiana. By Richard Schomburgk. (Adelaide: 1876.)

THE able and indefatigable superintendent of the Botanic Garden at Adelaide was appointed, many years since, by the Prussian Government, naturalist to the Boundary Expedition to British Guiana entrusted by the British Government to his late brother, Sir Robert Schomburgk; and in this small, but extremely interesting volume, he gives an account of that "El Dorado," as he appropriately terms it, of tropical botany. Dr. Schomburgk's description of the floral treasures of the district, and especially of the Roraima mountains, where forms of the most wonderful beauty unfold themselves at every step, and undergo the most rapid transformations with every change of altitude, are enough to make the mouths of stay-at-home botanists water. The expedition was not, however, without its difficulties and dangers. On the Roraima mountain, which rises to the height of about 8,000 feet a few degrees north of the equator, the humidity of the air was so great that the artist who accompanied the expedition found sketching on the saturated paper impossible, while the powder in a loaded gun became changed, in a few hours, into a greasy mass. The ascent of the upper part of this mountain chain was a feat worthy of the most enterprising members of the Alpine Club. A perpendicular wall of sandstone rock, 500 feet in height, had to be scaled by the entire party by means of the net-work of climbing plants which covered it; the giving way of a single root would have involved one or more of the party in certain death. The account of this expedition dissipates the idea that food is everywhere abundant within the tropics, even in thickly-wooded and well-watered countries. For days together the party saw no mammals or birds, and were reduced to the point of starvation from the absence of all esculent vegetables. One observation of Dr. Schomburgk's is important, as being at variance with our modern theories regarding the purpose of the bright coloration of flowers. Near the summit of the mountain range, where the earth was carpeted with flowers of gigantic size, of the greatest brilliancy of colour and delicacy of scent, "it appeared almost as if this boundless abundance of flowers compensated for the total absence of animal life; all was wrapt in deep solemnity; not even a gorgeous humming-bird or a graceful honey-sucker was seen fluttering amongst the flowers." Has this singular observation been confirmed by other American travellers? Dr. Schomburgk's observations were not entirely confined to the flora of the country. While stopping at a Warrau settlement on the Barima river, he records the curious fact of a young woman nursing at one breast a child and at the other a young monkey; and states furthermore, that he has seen, "with the exception of the carnivorous, all kinds of animals suckled and reared by Indian women." While ascending the Roraima mountains his attention was arrested by rows of Indian hieroglyphic writing on the sandstone rock, roughly representing, for the most part, the human form, kaimans, and snakes. There is one defect in this interesting volume, which should have been rectified before going to press. Either from want of exact knowledge of the language on the part of the author, or from the deficiencies of a colonial printing-office, many of the sentences are so inaccurately worded as to be barely intelligible. A. W. B.

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.*]

On the word "Force"

IN the *Times*' report (Sept. 9, 1876) of Prof. Tait's lecture at Glasgow on Force, it is stated that "the lecturer showed how the incorrect physical ideas of Leibnitz, and some of his followers, had introduced the terms *vis viva, vis mortua,* and *vis acceleratrix,*" and that these terms were found also in English works. We may add that, until quite lately, Cambridge treatises on Mechanics always used the expressions "accelerating force" and "moving force" (to the great confusion of learners), with the noteworthy exception of Sandeman's "Motion of a Particle," where "effect" was used for "force." So troublesome and misleading was this terminology found for students that one well-known Cambridge writer in a little work on Dynamics, introduced it in a way which reminds one of the trembling and caution with which Sidney Smith brought the word "metaphysics" before his audience at the Royal Institution. But these authors could claim the venerable authority of Newton for those terms; and if they had taken care to introduce them in the *exact way in which he does*, no difficulty would have ensued. Unfortunately, until Mr. P. T. Main edited Newton's "Sections," our editions of that work began with Lemma I., and ignored his "Definitions" and "Laws of Motion." In the "Definitions" Sir I. Newton tells us that the term "accelerative force" is used as an abbreviation for "the accelerative quantity of a force," or the velocity generated by it in a given time; and the term "moving" or "motive force" as an abbreviation for "the motive quantity of a force," or the momentum generated by it in a given time; and if these expressions had always been explained in this way, *i.e.* as signifying what may be called the *velocity-effect* and the *momentum-effect* of a force, there would have been no room for misconception and no need of cautioning the learner against the notion that there were *two different kinds* of force. Perhaps with regard to Leibnitz it may be questioned whether his physical ideas were so incorrect, and whether he may not have used the terms referred to in the same way that Newton did, viz., as abbreviations, and so as to embody the notions of the different *effects* of a power or influence on the motion of a body, viz., its work-effect, its momentum-effect, its velocity-effect, &c. It must, however, be allowed that the term "conservation of *force*" (originally it seems due to Helmholtz) is very misleading, for a meaning of "force" is therein required which is not included in the original dynamical ideas; and the notion intended to be conveyed could only be given by a new term, "energy," or work-power, with its attributives actual and potential. But, after all, the whole controversy on the word "force" is as to the *method of measuring* a pressure or tension; if we regard the *time* of the action, the effect is represented by the momentum; and if the *space* through which exertion is made, the effect is represented by the work.[1] Either of these would then measure "force," and there would be no inaccuracy if careful explanation were given as to the method used and the sense of words. W. P. O.

Arnesby, Rugby

P.S.—In Prof. Tait's view of "force" is there not a confusion between *being* a mere rate and *being measured* by a rate?

[Our correspondent refers merely to the short abstract given by the *Times* of Prof. Tait's Lecture. Some of his remarks will be found inapplicable to the fuller report in our own pages. —ED.]

[1] "Walton's Mechanical Problems," chap. x.

Mr. Wallace and his Reviewer

IN NATURE, vol. xiv. pp. 188, 189, in a review of Mr. Wallace's recent work on "The Geographical Distribution of Animals," occurs the following paragraph: "Mr. Wallace admits the validity of *Elasmognathus* of Gill as a genus of Tapirs, and adopts Dr. Gray's multitudinous division of the well-defined and eminently natural group of the Eared Seals (*Otaria*). Many naturalists would hesitate before following Mr. Gill or Dr. Gray as authorities on these (or perhaps we may add many other) subjects."

I freely admit the truth of the proposition that there are "many subjects" on which I am not authority, if I am on any; there are none, I presume, who are authority on all things. I will not even contest the allegation as to wrong-doings in regard to the generic differentiation of Baird's tapir; I beg, however, to be allowed to excuse myself by "authority" for such wrong-doing.

The animal in question is distinguished from all others (I have seen skins and skeletons of every known species, and about 100 skulls), and especially from the typical American tapirs by the want of basal apophyses to the nasal bones, the extension of the supramaxillaries behind, into their lowellæ, and their extension upwards into swollen portions, which tightly embrace the mesethmoid, the complete ossification of the latter in the adult; with these features are co-ordinated others less marked, *e.g.*, abbreviation of the cranial box, comparatively small size of the cerebral cavity, &c. The genus has been accepted by Prof. Verrill, Dr. von. Frantzius, Dr. Murie (see his article in *Journ. of Anat. and Phys.* vol. vi., pp. 131–169), as well as Dr. Gray, and every trained mammalogist and anatomist to whom I have shown the skulls (*e.g.* the late Prof. Agassiz, Prof. Baird, Prof. Cope, E. Coues, Dr. H. Allen, Mr. J. A. Allen) have concurred with me that the type is entitled to generic distinction.

As to the eared seals, the critic is wrong as to a matter of fact. Mr. Wallace has *not* followed Dr. Gray in his arrangement of the constituents of that family, but, as he expressly states, has followed Mr. J. A. Allen's elaborate monograph of the *Otariids* of Western America. Two more different arrangements of the same group could scarcely be. For the generic features of the arrangement adopted, I am quite willing to assume the responsibility which Mr. Allen has devolved upon me,[1] notwithstanding the critic's emphatic condemnation. Beside Dr. Gray and myself, F. Cuvier and many of the other older naturalists, as well as Allen, Scammony Elliott, &c., have recognised generic differences between the Otariids.

But over and above all these I can plead in extenuation of my wrong-doing the example of a very eminent and accomplished naturalist, Mr. P. L. Sclater; I feel assured that I am not mistaken in supposing he will be regarded as the best possible authority on such subjects. That zoologist has differentiated the deer into genera distinguished *solely* by the palmation or non-palmation of the horns and many genera of birds on equally slight ground which your limits forbid me to mention. I think no rational naturalist familiar with the details of structure of the deer and tapirs and the variations of horns in the former, will contend that the differences between the tapirs is of less systematic importance than those used to differentiate *Cervus* and *Dama*. Hence I think I have the best precedents for my action, and if I am subject to censure, the eminent Englishman whom I have cited is still more so.

But far be it from me to deny that my critic is not at all correct in his statement (shortly preceding the passage first quoted) that "it would be easy to point out many passages in which Mr. Wallace has not, in our opinion, made the most judicious choice of authorities." One passage (*Op. cit.*, vol. ii. p. 120) I beg to reproduce in corroboration, but, in justice to Mr. Wallace, I must add that although there are many other errors, the passage thus quoted is an exceptional one in a valuable work.

"*Fresh-water Fishes.*[2]—The Nearctic region possesses no less than (1) five peculiar family types, and (2) twenty-four peculiar genera of this class. The families are *Aphredoderidæ*, consisting of a single species found in the (3) Eastern States; *Percopsidæ*, founded on a species (4) peculiar to Lake Superior; *Heteropygii*, containing (5) two genera peculiar to the Eastern States; *Hyodontidæ* and *Amiidæ*, each consisting of a single species. The genera are as follows: (6) *Paralabrax*, found in California; (7) *Huro*, peculiar to Lake Huron; (8) *Pilcoma*, *Bolcosoma*, (9) *Bryttus* and (10) *Pomotis* in the Eastern States—all belonging to the Perch family. (11) *Hypodilus* and *Noturus*, belonging to the *Siluridæ*. (12) *Thaleichthys*, one of the *Salmonidæ* peculiar to the Columbia River. (13) *Moxostoma*, (14) *Pimephales*, (15) *Hyborhynchus*, (16) *Rhinichthys*, in the Eastern States; (17) *Ericymba*, (18) *Exoglossum*, (19) *Leucosomus*, and (20) *Carpiodes*, more widely distributed; *Cochlognathus*, in Texas; (21) *Mylaphorodon* and *Orthodon*, in California; *Meda*, in the River Gila; and *Acrochilus*, in the Columbia River—all belonging to the *Cyprinidæ*. *Scaphirhynchus*, found only in the Mississippi and its tributaries, belongs to the sturgeon family (*Acipenseridæ*)."

Whatever may be the "authority" followed, the following are the facts almost all familiar to every American ichthyologist, and matters of record respecting the forms enumerated. (1) *Five* families are mentioned in one place (just quoted), and *six* in others (*op. cit.*, vol. ii., pp. 115, 143); but the sixth (*Lepidosteridæ*) is not peculiar; (2) Twenty-four genera are said to be peculiar, but twenty-*nine* are enumerated, as is indeed recognised in the next paragraph of the work. (3) The family *Aphredoderidæ* is represented by two species found in the Western and Southern as well as Eastern States; (4) The *Percopsidæ*, far from being confined to Lake Superior, are found at least as far as Lake Champlain to the east, the

[1] "These [genera recognised by Gill] appear to be natural groups of true generic rank, and properly restricted; and, after a careful examination of the subject, and specimens of four of these five types, they appear to me to include all the natural genera of the family."—Allen, "On the Eared Seals (*Otariidæ*)," p. 38.

[2] The punctuation of the original is reproduced.

Potomac River to the south, the Ohio River in the west, and many other places; (5) The *Heteropygii* have three genera (as understood by Putnam, the only naturalist who has thoroughly studied them) confined to the western and southern states; (6) The genus *Paralabrax* is an entirely marine one, very closely related to *Serranus* (*cabrilla*, *scriba*, &c.), and is represented extensively on the western coast of America, as well as elsewhere in the Pacific Ocean; (7) *Huro nigricans* (the only species) is a mere synonym of *Grystes* or *Micropterus nigricans*, which extends to Florida in the south-east, and Mexico toward the south-west; (8) *Pileoma* is a later name for *Percina;* (9) *Bryttus* and (10) *Pomotis* are not *Percidæ* according to most American authors, nor according to Dr. Günther's recently promulgated views (the vertebræ being only *A* 10 + *C* 14), and belong to a quite peculiar family; (11) *Hypodelus* is a misnomer for *Hopladelus;* (12) *Thaleichthys* is as much a marine genus as *Osmerus* (Smelts); there is no such restriction at all as indicated by the remarks on the distribution of (13) *Moxostoma*, (14) *Pimephales*, (15) *Hyborhynchus*, and (16) *Rhinichthys* on the one hand, and (17) *Ericymba*, (18) *Exoglossum*, (19) *Leucosomus*, (= *Semotilus*), and (20) *Carpiodes* on the other; and the categories might indeed, as to most causes, be almost reversed; (21) *Mylaphorodon* is a misnomer for *Mylopharodon.* The number of genera enumerated as peculiar might, too, be very safely more than doubled, and by reference to Günther's work and subsequent corrections, *Centrarchus*, *Ptyonotus* (= *Triglopsis*), and *Hysterocarpus* could have been added. All these errors might have been prevented if Mr. Wallace had been familiar with ichthyology and its literature. The paragraph cited also quite conceals the remarkable distribution into secondary faunas of the American genera, and is calculated to entirely mislead respecting the contrasts between North America and the Old World. His use of the term "Eastern States" (instead of "Eastern Province," as Baird calls the division meant) is confusing, inasmuch as it is a geographical designation for a particular group of states.

Smithsonian Institution, Washington, THEO. GILL
September 21

The Self-Fertilisation of Plants

UNDER this title there is an article in NATURE, vol. xiv. p. 475, mentioning some observations on flowers, and concluding thus:—"In view of these examples . . . . it can hardly be that colour, fragrance and honeyed secretions in flowers have been developed solely to secure cross-fertilisation." In reply to this article it may be worth showing that of the examples relied upon the first and last are most probably incorrectly observed and erroneously interpreted, whilst the others are of no consequence at all, so far as the good effects of cross-fertilisation are concerned.

