THURSDAY, JUNE 19, 1884

THE LONDON WATER-SUPPLY

The London Water-Supply; its Past, Present, and Future. By G. Phillips Bevan, F.S.S. With a Map showing the Districts of the Water Companies. (London: E. Stanford, 1884.)

THE London water-supply is so important a question, and at the same time one upon which there prevails so much misapprehension, that the appearance of an impartial, candid, and, in the main, accurate treatise like the one before us must be judged seasonable. A full discussion, indeed, of so many-sided and complicated a subject cannot be expected within the compass of 112 pages. Nor is there, perhaps, any man living who is qualified to give an authoritative deliverance on all the considerations involved, —on the one hand, medical, chemical, and engineering, and on the other hand, financial, legal, ethical, and municipal, if not actually political. These two main branches of the inquiry should be kept substantially distinct. For it is at least conceivable that a water-supply might be found irreproachable in quality and ample in quantity, and yet might be furnished on terms so iniquitous as to call for a sweeping reform. Again, a contaminated water might be dealt out in a manner which at least involved no injustice or oppression.

As a matter of course, we shall discuss Mr. Bevan's pamphlet mainly from the sanitary point of view, though we admit that as a whole it well merits the careful study of the ratepayers of the metropolis.

Our author begins with an account of the ancient supply down to the reign of Charles II. This chaper, like history generally, is mainly a record of errors and oversights. It would seem that whilst as individuals we recommend forethought and prudence, yet as a community we very literally "take no thought for the morrow," and thus drift into positions from which we can escape, if at all, only at great cost.

The second chapter deals with the modern supply. It appears that as far back as 1821-28 there was general dissatisfaction both with "the high-handed and arbitrary character of the rates" and with the quality of the water furnished. One company, we learn, took in its supply from the Thames at the mouth of a main sewer, and served out this liquid to its customers without any process of purification. As a specimen of neglect on the part of Government, we may mention that a Royal Commission was appointed to examine the water-supply as far back as 1828. A Select Committee of the House of Commons was still "considering" the report of the Commissioners just six years afterwards, while the Select Committee of the House of Lords took another six years over the matter, and did not consider it until 1840.

Even in those early days attention was drawn to "the filthy and polluted state of the cisterns and butts into which water is received." This nuisance is a necessary consequence of the intermittent system of water-supply. In addition comes the fact that the cistern is generally placed where it is fully exposed to the sun in summer and to the frost in winter.

We find next a history of the cholera epidemics, their bearing on the water-supply question, and the evidence which they yielded as to the influence of sewage pollution. This influence, as worked out by Mr. Simon, is most striking. Among the population of 166,906 persons supplied with a fairly good water by the Lambeth Company in 1854, the deaths from cholera were at the rate of 37 to 10,000 living. Among the 268,171 persons supplied by the Southwark and Vauxhall Company with a polluted water, the death-rate from cholera was 130 per 10,000. Now, as the two companies at that time competed with each other, their "mains branching within the same area, often running parallel in the same streets," this case was a truly crucial instance. The observations thus made proved to be of no small value. The water companies introduced a variety of improvements. The intakes were removed further from sources of pollution, and more efficient arrangements for filtration were adopted. In 1856 Professors Hofmann and Blyth were able to announce that the organic matter in the water supplied was nearly one-half less than it had been in 1851. It is to be regretted, however, that the lesson was over-learnt, and that fanciful and exaggerated notions concerning "contamination" became fashionable. The dogma—for it is not a demonstrated truth—was put forward that all nitrates present in subsoils and rocks result from the decomposition of animal matter. Hence the presence in a water of such salts was deemed a proof that sewage or kindred matters had at some time gained access to the source in question. To this subject, however, we shall have to return below.

An important step has been the closing of the public wells and pumps in and near London. The water of these wells was not merely found to be grossly polluted, but positive proof was obtained that those who drank it suffered exceptionally from cholera. The popularity of these wells may strike us as remarkable. But we must remember that such water cost the consumer nothing. In addition, as Mr. Bevan points out, "the cisterns of the neighbouring houses were generally foul and the water heated, while the well water came up fresh, cool, and sparkling, from the quantity of carbonic acid contained in it."