First, the flowers of *Browallia elata* have been most accurately described by F. Delpino ("Ulteriori osservazioni sulla dicogamia nel regno vegetale," Parte I. p. 140-143), and this excellent observer has fully convinced himself that it is cross-fertilised whenever it is visited by Lepidoptera or Bombylius.

Claytonia virginica and *Ranunculus bulbosus* simply confirm the well-known fact that many flowers have recourse to self-fertilisation when not visited by insects (see H. Müller's "Befruchtung," p. 443-448, NATURE, vol. viii. p. 433, vol. ix. pp. 44, 64, vol. x, p. 122).

As to the last example, *Ranunculus abortivus*, it is inadmissible to conclude from the fact that one has not observed visitors on a plant, that this plant is wholly neglected by insects.

With regard to the article as a whole, it seems to me somewhat rash to call in question a comprehensive and well-founded theory on the basis of a few superficial observations.

Lippstad, October 20 HERMANN MÜLLER

The Proposed Zoological Stations at Kiel and Heligoland

IN NATURE, vol. xiv. p. 535, there appears amongst the occasional Notes, a short report of a proposal of the Association of German Naturalists to found two new Zoological Stations at Kiel and Heligoland. The establishment of such stations could not fail to be of immense service to biology, but it is much to be regretted that the Association is inclined to put aside the claims of the present Zoological Station at Naples in favour of these two new institutions. To act in this way would be both unwise and ungenerous: unwise, because a station on the shores of the Mediterranean can obtain a great variety of forms which are not to be found in the North Sea and the Baltic; and ungenerous because the Naples Station has been the means of proving both the value and feasibility of such institutions, and without it the present proposals would never have originated. It is indeed surprising to see a body of German naturalists refusing their support to an institution like that at Naples, which has already rendered such signal services to biology, in which so many of themselves have made important discoveries, and which is, moreover, founded almost on the site of the classical investigations of Kölliker, Gegenbaur, and Hæckel.

It is to be hoped that the Commission appointed by the Association to draw up a memorandum will see their way to urging the claims of the existing Zoological Station at Naples without thereby interfering with the prospects of the similar institutions which it is proposed to found. F. M. BALFOUR

Trinity College, Cambridge

The Flame of Chloride of Sodium in a Common Coal Fire

MR. HARDMAN, in NATURE, vol. xiv. p. 506, gives an account of a number of experiments which he considers to bear out the old theory that the blue flame produced by throwing common salt on a coal fire is due to carbonic oxide. His letter induces me to give an account of a series of experiments which I made last winter, in company with Mr. R. A. Lundie, and which led me to an exactly opposite conclusion. Our experiments were all made with the help of a spectroscope, no dependence being put on observations made with the naked eye:—

1. We examined, with the spectroscope (which was a small direct-vision one), a *very distinct* blue flame of CO, burning in a coal fire; this, as far as we could see, gave no bright lines. A little common salt was then put on the fire, when at once a very marked spectrum appeared, the most characteristic part of which was a pair of bright lines in the blue, and another pair in the violet beyond the spectrum of the glowing coals, against which the flame was generally seen. This flame was very persistent, and frequently long after the *flame* had ceased to be distinguishable, the *spectrum* was still quite marked.

2. We did not succeed in getting the spectrum with other salts of soda, such as carbonate, phosphate, and borate; nor yet with microcosmic salt, while on the other hand, with other chlorides and chlorates, such as KCl, $KClO_3$, and NH_4Cl almost exactly the same spectrum was obtained, and with bromide of potassium a very similar, if not an identical, spectrum was also obtained.

3. We were able, but with more difficulty, to get the characteristic spectrum, when a blow-pipe flame was made to play down on chloride of soda, or ammonia, lying on an iron plate; and in this case it was observed that the blue flame *seemed* to be produced only when the flame which had passed over the salt came to a colder part of the plate where there was more salt.

Want of time has prevented me from continuing my experiments, and I do not venture to suggest any theory to account for the phenomenon. It is possible that part of the blue blaze is due to carbonic oxide, but I am convinced that this is not a complete explanation. Neither do I think that Mr. Müller's explanation (NATURE, vol. xiii. p. 448) is sufficient, though a number of our earliest experiments, in which a brass plate took the place of the iron plate (in experiment 3), certainly favour this explanation to a certain extent. The flame thus produced gave the characteristic spectrum very brightly, but at the same time new lines (copper) appeared in the green. I would add that I have as yet been unable to get satisfactory measurements of the positions of the lines, the spectroscope I used for most of my observations having no micrometer nor scale.

C. MICHIE SMITH

Keig, Aberdeenshire, October 13

OUR ASTRONOMICAL COLUMN

THE INTRA-MERCURIAL PLANET QUESTION.—M. Leverrier has made a further communication to the Paris Academy on this subject. With the view to testing the sufficiency of the method employed, to afford a guide for prediction of future transits of such a body over the sun's disk, admitting that the observations in which appreciable motion is recorded really refer to an intra-Mercurial planet, he applies it in the case of Mercury. Transits of Mercury were observed by La Concha at Monte Video, November 5, 1789; by Keiser at Amsterdam, November 9, 1802; by Fisher at Lisbon, May 5, 1832; and by Houzeau at Brussels, May 8, 1845. Taking for the heliocentric longitudes of the body observed, the tabular longitudes of the earth at the epochs of the observations, the following formula for the heliocentric longitude (ν) at any time, is obtained—

$$\nu = 56^{\circ}{\cdot}04 + 4^{\circ}{\cdot}092307\,j - 7^{\circ}{\cdot}66 \sin \nu - 9^{\circ}{\cdot}18 \cos \nu,$$

where j is the number of days from November 5, 1789.

Then admitting the place of the node of the orbit to be in 46°, a transit is indicated by the formula for November 9, 1848, which actually took place.

The problem under discussion, as it refers to a possible intra-Mercurial planet, is susceptible of many solutions, which it becomes necessary to determine. They are comprised in the formula

$$\nu = 139^{\circ}{\cdot}94 + 214^{\circ}{\cdot}18\,k + (10^{\circ}{\cdot}901252 - 1^{\circ}{\cdot}972472\,k)\,j + (-5^{\circ}{\cdot}3 + 5^{\circ}{\cdot}5\,k) \cos \nu.$$

j in this case being reckoned in days from 1750·0, and k being an indeterminate, which may receive values either positive or negative, but necessarily whole numbers.

If $k = 0$, the solution, very precise, is the one already given where the duration of a revolution is 33·02 days, and the semi-axis 0·201.

If $k = -1$, the solution is as exact as the preceding one. The revolution is 27·96 days, and the semi-axis major 0·180.

If $k = -2$, the solution is less exact; the revolution becomes 24·25 days less than the period of the sun's rotation.

If $k = 1$, a solution of the same degree of precision with the last is obtained, with a revolution of 40·32 days.

And if we put $k = 2$, when the revolution would be 51·75 days, large errors will remain.

In all these hypotheses the calculated epochs of transit in 1859 (Lescarbault) and 1862 (Lummis) are very nearly the same. Under these conditions M. Leverrier assumes that we may venture on the calculation of the times of future conjunctions, which occur in the vicinity of the nodes, situated in 192°·9 and 12°·9, the first point being the ascending node, and with the orbit corresponding to $k = 0$, he determines the times of conjunction in the intervals 1853–1863, 1869–1877, and 1885–1892. The tables show that the epochs of transits will be regulated by a period of about seventeen years, in the middle of which the transits will occur, but after which none would be seen for many years. Lescarbault and Lummis it appears observed at the end of one series of transits, which explains why in searching after them in the same region of the sky observers have not seen anything, and seven or eight years might elapse without more success. M. Leverrier then examines the possibility of a transit of the hypothetical planet in the spring of 1877. The conjunction with the sun would occur on March 22 at a distance of 10°·9 from the node, and if this distance be considered certain, as well as the assumed inclination of 12°, there would not be a transit, but in view of very probable modifications of these numbers, a transit may be possible; and he then urges observers to a close watch upon the sun's disk on the 22nd of March next, seeing that there would be no other transit at the spring node before 1885; and a similar examination of the conjunctions at the opposite node (September and October) shows that for the present they do not occur under more favourable conditions. The conjunction in 1876 would take place on September 21, when a transit, though not altogether impossible, is very doubtful. For a transit at this node it is necessary, under the assumed conditions as to the position of the orbit, to wait until about 1881.

For the present, then, there remains no other resource than a direct search off the sun's disk, and M. Leverrier remarks that Dr. Janssen "ne désespère pas d'y parvenir, grâce aux perfectionnements de l'optique céleste, auxquels il a si puissamment contribué." The remaining part of the communication to the Academy is occupied with ephemerides of differences of right ascension and declination of planet and sun for the last half of October.

Mr. De la Rue has instituted a very close examination of the Kew heliographs, with some interesting results.

THE VARIABLE STARS S CANCRI AND U GEMINORUM.—The following are times of visible geocentric minima of S Cancri, calculated from the elements of Prof. Schönfeld's latest catalogue, where the period is 9d. 11h. 37·75m.:—

	d.	h.	m.		d.	h.	m.
1876, Oct.	30	15	9	1877, Jan.	14	12	3
Nov.	18	14	22	Feb.	2	11	18
Dec.	7	13	35	,,	21	10	35
,,	26	12	48	March	12	9	52
				,,	31	9	9

While the irregularity of intervals between the observed maxima of U Geminorum of late years appears to forbid the hope of making a reliable prediction of these epochs at present, it may assist observation of the right object if it is noted that the variable precedes the principal component of Σ 1158, 1m. 26·5s., and is north of it 7′ 31″. The writer is informed by M. Otto Struve that this star does not quite disappear in the Pulkowa refractor, but with instruments of more ordinary dimensions it is invisible during the greater part of the period of 9½ days. There is a star 12·13m. very near its position.

BIOLOGICAL NOTES

CEPHALISATION.—Such is the name given by Prof. Dana to what he terms a fundamental principle in the development of the system of animal life. Its meaning can be best explained by the employment of the instances used by its author. The lobster and the crab are closely allied decapod crustaceans. In the lobster the tail is large, the cephalo-thorax elongate, and the antennæ of considerable size. In the crab the tail is minute, packed under the cephalo-thorax, which is short, as are the antennæ; and from this we may infer that passing upwards from the Macrural to the Brachyural forms there is an abbreviation and a compacting of structure before and behind the head. "In the whale the tail is the propelling organ and is of enormous power and magnitude, and the brain is very small and is situated far from the head extremity in a great mass of flesh and bone furnished with poor organs of sense." The principle is therefore that in low types "there is, usually, large size and strength behind, an elongation of the whole structure, and a low degree of compactness in the parts before and behind; in the high, there is a relatively shorter and more compacted structure, a more forward distribution of the muscular forces or arrangements, and a better head." The analogy is ingenious, but we can see nothing of value in the argument more than a repetition of the well-known principle that height in the scale of creation and amount of cerebral development are correlated phenomena. Are we to place the koala, which, by the way, is wonderfully like some of the much higher Lemurs in its proportions, at the top of the Marsupial phyllum and the kangaroos at the bottom, because the former wants the tail and has a blunt nose, whilst the latter have an enormous caudal appendage and a slender snout? Is the sun-fish so much higher than the eel, and the ostrich than the lyre bird? We fear that cephalisation is not a true law of nature.

RHINOCEROSES.—Anyone visiting the Zoological Gardens in Regent's Park at the present time can obtain ocular proof of the existence of two species of single-horned rhinoceros, differing in size, texture of integument, and skin-folding. On a former occasion (NATURE, vol. ix. p. 466) we were able to demonstrate to our readers the distinguishing points in the last-mentioned of these features, and in the present instance we desire to draw their attention to an important paper by Prof. Flower, F.R.S. (*Proc. Zoolog. Soc.* 1876, p. 443), just published, on the differences between the skulls of the same two species. There are thirty skulls of single-horned rhinoceroses in the two great metropolitan zoological museums, and from a comparison of these Mr. Flower has been able to draw several important conclusions. One of these is that in the Indian Rhinoceros (*R. unicornis*) the posterior termination of the bony nostrils (the mesopterygoid fossa) is considerably narrower than in the Javan species (*R. sondaicus*), at the same time that the vomer terminates behind by becoming lost, through fusion, in the pterygoid processes, instead of ending free, lamelliform, and pointed. In the Indian rhinoceros, also, the upper grinding teeth have a pattern which is easily distinguishable from that of the Javan animal, a peculiar little circular "accessory valley" being developed in the first and second molars of the former, not found in the latter. In the same paper Mr. Flower also brings forward an interesting difference between the skulls of the single and double-horned rhinoceroses, the external auditory meatus being embraced below by the fusion of the post-glenoid and post-temporal processes of the squamosal portion of the temporal bone in the one group, whilst in the other these two processes remain separate, as in the horse and tapir. The African species agree with the two-horned Asiatic in this respect, so that the character separates the unicorn from the bicorn Rhinoceroses.

PASSERINE BIRDS.—Within a few pages of the paper above referred to is one by Mr. A. H. Garrod upon some of the peculiarities in the anatomy of Passerine Birds. The nature of the voice-organ is the point laid most stress upon. For a long time it has been known that there is a small section of the Passerine birds which has no muscular organ of voice that may be employed for singing. These *all* were supposed to inhabit America, although from the conformation of their wings, wherein they alone resemble the aberrant genera just mentioned, Herr Cabanis, of Berlin, as long ago as 1846, predicted that the Old World Ant Thrushes (*Pittidæ*), lacked the voice organ. Mr. Garrod, from a dissection of several specimens of two species of *Pitta*, demonstrates that Cabanis was quite correct in his surmise, and that the voice-organ is absent in them. He also describes the same organ in the Lyre Bird of Australia (*Menura superba*), and in its diminutive and interesting ally *Atrichia rufescens*. The paper ends with an outline plan of the classification which introduces more than one novel feature.

BAROMETRIC VARIATIONS

IN the "Notes," NATURE, vol. xiv. p. 464, I see reference is made to my results on this subject, and it is suggested that General Myer's International observations will be of the greatest value in connection with the question whether there may not be some other attractive force than gravitation connected with these variations.

I had come to the conclusion nearly twenty years ago (see British Association Transactions for 1859) that the *mean* pressure of the atmosphere for the whole globe was probably less for July than for January. This conclusion was derived from observations made at a great number of stations in both hemispheres during these months in the same year (1844). A considerable part of the earth's surface was not covered by these stations. About a year ago I received from Gen. Myer a copy of the *Bulletin of International Observations* made on February 7, 1875, at 7h. 35m. A.M., Washington Mean Time, and I was glad to see in such observations the means of making more complete comparisons of the mean barometric pressure for given instants on different days. It was only a few months later that I found I could obtain a sight of other *Bulletins* at the Meteorological Office. I had time, however, to compare only two *Bulletins*, that sent me by Gen. Myer for February 7, and another for the 27th of the same month (1875) which seemed to show a lower pressure generally than the first. Other investigations have prevented me from seeking for a larger series of *Bulletins* to carry out the comparisons; but it seems to me that the comparison then made is sufficiently interesting to merit notice.

The mean barometric pressure at 7h. 35m. A.M., Washington M.T., was found for each of the countries in the *Bulletin*, on each of the two days mentioned; the differences of these mean pressures were then taken; they are given, with the numbers of stations from which the results are obtained, in the following table:—

Country.	Number of Stations.	Difference of Pressures. in.
Russian Empire	23	+ 0·19
Denmark	3	+ 0·21
Greenland, Iceland, and Faröe	3	− 0·48
Norway	3	+ 0·33
Austria	12	+ 0·06
Turkey	5	+ 0·19
Mediterranean, Gibraltar, Corsica	3	+ 0·15
Germany	21	+ 0·30
Switzerland	2	+ 0·68
Italy	13	+ 0·32
Algeria	9	+ 0·27
Netherlands	4	+ 0·52
Belgium	1	+ 0·55
France	21	+ 0·54
Spain	1	+ 0·27
Portugal	1	+ 0·26
Great Britain and Ireland	41	+ 0·32
Canada	18	+ 0·53
United States	96	+ 0·37
West Indies	7	+ 0·09
Ceylon	1	+ 0·21
Cape of Good Hope and Natal	2	0·00

It will be seen that, with the exception of the small area about Iceland, all the differences are positive; or the barometer stood higher on February 7, 1875, at 7h. 35m. A.M. W. M.T., than on the 27th at the same hour. I have no doubt that when the investigation is made with the care it merits, much more marked results will be obtained. All these series, however, with the exception of the last two stations, are in the northern hemisphere; it is then of course possible that the atmosphere was playing at "hide and seek" with us, and had moved away to places for which no observations are at present forthcoming. There may also have been some difference in the amount of vapour in the air on these two days; this I have not attempted to calculate, but for two days in February, in the northern hemisphere, it will probably be very small.[1]

In the first investigation already referred to, I had calculated the mean tension of vapour in the lowest stratum of the atmosphere for each station; this, it is now agreed, does not indicate the pressure of vapour on the barometer, but the result was that the vapour tension was greatest in July, when the mean barometric pressure was least. A reason for the increased mean vapour tension for the whole globe in July will be found in Dove's result that the mean temperature of the whole atmosphere is greatest in that month. I shall probably take the liberty of returning to this subject.

JOHN ALLAN BROUN

[1] I see from the *Bulletin* in my possession (that for February 7) that the thermometer was, on the average, below zero (centigrade) in Europe, and from 10° to 30° below zero in America; the higher pressure on the 7th could scarcely then be due to the vapour in the air. For any considerable exactness in such comparisons, series of observations like those of General Myer should contain the *observed* pressures for each station (or the correction to the sea-level) as well as the calculated sea-level pressures; since if, at any high level station, the observed pressures are *exactly the same* on two days one of which has a higher temperature than the other, the calculated pressures for the sea-level will differ, that for the lower temperature being highest. The greatest mean error due to this cause in the present instance will not, in all probability, exceed ±0·01 inch.

PRINCIPLES OF TIME-MEASURING APPARATUS[1]

III.

Clock-Escapements.

AN escapement in general is to be considered a good one just in proportion as it prevents variations of friction in the clock-train from reaching the pendulum.

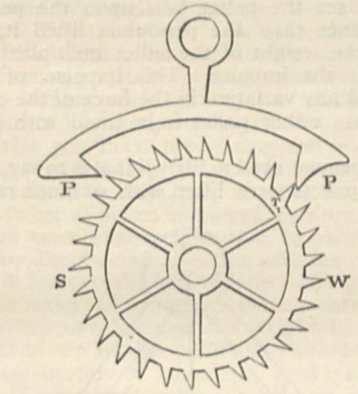

FIG. 14.

The first form of escapement with which the pendulum was used is that early form mentioned in our description of the clock from Dover Castle; but this was speedily abandoned on account of the unduly large arc through

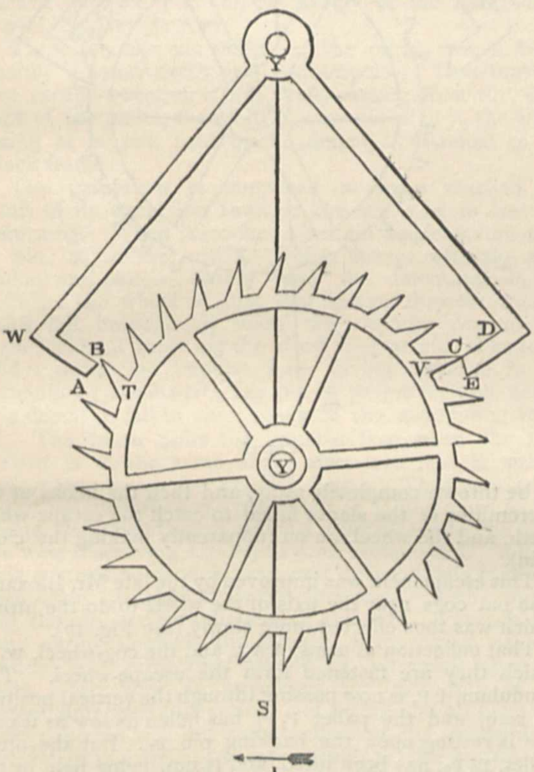

FIG. 15.

which the pendulum had to swing in order to liberate the teeth of the escape-wheel. The form next employed is that shown in Fig. 14. The principle is nearly the same, except that the pendulum need only swing 2° or 3° in order that the teeth may pass.

S W is the escape-wheel. The tooth T is now being held by the right-hand pallet, P; in point of fact, as the pendulum is swinging to the left, the pallet is actually recoiling or driving it back a little. By-and-by the pendulum will return, lift the pallet, and allow the tooth to escape, when the same action will take place upon the opposite pallet. You can readily see what the effect would be, supposing a little more force to be occasionally transmitted by the clock-train; it is obvious that the pendulum would be beaten backwards and forwards by the action of the pallets, and the time of the clock would be greatly accelerated. The reverse action would take place supposing a little less force to be transmitted. This escapement is called the recoil escapement.

We now come to the dead escapement (see Fig. 15), invented by the same Graham who discovered the mer-

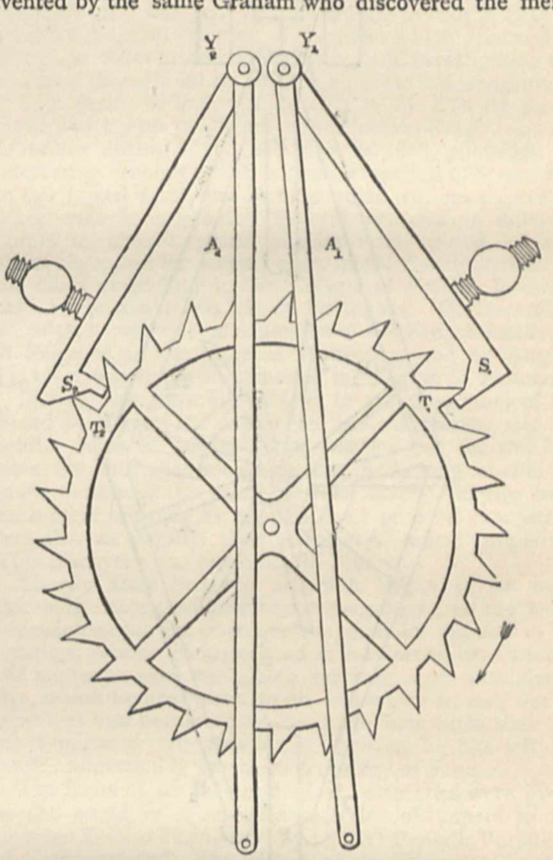

FIG. 16

curial pendulum. The escapement is so called because, during the greater part of the swing of the pendulum, the seconds hand lies motionless or dead, upon the division of the clock dial.

That tooth T of the escape-wheel has just got clear of the left-hand pallet, and V has fallen upon the face C D of the right hand. W A and C D are portions of circles described from Y, the axis of motion of the pallets, and you see they have therefore no tendency to drive back or recoil the escape-wheel.

In order to understand its advantage, I must ask you to follow very carefully what I am now going to say. As I told you when we were discussing barometric compensation, any force acting upon the pendulum in the same direction as gravity, will cause it to swing faster, and any force against gravity to swing slower. The force of the clock train, when it gives impulse to the pendulum, may act either *with* or *against* gravity; that is to say, it may

[1] Lectures by Mr. H. Dent Gardner, at the Loan Collection, South Kensington. Continued from p. 556.

be given when the pendulum is *falling* or *rising*. In the first case any variation in the friction of the clock-train tending to increase the impulse will make the clock gain, in the second, to make the clock lose. But why could we not so arrange an escapement that the impulse should be given, half when the pendulum is falling, and half when it is rising? and then any variation in the force of the impulse will simultaneously cause the clock to gain and lose, and so correct itself.

This is what can *nearly* be done in the dead escapement, but not exactly, because the condition of so doing is that each tooth of the escape-wheel, shall drop exactly upon the corners C and A, dividing the dead faces C D, W A,

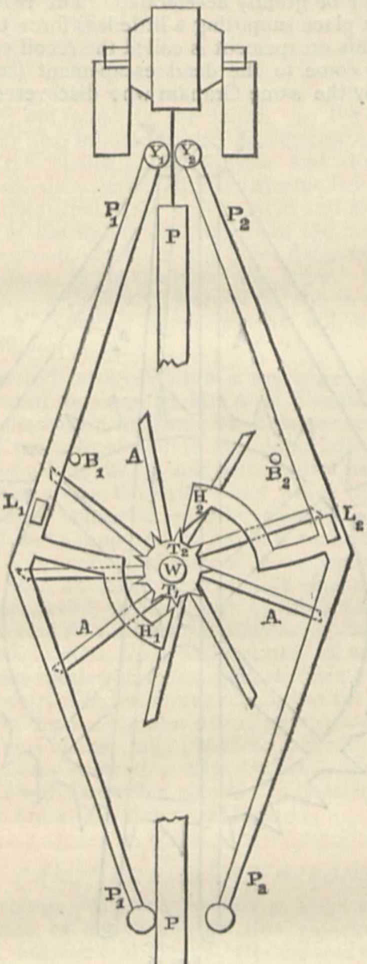

Fig. 17.

from the impulse faces C E, A B, and you are bound to allow a little margin for safety. But just in so far as this condition is fulfilled, so the escapement is a good one.

Gravity Escapements.

To understand the principle of these you cannot do better than refer to Fig. 16, which shows the original form invented by Mudge. The tooth of the escape-wheel T_1 by operating upon the slant S_1 has lifted the pallet S_1 Y_1 to its present position, and the tooth is now being held by the hook at the end of the pallet. The pendulum, which is detached from the pallets, is advancing towards the arm Y_1 A_1 connected with this pallet, and will by-and-by lift it, freeing the escape-wheel: the other tooth of the wheel will then operate upon the slant S_2, of the other pallet S_2 Y_2, and lift that until it is in turn detained by the hook at its extremity. Meanwhile the pendulum carries the first pallet to the extremity of its swing, and then returns with it; but as there is now no tooth in the way to receive it, the pallet S_1 Y_1 will drop, until it occupies a corresponding position to that in which the pallet S_2 Y_2 is at present situated.

Thus you see the pallet falls upon the pendulum a greater distance than the pendulum lifted it, and this difference—the weight of the pallet multiplied into this space—forms the impulse. This impulse, of course, is constant, and any variation in the force of the clock-train will only cause either pallet to be lifted with greater or less rapidity.

This escapement used to "trip," that is to say, that occasionally the pallets were lifted with so much rapidity, as

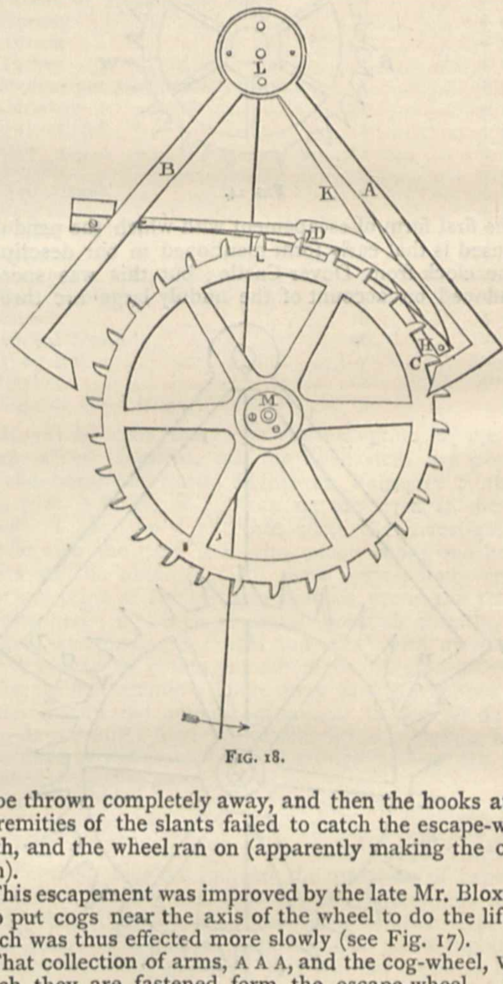

Fig. 18.

to be thrown completely away, and then the hooks at the extremities of the slants failed to catch the escape-wheel teeth, and the wheel ran on (apparently making the clock gain).