Mention is made of the establishment in 1868 of a system of inspection of the water supplied to the metropolis. It is not, however, generally known that all the reports issued prior to the investigations undertaken by Mr. Crookes and by Drs. Odling and Meymott Tidy have been based on the analysis of "a single sample of each company's water, taken on one day only in the course of the month." It is plain that such an examination is not alone "rather of a perfunctory nature," as Mr. Bevan says was the case previous to 1865, but positively misleading. We must agree with Messrs. Crookes, Odling, and Tidy that it is "quite impossible to judge fairly the purity or otherwise of a month's supply by an odd sample taken at random in the manner adopted." Hence we are by no means satisfied that the monthly reports issued by Colonel Sir Francis Bolton are of the "immense practical value" which Mr. Bevan seems to believe.

The third chapter is devoted to the existing water companies—their supplies or feeders, reservoirs, and filter-beds; the statistics of the districts supplied, and, above all, their scale of charges. Into these questions, important as they are, we cannot here enter. We notice merely Mr. Bevan's argument against the compulsory sale of water by meter. He contends that it would "simply result in the greatly decreased use of the water, very much to the detriment of cleanliness and godliness." Surely this hypothetical objection can count for little when weighed against the illogical rating system, which makes a man liable to pay more for his water-supply because his rent and taxes have been raised, *i.e.* because he is poorer! Mr. Bevan, in concluding this chapter, expresses the hope that "either from the operation of purchase, control, or competition, the water question will soon reach a fair and equitable level to both consumer and supplier."

We come now to the main question: Is the existing water-supply satisfactory in quality? and, granting this point, is it not self-evident that, as Mr. Bevan puts it, "it is impossible that the enormous drain upon the Thames can be kept up without its showing signs of exhaustion." The existing supply must, therefore, be supplemented by some new source. Now, in spite of the alarmist speeches, papers, and letters, some of them by authorities of eminence, we still hold that the waters of the Thames and the Lea are not contaminated in such a manner as to render their use inadmissible. It is perfectly true that the country along the Thames and its tributaries above the points where the water companies take in their supplies is inhabited by a large population, whose drainage, not always purified, finds its way ultimately into the river. Now, the late Royal Rivers Pollution Commission, upon what to us seems very scanty evidence, committed itself to the dogma that, "if a river was once polluted with sewage matter, the water of that river was for ever unfit for dietetic purposes, and no practical distance of flow would render such a river safe."

On the other hand, the Royal Commission on Water-Supply (1869) declare in their report (§ 180) that "the organic compounds dissolved in water appear to be of very unstable constitution and to be very easily decomposed, the great agent in their decomposition being oxygen, and the process being considerably hastened by the motion of the water. This purifying process is not a mere theoretical speculation; we have abundant practical evidence of its real action on the Thames and other rivers."

Further (§ 193), "These analyses of Thames waters made for the Commission (by Drs. Frankland and Odling jointly) are sufficient to show, not only the absence of any increase of objectionable matter in the river from Lechlade to Hampton, but that the variations in quality which commence at Lechlade, after showing several temporary changes in many parts of the river's course, fall at Hampton in general to a point as low as at Lechlade (110 miles up stream), and in one respect, viz., the organic nitrogen, *to a point even lower.*"

One more extract may be permitted (§ 214): "Having carefully considered all the information we have been able to collect, we see no evidence to lead us to believe that the water now supplied by the companies is not generally good and wholesome."

It may be urged that these conclusions being based upon evidence obtained in 1869 may not be strictly applicable at the present day. To this the reply is very simple: the results obtained by Messrs. Crookes, Odling, and Tidy in 1881 and subsequently "are in complete agreement with those of the Commission on Water-Supply." Further, certain improvements have since been effected which must lessen the contamination of the Thames above Hampton. We need merely refer in passing to the corroboration which the views of the Water Supply Commission have received from the recent analyses and observations of Dr. F. Hulwa on the Oder at Breslau, of Prof. Leeds on the Brandywine and Passiac Rivers at Paterson, Jersey City, and Newark, or of Delalande on the Vesle at Rheims. All these chemists agree that, since rivers have a self-purifying power, this power, if not interfered with by the continuous introduction of pollution along their course, restores them, not indeed to absolute purity, but to a condition fit for all practical purposes. The public are apt to forget that pure water is a mere abstraction, like the lines and points of the mathematician. It has no existence in nature, and were it procurable might prove ill-adapted for domestic and dietetic purposes.