This escapement was improved by the late Mr. Bloxam,[1] who put cogs near the axis of the wheel to do the lifting, which was thus effected more slowly (see Fig. 17).

That collection of arms, A A A, and the cog-wheel, W, to which they are fastened form the escape-wheel. The pendulum, P P, is now passing through the vertical position or zero, and the pallet P_1 P_1 has fallen as low as it can, and is resting upon the banking pin B_1. But the other pallet, P_2 P_2, has been lifted, and is now being held by the cog T_2, the cog can lift it no further because one of the arms, A A A, is caught by the locking stud L_2 (which is situated upon the opposite side of the pallet). By-and-by, however, the pendulum will reach the pallet, push it away,

[1] Mr. Bloxam discovered that the pendulum should quit and take up each pallet at angles depending upon its arc of vibration. The reader who wishes for further information cannot do better than consult Mr. Bloxam's elaborate paper, *Memoirs* R.A.S., vol. xxii. p. 103; and another, vol. xxvii. p. 61.

and liberate the wheel; the cog T_1 will then immediately operate upon the hook H_1 and lift the other pallet. Meanwhile the pendulum swings away to the right, carrying the pallet $P_2 P_2$, and returns with it, but as there is now no cog P_2 to receive it, it falls to the lower position corresponding to that now occupied by $P_1 P_1$, the excess of its fall over its rise, upon the pendulum as in the preceding case constituting the impulse.

This form of gravity escapement has been further modified and improved for ordinary use by Sir Edmund Beckett.[1] The only way in which variations in the force of the clock-train can disturb the pendulum in these escapements is by putting more or less pressure upon the locking studs, giving the pendulum more or less trouble in liberating the escapement; and with reference to this you must not be deceived by so-called improvements for detaching the pendulum completely from the escapement, for they really never do so, and generally by the number of pieces employed, hamper the pendulum with much more friction than that to which it would be exposed by direct communication with the clock-train.

You will see that the general effect of a gravity escapement is to make the pendulum move rather faster than if it were a free one, because the weight of the pallets is equivalent to two smaller pendulums attached to it during the greater portion of its swing. And the effect of any increase of pressure is quite the reverse of what would happen with a direct escapement, for it increases the pressure upon the lockings without increasing the impulse, and will consequently cause the arc of vibration to fall off.

The last clock-escapement I shall describe is a detached one (see Fig. 18), the design of the Astronomer Royal, Sir George Airy.

There is only one pallet, A, the other arm, B, being merely a safety-catch and counterpoise. That tooth of the escape-wheel, C, is not really resting upon the dead face of the pallet, though it is very close to it, the wheel being at present held by the detent, D, fastened to the clock frame.

The pendulum is supposed to have reached the limit of its excursion towards the left, and to be now returning. When it reaches a certain angle before zero, a pin, H, in the arm K (which swings with the pendulum and pallets), passes under the detent, lifts it, and unlocks the wheel at just that instant that the tooth C shall fall immediately upon the *impulse face* of the pallet without touching the dead face at all. The tooth slides down the impulse face, giving impulse to the pendulum; meanwhile, the pin H passes on and allows the detent to fall in time to catch the succeeding tooth L. The tooth quits the impulse face when the pendulum is at the same angle after zero that it was at before zero when the impulse began. Thus you get an equal impulse when the pendulum is falling as when it is rising, the advantage of which I pointed out to you when we were discussing Graham's dead escapement. Besides this, you get no dead friction, and the pendulum is almost completely detached from the clock-train. Upon returning the pin H clears the detent this way. You see that long spring beneath the detent, commencing near its middle, and projecting beyond its extremity upon the right; just now, in unlocking, the extremity of the detent supported this spring, and detent and all gave way before the pin H. But upon returning, the extremity of the detent of course gives no support to the spring, and the pin H pushes it upon one side without disturbing the detent. This escapement is used in the normal sidereal clock at Greenwich.

(*To be continued.*)

[1] The Westminster Clock has one of his forms. A locking stud is placed upon the back of one pallet and the front of the other, and there are two collections of arms (of three each) on either side of the cog-wheel, to meet them. The cog-wheel itself has also three cogs. This escape-wheel, with a seconds pendulum, turns once in six seconds, and its velocity is controlled by a fly.

CHARLES SAINTE-CLAIRE DEVILLE

M. CHARLES SAINTE-CLAIRE DEVILLE, the distinguished geologist and meteorologist, and brother of M. Henri Sainte-Claire Deville, the well-known chemist, was born of French parents in 1814, at St. Thomas, in the West Indies. At the age of 19 he was enrolled a pupil of the School of Mines, in Paris, and after a course of study there undertook, at his own expense, a scientific expedition extending from 1839 to 1843, to the Antilles, Teneriffe, and Cape Verd Islands. He spent upwards of a year investigating the geology of Guadaloupe, and wrote a detailed account of the terrible earthquake which laid waste that island in 1843. The results of this expedition he published in two series of memoirs, the one appearing from 1856 to 1864, on the geology of the Antilles, Teneriffe, and Cape Verd Islands, and the other from 1861 to 1864, principally on the meteorology of the Antilles. He was sent by the Institute to Italy in 1855 to examine the great eruption of Vesuvius which occurred in that year. After attentively following and investigating the eruption through all its phases, he wrote a description of it in a series of letters addressed to M. Élie de Beaumont, which were published in the *Comptes Rendus* and the *Moniteur* during 1856. He also, in 1858, published an interesting account of the volcanic eruptions of Stromboli, in the Lipari Isles, and in later years, various papers on other volcanic eruptions. Several memoirs on different points in chemistry and physics were written by him about 1852, and for several years he filled with distinction the chair of geology in the College of France, formerly held by the illustrious Élie de Beaumont. On December 28, 1857, he was elected a member of the French Academy of Sciences in the place of Dufrenoy, and on August 13, 1862, was made an officer of the Legion of Honour.

During the time he worked in the laboratory of his friend M. Dumas, he discovered the amorphous and insoluble form of sulphur, thus pointing out for the first time the fact that an elementary body may at will be made to assume two totally distinct states, differing from each other not only as regards their physical characters, but also as regards their essential chemical properties. This discovery was published in 1852.

Shortly after this his attention began to be more decidedly attracted towards meteorology; so much so, indeed, that for the past twelve years he appears in his writings almost exclusively as a meteorologist. Indeed the meteorological work, both scientific and administrative, which he undertook to do, and which he did, was so laborious and harassing as to leave him little time for other pursuits. By this work, however, he has left his mark unmistakably on the meteorology of France.

The fruits of his meteorological researches were given to the world in a remarkable series of papers in the *Comptes Rendus* during 1865-67, on the "Periodic Variations of Temperature." The object of this investigation was to prove the existence of annual and super-annual periodic perturbations of temperature, and to state with precision the character and nature of these periods. Having shown the occurrence of similar perturbations of temperature on four days of the same date in February, May, August, and November, these days being placed on the terrestrial orbit at equal intervals, and which, by the way, correspond with the dates of the festivals of the "Ice Saints," he inquired how far similar perturbations occur on any four days of the year separated from each other by equal intervals of time. Since the observations showed that some years and groups of years presented for the same days perturbations different from those of other years, being sometimes above and sometimes below the normal means of the days, an inquiry was raised as to the limits of the antagonism thus disclosed both as regards the amount and the cycle of years it embraced. Lastly, since these perturbations, if they exist, must exercise an important influence on all the other atmospheric conditions, the still larger inquiry was suggested, viz., the sifting and separation of the facts so as to make them disclose the nature and limits of this influence in each particular class of meteorological phenomena. The theory advanced to account for these perturbations was that first suggested by Erman of Berlin, by which they are considered as due to different streams of meteoric matter which are periodically interposed between the earth and the sun—a theory which in view of the facts is open to serious doubt. But the great value of these memoirs lies in their suggestiveness and in the important lines of meteorological inquiry therein pursued and indicated. Indeed the author states that a main object he had in view would be gained if he thereby enlisted the younger meteorologists to aid in establishing clearly in meteorology the notion of periodicity, which in truth is only another name for law and harmony, the evolution of which from facts apparently so entangled and so discordant is the problem presented by meteorology. It may be added here that his two daughters materially assisted him in the laborious calculations for this work. He subsequently wrote various papers on the connection between atmospheric pressure and temperature, on the aurora, and on terrestrial magnetism.

He was one of the founders of the French Meteorological Society, and it was during his term of presidency of the Society that the Meteorological Observatory of Montsouris was established chiefly through his influence and that of M. Dumas, for the special purpose of investigating terrestrial physics, inclusive of the work usually undertaken by meteorological observatories. This observatory remained under his direction from the date of its establishment in June, 1869, to June, 1872, when he was appointed Inspector-General of Meteorological Stations in France. Under his management and that of his successor, Marié Davy, the well-known meteorologist, the Montsouris Observatory has gradually come to occupy, as our readers are doubtless aware, a well-marked sphere of action which we hope similar observatories in other countries will not be slow to adopt. This special sphere of action concerns the application of meteorology to the great national questions of agriculture and public health, particularly the health of large towns; and it consists in a well-devised scheme of chemical and microscopical observations regularly conducted, having for their object the investigation of the composition of the air, more especially as regards the variations of its aqueous vapour, carbonic acid, nitric acid, and ammonia, and its organic and inorganic impurities.

As Inspector-General of the French meteorological stations, he went to Algiers for the purpose of organising the meteorological stations of that country. Owing to the fatigue incident to this journey and the inclement weather he experienced his health was impaired, and it remained in a weak state up to the last. This illness was the more severely felt by a system already enfeebled by a malady which he had contracted thirty-three years before in the service of science. When in 1843 he had just completed his three years' exploration of the volcanic isles of Africa and the Antilles, and it only remained to him to put into shape the rich materials he had collected, the great earthquake, already alluded to, of Pointe-à-Pitre, Guadaloupe, occurred, by which he not only lost the whole of his valuable collections, but was called to mourn the loss of his uncle and several other members of his family, who perished in that catastrophe. The mental suffering and fatigue consequent on these disasters brought on a rheumatic affection, from which he never recovered, and it was to an aggravated form of this malady that he succumbed on October 10, at Paris.

Thus died Charles Sainte-Claire Deville in the midst of his work—a man of singular modesty and amiability of disposition, as well as an enthusiastic worker in science. His funeral was largely attended, but in accordance with a desire expressed in his will, no official deputation of the Academy was present on the occasion, and no funeral oration was pronounced over his grave.

RECENT CAVERN RESEARCHES IN NEW ZEALAND

THE following is the substance of a paper on Cave-Hunting, by Dr. Haast, read at the Philosophical Institute of Canterbury, New Zealand, some time since, and which has been recently forwarded to us.

In the spring of the year 1872, Mr. E. Jollie having suggested to Dr. J. Haast, president of the Institute of Canterbury, that an inspection of the Moa-bone Point Cave, and of the ground near its entrance, would probably help to fix the period of the extinction of the Moas, a subscription list was at once opened, and the results enabled Dr. Haast to commence the work and to carry it on for seven weeks.

Moa-bone Point Cave is situate on the eastern side of the Middle Island, in Banks Peninsula, an extinct volcanic system of large dimensions, which is believed to have been an island in Post-pliocene times, and to have been subsequently raised about 20 feet. The cavern seems to have been a pre-existing hollow in a doleritic lava stream, enlarged by the waves during the insular period. It was well known to Europeans at the very beginning of the Canterbury Settlement, was even inhabited by some of the earliest settlers, of whom ample traces were left behind. Immediately east of the cavern is a small plain, occupied with dunes of drift sand, and bounded seaward by a line of boulders, detached from a small doleritic headland on the western side of the cave when the peninsula was an island.

The entrance to the cavern is from 13 to 14 feet above high water, 30 feet broad and 8 feet high, but is partially occupied by a mass of rock 12 feet long, 6 feet broad, and 10 feet high. This opens into the "First Chamber," which measures, from north to south, 102 feet long, 72 feet broad towards the middle, and about 24 feet high. From its inner or southern end a small passage leads into a "Second Chamber," 18 feet long in a direction N. by W. to S. by E., 14 feet wide, and 11 feet high. At the inner end of this is a passage, 3 feet high, and 2·5 feet broad, leading into a "Third Chamber," measuring 22 feet from N. to S., about 20 feet high, and averaging 16 feet in width.

The floor of the first chamber consisted generally of remains betokening European occupation, but everywhere below them were portions of shells of edible molluscs. These beds gradually thinned out southwards, till at the entrance of the second chamber there was a continuous floor of marine sand.

The explorations appear to have been almost exclusively confined to the first chamber, and to have been commenced by digging two trenches, crossing each other at right angles, near the centre of the chamber. Several other excavations were made, and in one of them, towards the western side of the chamber, the following was the succession of beds, in descending order:—

	ft.	in.
1. European deposits	0	6
2. Shell bed	0	9
3. Tussock and ash beds	0	4
4. Shell beds	1	4
5. Ash beds	0	2
6. Ash beds, mixed greatly with shells	0	10
7. Ash and dirt beds	0	2
8. Agglomeratic bed	0	6
9. Ash bed	0	3
10. Marine sands (excavated to a depth of 7 ft., and found by boring to extend 5 ft. deeper before reaching the rock at the bottom of the cavern)	12	0

Whilst the beds, as might have been anticipated from their characters, were neither equally numerous nor equally thick in different sections, the following important features presented themselves everywhere:—

The basal bed was uniformly the "marine sand" (No. 10); the ash and shell bed (No. 6), the ash and dirt bed (No. 7), and the agglomeratic bed (No. 8), were also well-defined horizons; the shells found in the sixth bed and those above it belonged to species still occupying the adjacent estuary, and the same forms were found in all the beds alike; there were no shells in the seventh bed, or any below it, excepting those which the sea had lodged in the marine sand, some of which were estuarine species, and a very few valves of the common freshwater mussel (*Unio aucklandicus*), found near a "cooking oven" which had been excavated in the same bed; and the sixth and seventh beds were separated by a sharp and constant line of demarcation.