Taking all that has been said into consideration, we think that all judicious men will be slow to abandon the present supplies of water. There is one especial reason against such a change, which, though not of a sanitary nature, cannot in these days be left out of sight. In such a vital matter London must not make itself dependent upon any one source. Let us for a moment suppose that the alarmist succeeds in prevailing upon us to abandon the Thames, the Lea, and the other gathering-grounds in the neighbourhood of London, and that our entire supply is conveyed from Wales or Cumberland by a gigantic aqueduct. Would it be possible to guard all points of such a line, so as to be safe against the outrages which seem now the order of the day? A quantity of nitro-glycerine, which a man might carry in a carpet-bag without exciting suspicion, would suffice, if skilfully applied, to cause a breach in some part of the structure. And then? How long it might take to make good such a rupture we cannot estimate. In a railway accident, materials, tools, and workmen can be run along the line to the spot where they are required. An aqueduct would present no such facilities. It may be said that a reservoir might be constructed at the London end of the line of sufficient size to tide us over such a possible calamity, but the size and strength of such a store-tank would have to be enormous, and this in itself would present another element of danger.

But whilst it might thus be perilous to supersede the present supply, an addition to our resources will ultimately become needful. Of course, with Mr. Bevan, we can only hope that the additional supply will be the best procurable. But the author here reminds us that, "however pure may be the water at the outset, no power on earth can prevent careless, wilful, or accidental pollution in some part of its long course." In fact, experience tells us that no water-course, exposed to the air for any distance, will contain less than about 0·06 to 0·07 parts of "albuminoid ammonia" per million. The excellent waters of Manchester and Glasgow—the former collected on the barren and unpeopled moorlands of North Derbyshire, and the latter drawn from Loch Katrine—contain this proportion, and the New River water shows no more! It is, therefore, quite an open question what we should gain by going so far afield.

There is another very grave consideration: the soft waters with which not a few towns in the North of England are supplied, act upon the leaden service-pipes to such an extent as to become dangerous. It may even be questioned whether an occasional epidemic of fever is not a smaller evil than the continued occurrence of lead-poisoning. The use of iron service-pipes, or of lead thickly lined with tin, is troublesome and expensive. Perhaps sooner or later some unobjectionable material may be found to take the place of lead in the manufacture of water-piping.

A well-known authority on water analysis reminds us that waters from the mountains of Wales, Cumberland, &c., may possibly hold lead and copper in solution, and one has been found to contain appreciable quantities of arsenic. Great care would therefore be necessary in the selection of a supply from such districts.

The hardness of the New River water, of that furnished by the Kent Company, and indeed of the London water-supply in general, has often been complained of, and the softness of the northern waters has been urged in their favour. It is, however, by no means certain that from a sanitary point of view a soft water deserves the preference. Many medical authorities contend that a water of moderate hardness is preferable, for dietetic consumption, to such waters as are supplied to Huddersfield, Leeds, Manchester, &c. It is urged, not without a show of probability, that a supply of calcareous salts in drinking-water is especially advantageous in the formation of the bones of young children. Dr. C. Cameron of Dublin, however, maintains that there has been an improvement in the public health of Dublin since the soft water of the Vartry was substituted for the hard water with which that city was formerly supplied. Further inquiry, therefore, is necessary in this direction. It seems to us, however, that there is hardness and hardness. The hardness of water may be due to lime salts or to magnesian compounds. For the latter there is comparatively little need in the human system, and their regular ingestion is found unfavourable to health. But to condemn any water as prejudicial merely on the ground of hardness seems to us rash in the extreme, in view of the high standard of health existing in districts where hard waters only are available.

It has been proposed to increase the London supply by means of a system of artesian wells. Unfortunately, though a single such well may yield a large and continuous supply of water, this quantity cannot be multiplied by sinking similar wells in the neighbourhood, as has been found in the case of the celebrated well of Grenelle. Among the many schemes enumerated by Mr. Bevan, there is one prominent in its singularity. Shafts were to be sunk down to the chalk on each side of the Thames every quarter of a mile. Each such shaft was to have a canal communication with the river between high and low water mark, through which these shafts were to be filled with water. At some distance from each descending shaft another was to be sunk, into which the filtered water would flow as in an inverted siphon, until it rose to the level of the river. The water of deep wells is in general remarkable for its freedom from organic pollution. But this purity probably depends on the slowness of the filtration by which they are supplied.

Our author, after giving the details of a great number of projects, comes to no decided conclusion. He remarks that one of them will ultimately be adopted for the very good reason that a change of some kind will eventually be necessary. But he judiciously adds, "It need not be looked upon as in any way superseding the arrangements of the present supply."

FLOWERS AND THEIR PEDIGREES

Flowers and their Pedigrees. By Grant Allen. (London: Longmans, Green, and Co., 1883.)

THIS book consists of eight short essays on the evolution and distribution of plants which originally appeared as articles in several of the London magazines, supplemented with an introductory chapter. Two of these essays treat of the reasons for the presence of certain plants in our insular flora, as illustrated by the Hairy Spurge (*Euphorbia pilosa*, L.) and the Mountain Tulip (*Lloydia serotina*, Rchb.). The remainder discuss the evolution of certain types of plants, the examples taken being the daisy, strawberries, cleavers, wheat, the family of Rosaceæ, and the cuckoo-pint. The articles are written in the author's well-known pleasant style, and cannot fail to attract and interest many who have never previously turned their attention to the study of our common weeds.

Mr. Grant Allen has a great horror of a "microscopical critic," which he defines as "a learned and tedious person who goes about the world proclaiming to everybody that you don't know something because you don't happen to mention it." After reading this book, however, one feels tempted to reassure him on this head. For the work contains a considerable number of things which we may venture to state nobody ever knew before. Take, for instance, the text of the fifth essay, that on the origin of wheat: "Wheat ranks by descent as a degenerate and degraded lily"; and again, "While the daisy has gone constantly up and while the goose-grass has fallen but a little after a long course of upward development, the grasses generally have from the very first exhibited a constant and unbroken structural decline." This, we think, will be an entirely new view to the botanical morphologist. On these lines he proceeds to trace the evolution of the wheat-plant, from an imaginary primitive Monocotyledon, and suggests that *Alisma ranunculoides* might represent the earliest petal-bearing type in this line of development, except for the fact that its petals are pinky-white instead of yellow! From this plant he traces the descent of the wind-fertilised rushes, the stamens of which he states hang out pensile to the breeze on long slender filaments. This is certainly not the case: the filaments of the rushes are short and rather broad, and the anthers are usually fixed by the base, and not at all more adapted for wind-fertilisation than those of such a plant as the bog-asphodel, which is regularly fertilised by insects.

From the rushes both the sedges and grasses are derived, but on different diverging lines. The former class of plants Mr. Grant Allen considers to be very degenerate in type, the calyx and petals, which were brightly coloured in the lilies, being reduced to the six small dry bristles which we find in some species of Scirpus. He does not explain, however, how it is that some Cyperaceous plants possess seven or eight of these bristles. But the most extraordinary suggestion is that the female flower of a Carex is represented by "a single ovary inclosed in a loose bag, which may perhaps be the final rudiment of a tubular bell-shaped corolla like that of a hyacinth"! Surely the nature of the utricle of a Carex has been clearly enough demonstrated by the structure of the flowers of monstrous specimens and of allied genera. To complete his remarks upon the sedges he adds a footnote, in which he says: "The sedges are not in all probability a real natural family, but are a group of heterogeneous degraded lilies, containing almost all those kinds in which the reduced florets are covered by a single conspicuous glume-like bract." Now there is probably hardly any large order in the vegetable kingdom so natural as that of the Cyperaceæ, so little connected with any other, and of which the genera are so closely allied together, as is proved by the comparatively small number of genera in it, and the large number of species which many of the genera contain.