There can be no doubt that, omitting the "European bed," the facts fully justify Dr. Haast's division of the deposits into two distinct series—the "upper," or "shell-bed" series, consisting of the sixth and all the beds above it; and the "lower," of all those below it. The sharp line of demarcation separating the two sets of beds, as already stated, suggested to Dr. Haast that there had been a protracted interval of time between their deposition; and this is strongly supported by the fact that in a section at the entrance of the chamber a bed of drift sand, a foot thick, was found to separate them. It was continuous for some distance southward, but ultimately thinned out in that direction.

The aggregate thickness of the beds of the upper series varied in different sections from one foot to 7·5 feet, being thickest near the entrance, and especially under the shelter of the fallen rock; whilst that of the lower series, exclusive of the marine sand, fluctuated from 8 to 15 inches. The *relative* thickness of the two sets varied considerably in different sections, the lower being but 18 per cent. of the upper at the western end of the cross section in the first excavation, whilst each was one foot thick at the eastern end of the same section. From the data at hand it appears that on the average the thickness of the lower series was about 30 per cent. of that of the higher.

Dr. Haast's "agglomeratic" bed consists of pieces of rock fallen from the roof. Though this fall of fragments was not actually restricted to any one period, inasmuch as all the beds contain lumps and blocks of the kind, it seems to have been peculiarly prevalent during the era represented by the agglomeratic bed.

List of Objects found in the Lower Series of Deposits.

A.—REMAINS OF MAMMALS.

Bones of Man	1
,, Ziphoid Whales	8
,, Sea Leopard (*Stenorynchus leptonyx*)	39
,, Fur Seal (*Arctocephalus lobatus* (?) and *A. cinereus*)	332
,, Small Fur Seal (*Gypsophoca subtropicalis*)	27
,, Dog	43
,, Porpoise	24

B.—REMAINS OF BIRDS.

(*a*) *Extinct Birds* (*Moas*).

Bones of *Dinornis robustus*	13
,, *Palapteryx crassus*	18
,, *Euryapteryx gravis*	35
,, *E. rheides*	94
,, *Meinornis casuarinus*	17
,, *M. didiformis*	103
,, *Aptornis defossor*	1
,, *A. otidiformis*	2
Fragments of bones of different species	51
Tracheal rings of Moas	37
Trays of portions of eggshells of Moas	3

(*b*) *Recent Birds.*

Bones of Spotted Shag (*Graculus punctatus*)	107
,, Black Shag (*G. carbo*)	18
,, Pied Shag (*G. varius*)	15
,, White-throated Shag (*G. brevirostris*)	12
,, Small Blue Penguin (*Eudyptula undina*)	67
,, Grey Duck (*Anas superciliosa*)	17
,, Nelly (*Ossifraga gigantea*)	6
,, Large Kiwi (*Apteryx australis*)	3
,, Kaka (*Nestor meridionalis*)	5
,, Kakapo (*Stringops habroptilus*)	2
,, Tui, Gulls, Terns, and smaller birds	148
Feathers of Kaka	11
,, Nelly	1
,, Spotted Shag	39
,, Harrier (*Circus assimilis*)	1
,, Undetermined	5

C.—REMAINS OF FISHES.

Bones of Hapuku (*Oligorus gigas*)	39

D.—REMAINS OF MOLLUSCS.

Tray of *Unio aucklandicus*	1
,, *Mesodesma cuneata*	1
,, *Mactra discors*	1
,, *Artemis subrosea*	1

E.—OBJECTS OF HUMAN WORKMANSHIP.

(*a*) *In Bone.*

Canine Tooth of Dog, bored at base	1
Needle made of humerus of Nelly	1
Awl ,, tibia ,,	1

(*b*) *In Wood.*

Apparatus for lighting fire, by circular motion, made of Pukatea (*Atherosperma novæ zealandiæ*)	2
Apparatus for lighting fire, by rubbing lengthwise, made of Komaku (*Carpodetes serratus*)	5
Fork, made of Manuka (*Leptospermum scoparium*)	2
Portions of apparatus for lighting fire by rubbing lengthwise, made of Patete (*Melicope ternata*)	1
,, Spear, made of Nene (*Dracophyllum* sp.)	1
,, Pile, made of Totara (*Podocarpus totara*)	2
,, Canoe (?), one made of Tawai (*Fagus menziesii*), one made of Pukatea	2
,, Bird Spear (?) made of Tawa (*Mesodaphne tawa*), a tree of the North Island only	2
Four pieces of Pukatea, and three chips of Totara	7

(*c*) *In Stone.*

Polished adze, perfect	1
,, Implements, fragmentary, one resembling the point of a tool called Tamatau by the Maoris, formerly used by them to make fish-hooks	17
"Cores" of agate, quartz, and chalcedony	4
Chipped flint implements (ten cores, two spearheads, three knives, nineteen flakes)	34
Pieces of gritty sandstone, Taraiwaka of the Maoris, some with grooves for sharpening tools	4
Four pieces of Obsidian (Tuhua), two of pumice stone	6

In addition to the objects just tabulated, three "cooking ovens" belonging to the lower series of beds were met in the First Chamber. After serving as ovens they were converted into kitchen middens.

Returning to the list of objects of interest: the human bone was a portion of the right ramus of a lower jaw of an individual probably not quite mature. It was found six inches deep in the marine sand, and may have been carried in by the surf, as it lay near the greater portion of the skeleton of a fur seal, which had doubtless been washed in.

The very few valves of the freshwater mussel already mentioned were the only indication that the men of the era of the Lower Series of beds made use of molluscs or their shells. All the other molluscous remains were without doubt washed in by the waves of the sea, and lodged in the marine sand where they were found. The favourite and chief food of the period was obviously the Moa, of which at least eight species belonging to five genera were thus utilised; though, as the table distinctly shows, smaller birds were by no means despised. As no portions of skulls were found, with the exception of very small fragments, it has been inferred that the brain of the Moa was considered a great delicacy. The leg-bones were usually broken, some were calcined, whilst others were in a splendid state of preservation. None of them were gnawed, and even the smallest of them were, without exception, quite intact, except such as had been cut or broken by man; a fact especially noteworthy, as the table shows that there were contemporary dogs. Dr. Haast's earlier researches had led him to the conclusion that the Moa hunters had chased the dog for food, but had not domesticated it. There can be no doubt that this view is considerably strengthened by his recent labours.

There is now satisfactory evidence that the men of the Lower Series used *polished* stone tools as well as such as were merely *chipped*.

The bone needle was 4·25 inches long by ·2 inch broad, and is believed to have been used rather as a bodkin to carry a thread through holes made by the awl. The perforated canine of dog was no doubt worn as an ornament.

Bones of Moas and of other birds presented themselves at very slight depths in the marine sand in the second and third chambers, mixed with ashes and other signs of human occupation.

List of Objects found in the Upper Series of Deposits.

A.—REMAINS OF MAMMALS.

Bones of Man	...	3
,, Ziphoid Whales	...	12
,, Porpoise	...	9
,, Dog	...	51
,, Sea Leopard	...	11
,, Fur Seal	...	37
,, Small Fur Seal	...	19
,, Rat	...	3

B.—REMAINS OF BIRDS.

(*a*) *Extinct Birds* (*Moas*).

Small pieces of Moa bones, bleached and decomposed	...	7

(*b*) *Recent Birds.*

Bones of Spotted Shag	...	104
,, *Graculus* sp.	...	17
,, Grey Duck	...	8
,, Harrier	...	3
,, White Crane (*Ardea alba*)	...	2
,, Paradise Duck (*Casarca variegata*)	...	3
,, Large Kiwi	...	2
,, Nelly	...	1
,, Small Birds not yet determined	...	37
Feathers of Spotted Shag	...	62
,, Kakapo	...	49

C.—REMAINS OF FISHES.

Bones of Hapuku	...	164
,, other Fishes not yet determined	...	37

D.—REMAINS OF MOLLUSCS.

Tray of Mussel (*Mytilus smaragdinus*), numerous	...	1
,, Cockle (*Cockle stutchburyi*), numerous	...	1
,, Pipi (*Mesodesma chemnitzii*), numerous	...	1
,, *M. cuneata*, numerous	...	1
,, Periwinkle (*Amphibola avellana*), numerous	...	1
,, Kokotu (*Lutraria deshayesii*), about thirty lying together	...	1
,, *Mactra discors*, a few	...	1
,, *Voluta pacifica*, a few	...	1
,, *Unio aucklandicus*, a few	...	1
,, *Haliotis iris*, a few	...	1

E.—OBJECTS IN WOOD, BONE, OR FIBRE.

Pieces of a Toa, a long thin spear made of Tawa, to shoot birds with. At the upper end a barbed point, called Tara, was fastened, made of human or bird's bone	...	6
A Manga Oko-oko, a wooden fish-hook, made of Pukatea, with a small piece of whale's tooth, called Mata, standing backwards	...	1
Patu aruhe, fern-root pounders, four made of Maire (*Santalum cunninghamii*), a strictly Northern Island tree, and one made of Akeake (*Olearia* sp.)	...	5
Fragments of a Matiha Tuna, fork for spearing eels, made of Manuka	...	4
Portion of a Kaho, batten for a whare, made of Turepo (*Hoheria populnea*), ribbon wood	...	1
Portions of several Whaka kai, wooden dishes for preserving fat and juice	...	13
Taka ore kaka, parrot stands, made of Pukatea	...	2
Pu-tatara, small trumpet, made of a Struthiolaria shell	...	2
Mata, mouth of a flax bag, made of twisted thin sticks, for preserving birds after being cooked	...	1
Taka kai, matting used for covering the food in the hangi, or oven, to keep it clean	...	2
Parenga-renga, sandals made of flax, or Ti-tree leaves	...	3
Pawa shells (*Haliotis iris*), in which the holes at the exterior border were filled with flax, for keeping oil	...	4
Pieces of nets: the floater of pumice-stone is called Poito		4
Matao, fish-hooks, for catching Hapuku, made of Kaikaiatua (*Rhabdothamus solandri*), a Northern Island tree		4
Fish-hook, made of Rata (*Metrosideros*)	...	1
Piece of timber, of Pukatea	...	2
Karera, a wooden handle made of Totara, to fasten a piece of greenstone to be used as a chisel	...	1
Portion of a Patu-patu, a large wooden hammer	...	1
Tahatiti-whaka, a squared piece of wood (Totara), to fasten the sides of a canoe	...	1
Puru, made of Manuka, a pin to stop the holes of a canoe for letting water out	...	2
Kauhuhua, a wooden pin, made of Manuka, to fasten the battens across the canoe	...	2
Tokai, a thin long stick, used to keep the mouth of the fishing-net open	...	2
Ripipawa, a knife made of Manuka, to loosen pawa shells		1
Pieces of Matiha, fighting spear, made of Manuka	...	6
Pieces of timber, portions of mats, cordage, &c.	...	53
Portion of Korapu, net for catching Inangas or Whitebait		1

F.—OBJECTS IN STONE.

Portions of polished stone implements	...	3
,, ,, greenstone	...	1

Among the objects belonging to the era of the beds of the Upper Series, though to a comparatively modern portion of it, was a human skeleton which had been carefully interred. It was detected a few feet from the south-western wall of the First Chamber. The grave had been dug through all the deposits then existing, several feet deep into the underlying marine sand. The body was in a sitting posture, tied together with flax, the face toward the south-west, and it was covered with part of the sand which had been thrown out of the grave; the remainder, as well as the overlying beds which had been dislodged, being thrown around the spot. It was clear that the ground had afterwards been levelled, and that about six inches of shell-bed, level and continuous in all directions beyond the disturbed area, had been subsequently deposited over the grave, whilst over this again lay the European bed, three inches thick. The skeleton is that of a man nearly six feet high, and certainly not young.

It was evident from the accumulations deposited after the interment that the burial had taken place before the arrival of Europeans, and that during the interval the natives continued to frequent the cavern and to take their meals there. The latter fact leads to the inference that its occupation was not constant or even regular, but occasional only and by different tribes; for, judging from the character and superstitions of the existing natives it may be safely concluded that after the burial of one of them the cave would have become strictly *tapu* to all those having any knowledge of the fact, at least so far as taking a meal there is concerned.

On comparing the lists of objects found in the two sets of deposits, the facts which probably most strongly arrest attention are, (1) the presence of Moa bones in the Lower Series, but not in the Upper; and (2) that whilst the upper beds consist very largely of estuarine shells, it may almost be said that in the lower there are no traces of shells introduced by man. When the mind is in addition directed to the condition of the bones of the various species of Moa, as well as to the further fact that the valves of the bivalve shells were almost invariably disunited, there can be no hesitation in accepting Dr. Haast's name of *Moa-hunters* for the men of the Lower Series, and of *shell-fish eaters* for those of the upper. The Spotted Shag and the Dog appear to have been favourite dishes in each period.

The human remains mentioned in the second table were two pelvic bones of a full-grown male, and the ninth dorsal vertebra of a subject not quite mature. As they were all entire, and were the only relics of the human frame found throughout the whole thickness of the beds, Dr. Haast is of opinion that during all the time the shell-fish eaters were in possession of the ground they were either not addicted to cannibalism, or their relations with neighbouring tribes were of so peaceful a character as to afford them no opportunity to indulge in that horrible practice. Looking, however, at the great lapse of time represented by the shell accumulations, and the insecurity of life amongst savage tribes, he believes that had they been cannibals when, at least, the lower shell beds were formed, there would have been some evidence of the fact.

Excepting the Fur Seal (*Arctocephalus lobatus*) as of doubtful identification, the two lists of mammals differ only in the occurrence of the rat in the shell beds, where, however, there were but three of its bones. Its presence was further attested by its teeth-marks on many of the bones, and by its holes passing through the upper beds. A few of the bones had been gnawed by dogs, whence it may perhaps be inferred that the shell-fish eaters had effected its domestication.