The wheat plant being a degraded lily, it becomes necessary to trace the development of the flower of the one into that of the other, which is done by considering the palea of the wheat-flower as homologous with the calyx, and the lodicules as representing the corolla, a view which has long been considered untenable.

The two essays upon the distribution of plants call for some comment. Here the author is on firmer ground, for, thanks to the researches of Forbes and Watson, we have a much clearer notion of the origin of our flora than we can have of the pedigrees of the plants themselves. At the same time we must take exception to the suggestion that the seeds of the northern Holy Grass, which Robert Dick discovered in Caithness, were introduced into New Zealand from Siberia upon the feet of a belated bird. The plant in question does not occur, as far as is known, in New Zealand. The species which does occur both in New Zealand and Europe is found throughout the temperate Antarctic zone, extending even to the Cape. Nor is this distribution, as the author states, a very rare and almost unparalleled coincidence. The fact is that there is a very considerable number of plants common to the north and south temperate regions, most of which occur in North America, and seem to have descended towards the Antarctic regions along the line of the Andes.

But, apart from improbabilities in theory, there are numerous statements which cannot fail to convey erroneous impressions of plant-physiology. What, for instance, could be more misleading than the following statement concerning Potentillas? Those "which raised their leaves highest would best survive, while those which trailed or kept closely along the ground *would soon be starved out for want of carbonic acid!*" It is not the absence of carbonic acid gas that the plant would suffer from, but from the loss of light by which it could utilise it. These statements, and many others of a similar nature, suggest that Mr. Grant Allen has confined his observations too much to the flora of the British Islands. It is utterly impossible to form any correct idea of the history of the evolution of a plant without knowing thoroughly the structure of all the plants in any way related to it, and without having, moreover, a much clearer knowledge of the effects produced by external circumstances in modifying organs than we at present possess. In the meantime dogmatic statements concerning the evolution of any given plant are in the highest degree unsatisfactory, and likely to lead to error.

The book is nicely got up, and the language is in that easy and fluent style in which Mr. Allen is so proficient, and which goes so far towards investing the driest details of science with a poetical and even romantic interest.

H. N. R.

OUR BOOK SHELF

Wonders of Plant-Life. By Sophie Bledsoe Herrick. (London: W. H. Allen and Co., 1884.)

THIS is another well-intentioned but unsuccessful attempt to deal in a popular style with some of the more sensational parts of the science of botany. Inaccuracy is again the glaring fault: thus we read on p. 4 that "vegetable cells, in the earlier stages of development, generally approximate to the sphere in form"; on p. 17 that the vessels "serve to convey air through the tissues of the plant," and "are the lungs of the plant"; and again, on p. 24, that the red and ultra-red rays are those actively concerned in the process of assimilation. Similar inaccuracy may be traced in those of the illustrations which are original; for example, the drawing of Penicillium on p. 60. The frequent production of popular treatises shows that there must be some demand for such books. It is much to be desired that some botanist who is really master of his subject would take the matter up, and write in a popular style a trustworthy account of those parts of the science of botany which are of especial interest to the general public.

Histological Notes for the Use of Medical Students. By W. Horscraft Waters, M.A. (London: Smith, Elder, and Co., 1884.)

IN the introduction to this little work of 65 pages Mr. Waters states that, in taking the class of Practical Histology at the Owens College Medical School during the summer sessions of 1882-83, it had been his custom to give each student "sheets" containing a short account of the chief points to be observed in the specimens for examination. The present work has grown out of these notes, after careful revision and additions thereto by the author. Students of histology have already numerous similar treatises placed at their disposition, describing the various methods of staining, clearing, and mounting specimens; but room will always be found for additional ones bearing on this subject, provided they are the outcome of practical experience. These notes have been carefully prepared; the directions given are clear and concise, and beginners cannot do better than carefully follow them.