Dr. Haast supplements the description of his cavern researches with a brief account of his labours amongst the sand dunes in the adjacent plain. Numerous cooking ovens occurred amongst them, where they were often close together, and, like those in the cavern, appear to have been ultimately filled more or less with the refuse of feasts. A clear line of demarcation was found here also between the deposits of the Moa-hunters and those of the shell-fish feeders, and, except in one instance, where a few pieces of the fresh-water mussel were met with, no shells occurred in the older series of deposits. Judging from the greater number and volume of the kitchen middens found in the small area examined, there can be no doubt that the real camping ground of the Moa-hunters was on the plain, and that they used the cavern occasionally only for shelter or for their meals, and very rarely for cooking. It seems most in accordance with the facts, also, to suppose that the shell-fish eaters lighted fires in the cavern for warmth and light, and that they probably slept there, but that, like their predecessors, they cooked their food outside.

Dr. Haast gives a tabular list of the objects collected in the Moa-hunters' middens amongst the dunes, but it is to a very large extent a repetition of the contemporary cavern list.

Dr. Haast is of opinion that the time represented by the cavern deposits was very great, and, in support of his view, directs attention to the following facts and considerations:—

1. That the mere volume of the shell-beds alone must have a great chronological value, on any hypothesis.

2. That this value is greatly enhanced by the fact of the cavern being but occasionally occupied.

3. That even the occasional visits were probably suspended during a considerable interval after the interment of the Maori.

4. That on the inner or westerly portion of the adjacent plain there is a remarkable number of shell heaps, belonging to the era of the upper series of deposits, which the natives attribute generally to the Waitaha, the first immigrants, who preceded the Ngatimamoe, who in their turn preceded the Ngatikuri, the present inhabitants.

5. That though the cannibalism found in New Zealand when first discovered by Europeans had been practised for at least several centuries, there is an almost entire absence of human bones even in the shell beds, whilst the three solitary specimens of this kind which were met with were so entire and perfect as to negative the idea that the men of even that comparatively modern period were cannibals; and that the same view is borne out by a study of the Moa beds.

6. That as far back as the traditions of the Maoris go, allusion is made in their songs to the Weka (*Ocydromus australis*); yet amongst the hundreds of bones belonging to small birds, not a vestige of the Weka was met with in any of the deposits.

7. That beyond the vast period covered by the shell beds was that interval represented only by the uniform sharp line of demarcation between the two sets of deposits, by the intermediate layer of drift sand, by the disappearance of at least eight species of Moas, and by the strongly marked change in the food of the natives.

8. That since the extinction of the Dinornis and its contemporaries there has been a period sufficiently considerable for the conversion of an area then occupied with large lagoon-like lakes into that part of the Canterbury Plain which is now near the sea, and for the formation of sand dunes of great width upon it.

9. That further back still was the period of the Moa-hunters, to whose deposits, due allowance being made for their somewhat smaller volume, all the considerations applied to the beds above them may be repeated with equal force.

There seems reason to believe that the civilisation of the Moa-hunters was in many respects not inferior to that possessed by the Maoris when first visited by Europeans.

It is obvious that if the entire absence of Moa remains in the shell-beds of the cavern and the adjacent dunes is to be regarded as conclusive on the point, there can be no reason for hesitating to accept the opinion that an enormous amount of time must have elapsed since the extinction of the gigantic birds in at least that portion of the island.

In more recent papers, Dr. Haast expresses the belief that subsequent researches, in other parts of New Zealand, tend to confirm his conclusions.

THE GERMAN EXPEDITION TO SIBERIA[1]

THE travellers left Saissan on May 31, and arrived in Maiterek on June 4, in the company of his excellency the governor-general of West Siberia, General Pottaratzki, whom they met two nights previous to their arrival. Three tarantassas drawn by artillery horses conveyed them from Saissan on to the shores of the black Irtisch. Their way led again through the steppe mostly covered with Dschi, a kind of short, thick grass, with here and there patches of white alkaline soil; but after some time their eyes were refreshed by the appearance of a few trees, their number increased until the country became wooded, and therefore they hoped soon to reach the river. In the evening they saw before them the banks of the stream, swelled by the recent rain into a majestic river, its waters of a yellowish brown colour. For 200 versts into China the stream is navigable for steamers, but up to this time it is not used as a means of communication. Beautiful trees bordered the river, and it was a pleasant change for the travellers, who had seen no trees since the Ala Tau, to find magnificent poplars, asps, and many other trees and bushes. Though the steppe is grand yet it becomes tedious after a while. The travellers continued their journey in a lotka (a sort of boat) belonging to a rich Kirghiz, who is one of the fishers of the Saissan Nor (Saissan Lake). The lotka was propelled by two enormous oars worked in turn by eight Kirghiz or eight Cossacks. The journey down the Irtisch was rendered delightful by the beautiful vegetation near its banks, and the abundance of birds made it a perfect eldorado for the naturalist. They were tempted to stay here, but "heida" (Kirghisian for "on") was the call, which they had to obey. Gradually the strength and width of the river decline as it gets narrowed in by dense masses of reeds. In the evening they reached the settlements of some fishermen, resembling those seen in Norway—here as there frames for drying the fish, here as there the same disagreeable smell, so attractive for the black Milans, of which they shot a specimen of the Indian variety. A quantity of fish was caught, amongst them splendid specimens of a kind of Coregonus, carp, barbel, and sturgeon, the roe of which is prepared as caviare. Towards evening they landed amidst dense reeds.

Early on June 2 an excursion to the neighbouring lake was made. On the banks were a good many persons fishing, and numbers of birds—amongst them the East Indian kind of the bald eagle (*Haliætus leucoryphus*), sitting in pairs on the trunks of dead trees—were animating the shores of the river and the reeds. About half-past seven—sunset—they landed; Kirghiz with camels and horses were awaiting them, and they proceeded on their journey over the most desolate steppe imaginable towards the north. This steppe was very stony and sparsely covered with vegetation; only at the outskirts the crippled brushwood of the Saik-Saul, of a myrtle-like appearance, was to be found; further on nothing but bare gravel; eye-witnesses told the travellers that the appearance of this steppe was quite analogous to that of the desert of Gobi. For seven hours' march there was no water, although in spring this steppe is quite impracticable as the water then flowing down the mountains forms ponds and swamps in the loamy parts. Often they passed the dry beds of such ponds, looking like mosaic by reason of the frequent and regular cracks in the dry mud. Here the spermophilus was met with for the first time, and later on three kulans, the wild solipede of these parts of Asia (more horse than ass), accompanied by a young one. Never were the mirages seen more beautiful than on this steppe, though occurring every day, here were splendid blue lakes with trees on the shores so distinctly that they could fancy them to be real. Several other times Saiga antelopes were seen and kulans, once seven at a time, but none were obtained. At last they came to a depression and found a bad but welcome spring; they rested here for a few hours. On proceeding they had soon to pass through a hilly country covered with slate. This part was interesting for the geologist: granite followed immediately upon slate, then slate and granite, after this quartz, white and grey, and with this a coarse-grained sandstone. On June 4 they reached the outlyers of the Altai; here they saw a numerous fauna and many settlements of the Kirghiz with their cattle. The outlyers consist of granite, crystallised slate and a hornblend porphyry, they are fantastically shaped but quite bare, yet not without some picturesque beauty. The zigzag road led up hill. At last they saw in the distance a lovely valley with green trees, and with the joyous cry of "Maiterek" the Kirghisian guide galloped downward, followed as fast as possible by the others, to a yurt camp, situated in a wood of aspen trees near a murmuring rivulet. This was the place where the governor-general was expected, and at last, accompanied by many Kirghiz, his excellency the governor arrived with a large escort, including ladies. A friendly welcome was exchanged, and

[1] Abstract of the third and fourth letters dated from Maiterek, June 5, and a valley in the Tau Teke Mountains, in the Chinese Altai, June 11, respectively. Continued from p. 515.

after having rested a little while the whole procession moved onward, as fifteen more versts lay still between them and Maiterek.

The travellers proceeded on their journey towards the Altai in the company of the governor-general, his wife, and daughter, on June 6. The weather was most unfavourable from their departure up to their arrival in the Altaian Staniza on June 11, and now they had to undergo all the hardships from which travellers have more or less to suffer. The roads they had to traverse led nearly always along the steep narrow banks of rapid mountain streams, or along the verge of a threatening abyss, or they crossed over vast accumulations of snow filling up the ravines.

On the summit of the pass, about 6,000 feet high, covered with grass as yet undeveloped, was a spendid view of the distant Saik Saur mountains behind Saissan; a pale yellow line extended from these up to the horizon like the ocean, it was the steppe. Beautiful meadows covered with yellow and purple pansies were discernible in the valleys between the plateaus, wooden Kirghisian tombs, somewhat resembling log huts, gave to the whole the appearance of an Alpine landscape. It was strange to see the mole (*spalax*) burrowing at this height, where trees—even the hardy larch tree--had disappeared. One night's rest was spent in a yurt camp near the lake Marka Kul. They approached it along the steep shores of the river Kuldschir, the sole outlet of the lake, and one of the tributaries of the black Irtisch. The view here was delightful, the lake of an azure colour, surrounded on all sides by mountains rising 1,500 feet above its surface, covered with snow, and partly wooded. The banks of the lake are very steep and indented here and there with deep bays. With their nets they secured many fine fishes, which, apart from their scientific interest, were welcomed as a pleasant change to their every day fare of mutton. There is an abundance of fish in the Marka Kul, but it is caught only by the Chinese Kirghiz and the Russian Altaian peasant, and that in a very primitive way. Generally they divert one or other of the small tributaries from its course, and the fish remaining in the dry bed are caught.

In spite of the dangers of the roads, the governor's wife had availed herself of every possible opportunity to photograph the most beautiful parts of the wild mountain scenery about them: this excellent horsewoman rode without fear or giddiness, never dismounting even at the most dangerous places.

The travellers resumed their journey on June 9, but the bad weather still followed them; they passed through large virgin forests, along the borders of abysses nearly 1,000 feet deep; at last they camped on a green meadow facing the Tau Teke Mountains (Steinbock Mountains), so called on account of the numbers of Steinbock found there. Early on June 11 a Steinbock hunt was attempted, thirty Kirghiz on horseback acting as drivers, but they did not get anything. On going on, in about an hour they reached the top of the pass, the Burchat; here they saw two cairns with poles before them, the Chinese frontier poles, and now they left the Celestial Empire and rode on into Siberian territory, slowly descending from the height of about 8,000 ft., where trees cease to grow; the descent soon became steeper and steeper, and at last so rapid that even Cossacks and Kirghiz were obliged to dismount. When they reached the plain they were surprised to see the vegetation, trees, bushes, and flowers, so much richer than at the Ala Tau. Also in this camp the governor was welcomed by a deputation of Kirghiz, and after a short rest they rode on to the Altaian Staniza, a military post.

NOTES

ON the 25th ult. there was unveiled at Copenhagen a bronze statue to H. C. Oersted, the discoverer of electro-magnetism, who died twenty-five years ago. The monument, erected on a terrace of the old fortification, consists of a hexagonal pedestal surmounted by a statue of Oersted, and on which are three female figures representing the Past, the Present, and the Future. Oersted has in his hand the wire of an electric battery which he holds over a magnetic needle. The ceremony of unveiling was attended by the King of Denmark, the King of Greece, the Crown Prince, most of the ministers and diplomatic officials, professors and students of the University, and many other official, learned, and scientific men. The address was spoken by Prof. Holten of the Polytechnic, who sketched the private and scientific life of Oersted, and referred specially to the great discovery, first published in a small Latin pamphlet on July 21, 1821.

IT is fitting that we should record here the death of a modest but devoted student of science, Dr. Thomas Strethill Wright, of Edinburgh, at the age of 58. Dr. Wright was a practising physician in Edinburgh, but found time to make many researches, and probably a few discoveries, in various departments of science, both in biology and physics. From a memoir in the *Scotsman*, we learn that after settling in Edinburgh in 1853, he undertook a series of observations on British zoophytes, more especially those inhabiting the Firth of Forth, and not only discovered many important facts in their structure, but added to the British fauna several new and interesting forms. His memoirs on these animals, eighteen in number, were published in the *Annals of Natural History*, the *Edinburgh Philosophical Journal*, and the *Proceedings of the Royal Physical Society* of Edinburgh, and speedily attracted the attention of scientific workers in the same field both at home and abroad. He entered into a correspondence with Agassiz, Van Beneden, Claparède, Kölliker, and Allman, who in their writings repeatedly refer to the value of his observations and discoveries. But he did not confine himself to natural history studies. He was constantly at work with physical apparatus, and invented various singular forms of telephones, &c. Some of the most curious of his experiments on what he called Electric Cohesion Figures are described by himself in *Chambers's Encyclopædia*. But it is much to be feared that a great many of his most ingenious inventions and discoveries are entirely lost, as his modesty prevented him from bringing them before the Royal Society of Edinburgh, though he was frequently urged to do so. One of these was a mode of studying the scintillation of stars by observing them through a telescope of low power supported on a vibrating stand. In 1865 Dr. Wright was made a member of the Zoologico-Botanical Society of Vienna. His ingenuity and readiness showed themselves in the mode in which he constructed out of simple materials a piece of apparatus, or devised a new method of observation, or executed the beautiful drawings with which his natural history papers are illustrated.

THE Queen has acted justly and generously in granting to the widow of the late George Smith a pension of 150*l*. It is stated that Mr. Hormuzd Rassam will succeed the late Mr. Smith in his work of exploration in the East. A firman for two years has been conceded to Mr. Rassam.

THE Cavendish College, Cambridge, will be opened to-day by the Chancellor of the University, the Duke of Devonshire. The building when complete will be capable of accommodating 300 students. The objects of the college are—1. To enable students somewhat younger than the usual age to go through the University course. 2. To give a special training in the art of teaching to those students who desire to become schoolmasters. 3. To attract poor students by reason of the economy in cost of living. The College charges will be 84*l*. per annum, which will include tuition, University dues, board and lodging—in fact, everything but books and clothes. The residence will be nearly forty weeks during the year.

THE death of M. Lick, the well-known founder of the Californian University and Observatory is reported by an American paper as having taken place on October 1. Some difficulties are anticipated in the adjustment of the donation which amounts to 5,000,000 of dollars.

FOR the intended Liebig memorial the sum of 140,000 marks has been already obtained. Both Munich and the little town of Giessen, where Liebig began his important researches, will have memorials.

THE following changes are proposed to be made in the constitution of the Council of the London Mathematical Society for the ensuing session:—Lord Rayleigh to be president in succession to Prof. H. J. S. Smith, who becomes a vice-president, Mr. C. W. Merrifield to be a vice-president in the room of Dr. Hirst, who becomes an ordinary member of the Council. The two gentlemen who have been selected to take the place of the outgoing members, Dr. Sylvester and Mr. H. M. Taylor, are Messrs. A. B. Kempe and J. J. Walker.

MRS. CRACE CALVERT has given 700*l*. for the foundation of a scholarship of 25*l*. per annum in chemistry, at Owens College, Manchester, in memory of her late husband, Dr. Crace Calvert, F.R.S.

THE vacant Natural Science Scholarship at Exeter College, Oxford, has been awarded to Mr. Joseph Baldwin Nias, commoner, of Exeter College. The scholarship is of the annual value of 80*l*. and tenable for four years during residence.

THE following College Lectures in the Natural Sciences will be given at Cambridge during Michaelmas Term, 1876:—Gonville and Caius College—On the Physiology of Digestion and Absorption, by Dr. Bradbury; On Volumetric Analysis, by Mr. Apjohn. Christ's College—On Vegetable Physiology and Histology, by Mr. Vines. St. John's College—On the Principles of Qualitative Analysis, by Mr. Main; Instruction in Practical Chemistry will also be given; On Petrology, by Mr. Bonney; On Palæontology, by Mr. Bonney. Trinity College—On Electricity, by Mr. Trotter; an Elementary Course of Practical Morphology, by Mr. Balfour; Practical Physiology and Histology, by the Trinity Prælector in Physiology (Dr. Michael Foster), at the New Museums. Sidney Sussex College—Elementary Course of Vegetable Morphology, by Mr. Hicks. Downing College—On Chemistry, by Mr. Lewis; On Comparative Anatomy and Physiology, by Mr. Saunders.

THE soundings taken in the British Channel at the expense of the Submarine Railway Company with the steamer *Ajax*, have been completed. Not less than 3,257 specimens have been collected, and will be classified for the purpose of compiling a chart of the sea-bottom. On the 18th inst. the shaft at Sangatte had reached the depth of 122 metres; the boring, it is expected, will reach its termination, 130 metres, by the end of the month.

A SUM of 1,500,000*l*. has been allotted for the construction of the French Exhibition building of 1878. An artificial waterfall will be arranged at the Trocadero. Water will be pumped out of the Seine by colossal engines which will themselves be an attractive part of the exhibition. The waterfall will be illuminated every evening with coloured and electric lights.

AT the last meeting of the Dresden Society for Incineration, "Urne," it was announced that at the Brussels Exhibition of Hygienic and Life-saving Apparatus, the gold medal was awarded to the Siemens system. It was also announced that for the erection of an incinerating furnace in Saxe-Gotha, preparations for which have already been made, considerable contributions have been received. The agitation on behalf of incineration, it was stated, is making slow but steady progress in other countries.

A NOTIFICATION has been published by the French Government for the benefit of railway travellers, that the second and third-class carriages will be warmed next winter. The companies are at liberty to use any system they think best, but they must all adopt some system.

THE usual autumn *soirée* of the Manchester Field Naturalists' and Archæologists' Society is this year to be held in the Aquarium of that city, and is to comprise an exhibition which promises to be of a unique character. The special subject chosen is "The Mountain Limestone," and it is intended to illustrate every phase in the history of this formation, in an unusually comprehensive and attractive manner. Collectors willing to add to the completeness of the display, which it is intended to open to the general public for some days subsequent to the *soirée*, should communicate with Mr. Faraday, who is the Secretary to the Society, at the Manchester Aquarium.

THE popular impression that fair hair and blue eyes are characteristic features of German people has been confirmed by a recent census, although opinion among anthropologists has been divided on the subject. On a certain day every school in Prussia had to make a return of the black and blue and brown colour of the children's eyes. After a short time the results of this anthropological commission have been published, and they are, at all events, curious, though perhaps not of much scientific value The number of persons examined in Prussia amounted to 4,127,766. Out of that number, 4,070,923 were under fourteen years of age. With regard to the colour of their eyes, 42·97 per cent. had blue, 24·31 per cent. brown eyes. With regard to the colour of the hair, 72 per cent. had blonde, 26 per cent. brown, and 1·21 per cent. black hair. With regard to the colour of the skin, Prussia has only 6·53 per cent. of brunette complexion. In Bavaria the brunette complexion claims 15 per cent., the black hair 5 per cent., the brown hair 41 per cent., the fair hair 54 per cent.; and it is argued from this that the darker complexion in Germany came from the South. The Report contains a number of curious observations; for instance, that nearly one-third of the Jewish school-children are fair, which would certainly not be the impression left upon a casual spectator by the ordinary run of Jewish population.

THE course of lectures at the École Libre of Anthropology, established by the Faculty of Medicine of Paris in one of their buildings, is to be commenced on November 15. The scheme we announced last year is an accomplished fact. The lectures will be open to the public free of charge. M. Paul Broca will deliver lectures on anatomic anthropology; M. Paul Topinard, in biological anthropology, will lecture on the history of anthropology, the general, physical, and physiological characteristics of man, and on anthropometry; M. Eugene Dally, in ethnology, will lecture on the origin and filiation of human races; M. Gabriel de Mortillet, Sub-Director of St. Germain Museum, on prehistoric anthropology; and M. Hovelacque on linguistic anthropology. The lectures will be supplemented by demonstrations in the museums and excursions to prehistoric stations round Paris.

AT a public dinner given by the Anthropological Society of Paris, a proposal of a singular nature, signed by MM. Hovelacque, Dally, Mortillet, Broca, Topinard, and others, was circulated for additional signatures. Each of these gentlemen promises to write a will directing that his brain be sent to the Anthropological Society for inspection and dissection. It is thought that by procuring the thinking organ of persons whose habits and works are perfectly known, some light might be thrown on the laws of physico-mental organisation. The scheme having been published in several Parisian papers, has provoked a furious attack from the *Univers*.

WE have received two valuable *brochures* by P. Kropotkin on the Orography of Eastern Siberia, both being reprints from vol. v. of the "Mem. Russ. Geog. Soc." The first, "General Sketch of the Orography of Eastern Siberia," shows the main conclusions arrived at by the author after many years' study of the orography of Eastern Siberia and of the adjacent parts of Mongolia and Manchooria. He points out that a large table-land runs from the table-lands of Central Asia to Behring's Straits in the shape of an elongated triangle, forming the back bone of this part of the continent, and consisting of two terraces, a higher and a lower, both fringed with border-ridges. Two hilly tracts accompany the table-land on both sides and are composed of many short ridges running parallel to its edges, south-west to north-east; two broad belts of high plains spread out from the foot of the hilly tracts; two belts of lowlands reach respectively the Polar Sea and the Pacific; and, finally, various ridges run in the same north-eastern direction, diversifying the surfaces of the table-lands, of the plains, and especially of the south-eastern lowlands, which are also fringed by a belt of the Pacific coast ridges. These conclusions are supported by many sections, and the broad features of the land are shown on a map representing the different orographical characteristics by special colours. Some hints are also given as to the geological significance of this structure and as to its climatic and biological importance. The rough climate of the upper terrace of the table-land makes agriculture impossible on its surface, which is covered with larix forests and with marshy meadows; the agricultural settlements are, therefore, concentrated, partly on the lower terrace, but especially on the high plains and in broad ramifying valleys which cut deeply into the table-land and radiate to the east and to the south of the Baikal lake. The well-known sharp limits between the different floras, Manchoorian, Daoorian, and Saiask-Altaian, and partly also the limits between the respective faunas, are determined by the extension of different terraces of table-lands and plains, various orographical characteristics corresponding also to special geological districts. The second paper, "Materials for the Orography of Eastern Siberia," is a chapter from a detailed orographical description of Eastern Siberia, undertaken but not finished by the author. It deals mostly with the little-known hilly tracts of the southern parts of the Jenissei province, and is accompanied by a contour-map of the country. Both papers are in Russian.

THE October number of Petermann's *Mittheilungen* contains a map of the Island of Hawaii and its famous volcano, with some data on the subject by Franz Bingham. Another map shows the recent discoveries in Africa of Stanley, Gessi, and Young.

DR. ERWIN VON BARY set out on his scientific expedition from Tripoli in the middle of August, and will by this time have reached Ghât. Dr. von Bary, in the autumn of 1875, made, at his own expense, a preliminary journey in the provinces of Tarhona and Gharian, and obtained some useful practical experience. The chief object of his undertaking is the solution of the important problem of the age and nature of the Sahara; the traveller will also give his attention to the flora of the Hogar Mountain. The Berlin Geographical Society contributes to Dr. von Bary's expenses.

NEWS has reached Stockholm of Dr. Théel's expedition, which had arrived at Dudinskoj on September 11, too late to return to Sweden in the *Ymer* with Prof. Nordenskjöld.

THE well-known African explorer, Gerhard Rohlfs, gave a lecture at Augsburg on the 17th inst., on his journey to Morocco, and his four years' stay in that little-known country. Furnished in Tangiers with recommendations by the English resident, he journeyed under many difficulties and dangers into the interior, as far as the holy city Uesan, and the capital Fez, in which he made a long stay, for without much formality he was appointed general physician to the whole of the Morocco army. In this position, and as physician-in-ordinary to the Emperor himself, and supported by the friendship of the chief Cherif of Uesan, he made investigations in the land and the people, thus opening to the civilised world a comparatively new part of the earth. Rohlfs sketched the land from the coast of the Mediterranean, and the exuberant flora of the coast-lands of the latter sea. He described it as an uninterrupted garden studded with towns and the camps of the Arabs and Berbers, to the wooded snow-mountain of the Atlas; depicted the manners and customs of the people in Morocco, and on the Oases of the Sahara, and in the holy city, Uesan, whose inhabitants claim to be direct descendants of Mohammed. Finally he described his thirty days' journey to Tunis, through the endless desert, broken only by the broad valley of dried up rivers.

THE opening meeting of the French Geographical Society for the session 1876-1877, was held at Paris on October 18, under the presidency of M. Malte-Brun. Admiral Laroncière le Noury delivered an address on the International African Congress at Brussels. Letters were received from a commission who are attempting to establish a central observatory on Mont Pio IX. in the Apennines. They propose to render that establishment the centre of European meteorology, but the scheme is not likely to come to much. They propose to build a metallic chapel and construct a captive balloon for conveying passengers from the foot of the rock to the top. M. Malte-Brun informed the Society of the creation in Brussels of a Belgian Geographical Society. The success of the recent scientific meetings held in that capital is regarded as a sure sign of the speedy success of the new institution.

A REPORT, dated New York, October 4, to the Secretary of the Liverpool Underwriters' Association, states that all the steamers arriving that week report large quantities of ice between lat. 45 and 46·30 N., and long. 49 and 50·30 W. One steamer passed two, one very large, about 200 feet high, "apparently aground;" another steamer passed forty-eight icebergs, and a third passed sixty-eight. It is certainly unusual to see so much ice at this time of the year so far south. We do not know whether the disaster to the Behring Sea whaling fleet can have any connection with this southward drifting of icebergs. Twelve out of fourteen vessels have been destroyed and many men. The cause of the disaster is not stated.

IT will be pleasing to ornithologists to know that there is every probability of the speedy appearance of the long-expected work by Mr. Gätke on the ornithology of Heligoland. The MS. for the German edition is already far advanced, and simultaneously an English one will be produced under the editorship of Mr. Henry Seebohm. It is probable that no more fit person could have been found for the task than the last-named gentleman, who has devoted himself to the study of European ornithology for many years past, and whose spirited energy in the expedition of last year to the Great Petchora, along with Mr. Harvie Brown, has rendered him famous among his brother naturalists. The practical experience gained by him during his journeys in Norway and in various parts of Southern Europe, will doubtless stand him in good stead in the by no means easy task which he has set before himself. At present he is staying in Heligoland, whither he was accompanied on a collecting trip by Mr. Bowdler Sharpe and Mr. Francis Nicholson, of Manchester. We learn from the latter gentlemen, who have returned to England, that in addition to the great interest attaching to the renowned Gätke collection, the short expedition proved a great success ornithologically, over eighty species of birds having been obtained or observed, among them being the rare *Phylloscopus superciliosus*, which was shot by Mr. Seebohm.

IN a letter dated "Labuan, August 17," Governor Usshe says that he has had great difficulty in getting specimens of the beautiful new pheasant recently described by Mr. Sharpe as *Lobiophasis bulweri*. He has twice sent over from Labuan to the mainland of Borneo the trained collector who obtained the original specimen, but hitherto without success. As, however, the birds are plentiful about thirty-five miles inland, he hopes to be able to get some examples very shortly. Bulwer's pheasant seems, in the north-western portion of Borneo, to be confined to the Lawas River, where they are not uncommon, but on the Trusan and Brunei Rivers, which lie close to, the species is quite unknown to the natives, even by name.

THE Liverpool Geological Society held its first annual meeting of the session on the 10th instant, when the retiring president, Mr. T. Mellard Reade, C.E., F.G.S., delivered his annual address. The subject was an interesting one, being a calculation of the amount of solid matter removed annually from the surface of England and Wales in solution, in rain, or rather river water. The result of the calculations, which were of an elaborate nature, founded upon the analysis of water given by the Rivers' Pollution Commission in their Sixth Report, and the rainfall chart prepared by Mr. Symons, showed that it would take 13,000 years to remove, in this manner, one foot in depth of solid matter over the entire surface of England and Wales. This calculation was compared with others prepared by Mr. Reade, of the soluble denudation of the great river basins of Europe, viz., the Danube, the Rhine, and the Rhône. As throwing light upon the age of sedimentary deposits, the calculations taken, together with the amount of matter annually brought down in river water in suspension in the form of mud, are extremely interesting, and Mr. Reade deduced from them that the minimum amount of time which must have elapsed since the first sedimentary rocks we know of were laid down is, in round numbers, 500 millions of years, thus supporting the views of Lyell, Hutton, and other great geologists, as to the immense age of the world.