LETTERS TO THE EDITOR

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

Pile-Dwellings on Hill-tops

I OBSERVE this question to the fore in NATURE of February 21 (p. 382), and as I have lived many years among races who build various forms of pile-houses, and have often resided in them for a time, I trust you can allow me a few words on the subject. The custom seems attributed to several causes, *i.e.* to excessive moisture and as a protection against wild beasts, by Mr. Keane; to excessive rain and a wet climate, by Col. Godwin-Austen; to damp exhalations from tropical soil, by Mr. Dallas; and to the survival of a purposeful habit of building over water, by Mr. Tylor.

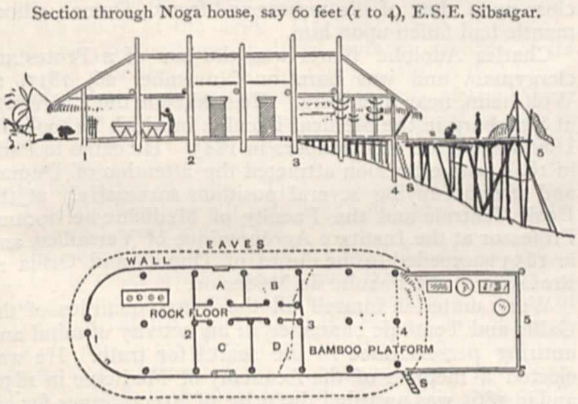
A considerable experience among Nogas, Miris, Singphus, Kamtis, Deodhains, and Duonias, who all build pile-houses a little varied in kind, convinces me that the above reasons are not strictly correct.

Possibly the Swiss lake-dwellers descended from Eastern races who built over water, and inherited a custom that perhaps subsequently proved to be beneficial to them when and where large Carnivora were common. As regards India, it seems to me there are good reasons for believing these pile-builders are the direct descendants of the pre-Aryan aboriginals, and if they brought the custom with them from the south, it must be of extreme antiquity, and have developed adaptations to local needs, as it is not here used over water.

It seems hardly due to moisture and tropical rains, as the Kasias, Augamis, and Garos, who live in the wettest climate of all, build on the ground. Again, among those who build on piles many live and sleep on the ground, using the piled part of the house for other purposes. The platforms also are generally too low to afford safety from tigers, and if so needful for health, why is the custom not more general?

Among the Miris, Singphus, Kamtis, Nogas, Mismis, and Deodhains that I have questioned as to the origin of the custom of building on piles, the answer is invariably that they do not know, that it is their tribal custom, &c. Pressed as to the advantages of it, or why they could not build on the ground like Hindus, they generally end by urging the absolute necessity of keeping things out of reach of the ever-present pig.

Section through Noga house, say 60 feet (1 to 4), E.S.E. Sibsagar.



1 to 2, Rice husking; 2 to 3, Sleeping, cooking; 3 to 4, Audience, &c.; 5, "Chang" outside; S, Steps up; A B C D, Sleeping-rooms.

Among many of these tribes, where stone for walls is not easily procurable, the jums even have to be at some distance *for the same reason.*

As an illustration of how this animal practically affects the question of house-building, I append a section of a typical average Noga house, as built by the tribes south-east of Sibsagar to the Upper Dihing. One end generally rests on the ground, while the other overhangs a slope for which there often seems to be no occasion, as plenty of level land is about. In all houses of this type the end devoted to husking rice rests on the ground, and the door at that end has a slab that can be raised to admit pigs to eat the husks. This compartment (one-third of the house) is divided from the living and sleeping part by a wall and a door with a stile to keep out pigs. There are generally from two to six, or more, sleeping-rooms on the ground, and beyond them again is an open room used for visitors, or to sit and work in during wet weather. It is hung round with horns and trophies, contains hunting and fishing gear, arms and utensils, and small stores. It is the recognised audience-hall, and built on piles; the floor of it is generally carried out beyond the eaves of the roof, often supported on long bamboos (where the slope is steep), and this outer part or raised floor is seen in some shape or other in all these houses. It is used to sit out on in fine weather, to work on; rice, yams, sliced vegetables, fruit, fish, flesh, &c., are put there to dry; pottery is made, and things laid while they are gone to the jums, safe from the prowling pig. From one end of the house to the other, indeed, these prolific scavengers are apparent as an institution.