WE have on our table the following books:—"The River Clyde," by James Deas (J. Maclehose). Piddington's "Sailor's Horn-Book," 6th edition (Fredk. Norgate). "Spiritualism," Prize Essays. "Chemia Coartata; or, the Key to Modern Chemistry," Dr. A. H. Kollmyer (Churchill). Heer's "Primæval World of Switzerland," edited by James Heywood, 2 vols. (Longmans). Oscar Peschel's "Races of Man" (H. S. King and Co.). "Text-book of Veterinary Obstetrics," by George Fleming, Parts I. and II. (Baillière, Tindall, and Cox). "A Study of the Rhætic Strata of the Val de Ledro in the Southern Tyrol," by T. Nelson Dale. Three more volumes of Stanford's "British Manufacturing Industries."

FROM the 18th inst. numerous spots have been observed on the sun, and a large number of protuberances detected round the disc by means of the spectroscope. The observations have been made at Brussels by Monkhoven, and reported daily in the *Independance Belge*.

A NEW and enlarged edition of Hayden's "Dictionary of Dates" is in the press, bringing the book down to this autumn. It is being thoroughly revised and corrected under the hands of Mr. Vincent, of the Royal Institution.

MR. MURRAY will publish during this autumn, "A Life of Thomas Edward, A.L.S., a well-known Scotch Naturalist," by Mr. S. Smiles, author of "Self-Help." The book will contain a portrait etched by Rajon; "The Effects of Cross and Self-Fertilisation in the Vegetable Kingdom," by Charles Darwin, F.R.S., and a new edition of "Kirke's Handbook of Physiology," by Mr. W. M. Baker. In this book many chapters have been rewritten, and about 160 new illustrations added.

WE are glad to find that a second edition of Mr. James Geikie's work, "The Great Ice-Age," has been called for. A considerable number of alterations have been made, and some parts have been almost re-written. Daldy, Isbister and Co. are the publishers.

THE additions to the Zoological Society's Gardens during the past week include a Rhesus Monkey (*Macacus erythræus*) from India, presented by Mr. M. Almond; a Grivet Monkey (*Cercopithecus griseo-viridis*) from North-east Africa, presented by Mr. T. T. Sich; three Palm Squirrels (*Sciurus palmarum*) from India, presented by Mr. Henry Grey; a Collared Peccary (*Dicotyles tajaçu*) from Venezuela, presented by Mr. C. J. Sims; a Greater-spotted Woodpecker (*Picus major*) European, presented by Mr. Henry Laver; a Magpie Tanager (*Cissopis leveriana*) from Brazil, purchased.

SCIENTIFIC SERIALS

Bulletin de l'Académie Impériale des Sciences de St. Pétersbourg, t. xx. Nos. 3 and 4.—From these parts we note the following papers:—On an artificial way of producing snow crystals, by J. Dogiel.—On the appearance of Encke's comet in 1875, with remarks on the existence of a resisting medium in the celestial space, by E. von Asten.—On a remarkable motion observed in a very sensitive level, by H. Romberg.—On the property of the *sphagnum* of marshes, to absorb liquid water and water vapour from the atmosphere, by N. Geleznof.—On the determination of the brightness of fixed stars by means of Zoellner's photometer and gradual elevation, by Ed. Lindemann.—On pentamethylethol and its derivatives, by A. Boutlerow.—Diagnose of new plants of Japan and Mandshuria, by C. J. Maximowicz (tenth part; this treatise is in Latin).—On the mean curvature of planes, by Ferd. Minding.—Some observations on reflex movements, by J. Setchenow.—On three new pinacolines, by A. Wischnegradsky.—On some derivatives from lepidene, by N. Zinin.—On the calculation of the elliptical orbit by means of the two radii vectores r and r', of the angle $2f$ they enclose, and of the time t between the two observations of the planet, by M. Kowalski. —T. xxi. Nos. 1 to 4.—From these parts we note the following papers:—Researches on the rabbit (*Lepus cuniculus*), from a zoo-geographical and palæontological point of view, by J. F. Brandt.—Some observations on the sexual glands of insects, by Dr. A. Brandt.—On dimethylparabanic acid, and on succidcyanic ethers, by N. Mentschutkin.—On the orbit of the double star Σ 1728 = 42 Comæ Ber., by O. Struve.—On the observations of the planets at St. Petersburg, by A. Sawitsch.—Results of measurements made on dolomite, barytes, titan-iron, and zinc blende crystals, by N. Kokscharow.—Researches on blood, by H. Struve.—On some derivatives from lepidene, by N. Zinin.—Analysis of the coal newly discovered at Gelazk, in Imeretia, by Heinr. Struve.—On the remains of extinct rhinoceros found in Russia, by J. F. Brandt.—On a new siphon barometer, by H. Wild.—Some observations made based on the theory of primordial cellular leaves in the vegetable kingdom, by A. Famintzin. —On an anemometer provided with a simple apparatus to measure the force of the wind, by H. Wild.—On the transformation of some hydrocarbons in the ethylene series and the corresponding alcohols, by M. Boutlerow.—On the milky sap of *Cyanchum acutum*, L., by the same.—On diphenylcarbinol and some of its derivatives, by A. Zagumennoy.—Osmotic phenomena produced in vegetable and animal cells by the action of ether, by H. Struve.—On the curves of the smallest perimeter on surfaces of revolution, by Prof. Minding.—Speech delivered at a public meeting of the Academy on December 29 last, in praise of the late Prof. Jacobi, by H. Wild.—On the question whether the Karian sea can be looked upon as an ice-cellar, by K. E. van Baer.—Report on the memoir by M. Wex on the diminution of waters in sources and rivers, by MM. Helmersen and Wild.—Experimental Researches on some functional properties of the smaller brain, by Ph. Owsiannikow and W. Weliky.—Photometric researches concerning the diffused light of the sky, by H. Wild.—On the double star Σ 2120 = Herculis 210, by O. Struve.—On the action of zincethyl on acetaldehyde, by G. Wagner.—Additional remarks by K. E. van Baer, on the memoir on the law of the formation of river beds. —T. xxi., No. 5 contains only a few papers of interest. We note the following:—On the mineral substances containing paraffin in the peninsula of Apcheron, by H. Abich.—On the properties of Leuchtenbergite under the microscope, both in its pure and in its metamorphosed state, by Duke Nikolas, of Leuchtenberg.—Microscopical properties of the Indian green aventurine, by the same.—On the chemical composition of dialurates, by N. Menschutkin.—On the morphology of *Ulothricheæ* (a genus of *Algæ*), by L. Cienkowski.

Revue des Sciences Naturelles, tome v. No. 1.—In this number M. Collot carries out in the plant-kingdom a line of inquiry that has been prosecuted in the animal. He shows that many plants before reaching their final form pass through forms very different from that; these young forms lack special character and show the average and most common conformation of the group to which the plant belongs (Australian Acacias, &c.), or serve to connect the most numerous species of a genus with species which have exceptionally retained in a permanent way the original arrangement (flax). They are more remarkable the greater the differentiation of the adult with reference to neighbouring groups (pines); and the order of appearance of fossil forms in strata is the same as the succession of forms in the same individual.—In a paper on absorption of bicarbonates by plants, M. Barthelemy finds that in natural waters, plants absorb more water than bicarbonate except when rapidly dried or in the flowering season. The quantity of bicarbonate absorbed, for the same absorption of water, varies with the nature of the plant. At night and in water saturated to the same degree, plants excrete a part of the bicarbonates absorbed during the day. The roots of plants give back carbonic acid, which maintains the bicarbonates saturated.—There are also papers on the development of insects, and on development of the embryo of *Nelumbrium speciosum*, and M. Bechamp, in a lengthy paper, attacks the doctrine of evolution.

FROM the *Naturforscher* (August, 1876) we note the following papers:—On the physical condition of Saturn, by L. Trouvelot.—On the spreading of drops of liquids into thin layers, by F. Cintolesi.—On a new fundamental law in electro-dynamics, by Prof. Clausius.—On the natural means of protection of flowers against their animal destroyers, by Herr A. Kerner.—On the action of light upon the electric behaviour of metals in water, by W. Hankel.—On the influence of shape upon the magnetism of soft iron cylinders, by Dr. Christoph Ruths.—On the phenomena of motion and electricity in the leaf of *Dionæa muscipula*, by Herr Hermann Munk.—On the magnetism of cobalt and nickel, by W. Hankel.—Phenomena of interference of light passing through two dimmed planes, by K. Exner.—On allotropic states of gold, by Julius Thomsen.—New inorganic cells, by Ferd. Cohn.—On the influence of gravitation upon the development of adventive roots and shoots, by L. Kny.—On the theory of the optical power of crystals of turning the plane of polarisation of light, by Herr Sohncke.—On the physical nature of the sun, by Herr O. Lohse.—On the diffusion of gases by absorbing substances, by S. von Wroblewski.—On electric light, by Herr E. Goldstein.—Further researches on the peptone-forming ferments in the vegetable kingdom, by E. von Gorup-Besanez and H. Will.—Arrangements for the protection of chlorophyll in living plants, by Julius Wiesner.

Mittheilungen der naturforschenden Gesellschaft in Bern, 1875, Nos. 878-905. From these parts we note the following papers: On the changes of generation in the animal kingdom, by J. Fankhauser.—On some observations of the sources and wells in the district of Bern, during the years 1872-4, by R. Lauterburg.—Topographical sanitary notes on the same district, by Dr. A. Ziegler.—On a multiple telegraphing apparatus, by Herr Rothen.—The greatest part of the publication is taken up by a very elaborate list of the plants growing in the Berner Oberland, by Prof. L. Fischer.

SOCIETIES AND ACADEMIES

PARIS

Academy of Sciences, October 16.—Vice-Admiral Paris in the chair.—The President referred to the sad loss sustained by the Academy in the death of M. Sainte-Claire Deville, and M. Dumas spoke on his life-work. The following papers were read:—Intra-Mercurial planets (continued), by M. Le Verrier.—Exploration of the whole of the coast which forms the gulf of the two Syrtes, by M. Mouchez. The extent of coast surveyed is 200 leagues. The work was difficult, owing to the nature of the land (banks and dunes of sand) and the hostility of the natives. This work fills the gap left by English hydrographers, who had stopped at Sfax, the last town of Tunis, and resumed at Berghazi, on the Egyptian frontier.—Itinerary of the double voyage of M. Nordenskjöld between Norway and Siberia, in 1876, in the *Eymer*, by M. Daubrée. The rapidity of this voyage is striking, twenty-four days from Norway to the mouth of the Jenisei and eighteen days home.—On the relation of the two specific heats of a gas, by M. Simon. *Perfect* gases are those which follow the laws of Mariotte and Gay Lussac. *Simple* and *tetratomic* gases are those whose molecules are formed of four smaller molecules, all alike, which may be treated as atoms (such appear to be hydrogen, oxygen, nitrogen, &c.). In such a gas he imagines the four atoms to occupy the summit of a regular tetrahedron, the side of which is greater than the diameter of any of them, and the interior of this tetrahedron filled with free or condensed ether. Taking account of the rotation of each elementary tetrahedron about its centre of gravity and regarding the vibrations of the atoms as *nil* or insensible, he has found the ratio of the two specific heats exactly $\frac{7}{5}$, or 1·40; while experiment gives values between 1·39 and 1·42. Hence may be inferred that the interior vibrations are really negligible, and in simple gases the physical molecules seem to remain sensibly invariable, so long as no electrical or chemical phenomena are produced.—Note on the presence and origin of Phylloxera in Orleans, by M. Mouillefert. There are facts to show that in advancing towards the northern limit of cultivation of the vine, the phylloxera is less rapid in its action; still the vine is none the less doomed to certain death; it is only a question of time.—Remarks on a recent note of M. Lichtenstein, on the reproduction of phylloxeras, by M. Balbiani.—Study of comparative analyses of several varieties of American stocks, resistant and non-resistant, by M. Boutin. He has found in all American stocks a resinoid principle; it exists also in French stocks, but in quantity a half less than in the resistant American stocks, and a third less than in the non-resistant. He accounts for the resistance by presence of this principle in a proportion not under 8 per cent. in the entire root, and 14 to 15 per cent. in the bark alone. The prick made by the insect, while causing nodosities on the root, is cicatrised by exudation of the resinous product; and this prevents loss of the nutritious juices of the plant. No such cicatrisation occurs in the non-resistant stocks, the resinous matter not being abundant enough. Perhaps the malic acid in the roots of American vines also contributes to their resistance.—Note on the velocity of propagation of waves, by M. Laroche.—On the chiselling action of acids on various metals, by MM. Trève and Durassier. The figures produced are in relation, not with the interior structure, but with the exterior action of bubbles of gas liberated during the reaction of the acids.—Combination of chloral and acetic chloride, by MM. Curié and Millet. Heated to 100° they unite (about half of the two bodies after twelve hours' heating); there is one molecule of each, and the bodies are simply juxtaposed. Subjected to nascent hydrogen, the body loses two atoms of chlorine and gives a new compound, which may be considered acetic chloride united with monochlorised aldehyde.—On a sulpho-antimoniuret of lead found at Arnsberg (Westphalia), by M. Pisani.—Observations on the origin of eruptive, vitreous, and crystalline rocks, by M. Lévy. His experiments are against Meunier's view that crystalline rocks are derived from vitreous rocks by way of devitrification. Most natural crystalline rocks owe their internal texture to *promorphic* phenomena, that is, phenomena anterior to their consolidation; secondary actions are also important, but they rarely quite mask the original texture of a rock.—On the comparative influence of leafy woods and of resinous woods on the temperature and ozonometric state of the air; consequences as regards climate, by M. Fautrat. Woods of both kinds have a refrigerant power, more marked in the resinous. The phenomena of assimilation and transpiration in leaves are accompanied by a fall of temperature. Above pines the maximum temperatures are always higher, and the minimum always lower, than outside; the phenomena lowering temperature on leafy trees are masked in pines, by others producing heat. Under woods, especially the resinous, there is less ozone than on open ground.

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