As a rule these pile-houses run from thirty to two hundred feet long, and are wholly on piles if in the level plains, but the several tribes have slight modifications. They are still built by the Deodhains, a remnant of the Shans who came into Assam in 1228, and gave it their name (from Ahom); about five hundred of these people still remain in some six or eight villages not far off, though dying out. Their language and written character possibly is a unique case of a written language not yet secured. While they remain Ahoms they keep and eat the pig and build on piles, but when converted to Hinduism the pig and piles are given up together.

I am aware that pigs are kept by Kasias and Garos, &c., who yet do not build on piles, but stone for walls and slabs of gneiss are there *alone* common, and are effectually used as inclosures or as barriers. There is practically no building-stone where we see the piles in use; and also bamboo is there common.

But there are many other things besides pile-dwellings that prove these now distinct tribes to have descended from a common stock. The "morongs," or houses in which the lads and single men sleep at night, away from their parents' houses, are seen under various names all through these hills, north, south, and east of Assam, a custom that has survived the differentiation of the languages. There are also "morongs" for the girls and single young women, and there are special and peculiar laws relating to morongs.

Liberty of the sexes before marriage is indeed practically so complete among all these tribes that really *morals begin with marriage.* After marriage they are better, I think, than civilised nations.

These customs and pile-buildings, &c., indicate a common origin, but there are also means by which we can ascertain the common *home* more or less accurately, and which show that these pile-builders are descended from the pre-Aryans of the plains, from Assam to the Indus, who named so many of the rivers. In and around Assam we find these names often begin and end with Di and Ti—as Dihing, Dihong, Dibong, Dibru, Dima, Dipha; Timu, Tiok, Tisa, Tiru, Tiwa, Tista, or Aiti, Galti, Seti, Tapti, Rapti, Kamti, Gulmthi, Ningthi, Lathi, &c. This Di, Ti, means in all cases "water,"—as Ti, water; Sa, the little, young = Tisa, the "young river"; and there are other forms—as Lushai Tui, Kachari Doi, Noga Ti, Tsi, Tzu; Chu is also Thibetan, Bhotan, and Chinee; Mongolian being Su, Ussu.

But the Himalaya has acted as a conspicuous speech-parting. South of it we have the pile-builders' form—Di, Ti, Doi, Da, Dzu; and north of it, from the east of China, all across Central Asia, Persia, and Asia Minor, to the Gulf of Salonica even, we have the northern Chu and Su in some form. Of Kara Su = black water, and Ak Su = white water (our Oxus) there are scores of instances; even the "Ind-us" and Eu-phrat-es, and many others, fall into the group.[1]

I drew up lists of these river-names some years ago in the *Journal A. S. Bengal*, vol. xlviii. part 1, 1879, pp. 258–70.

Thus it would seem as though the races who now build these pile-houses, often on hill-tops, are the descendants of those who named so many of the Indian rivers south of the Himalaya, *i.e.* the pre-Aryan inhabitants.

Whether these races originally came from the south or not we cannot yet be certain. But there are several customs, such as "head-hunting" and "pile-dwelling," held in common with races of the Archipelago; and among the most eastern Nogas the dress is as nearly as possible *identical* with that of the Dyaks, as illustrated in Dr. E. B. Tylor's "Anthropology," so that eventually it may be possible to say.

In conclusion, I might mention that the word "Naga," as applied to the tribes south and south-east of Assam, is an Anglo-Bengali-ism, and misleading. It should be Noga, which is the name by which these tribes are known in Assam. It is not a racial name in the hills at all, and has originated from the Noga word "Nok" for folk.

Thus, Who are you? is "tem nok?" or "o nok e?" N and L are interchangeable letters, and thus Dr. Rajendralala, Mitr, pointed out to me that the Noga Nok and the Sanskrit Lok = man, seem the same word. We use the word Log = folk (logue) almost hourly in Assamese, Bengali, and Hindi, and philologists may perhaps be able to say if we get our word folk from this same root, and for which it is the exact equivalent. But the word for these hill-men is "Noga," and they do *not* worship snakes. The real Nagas are in another part of

[1] The Assyrian hu, Greek eu, Scythian ku = water (A. Cunningham "Anct. Geo.," p. 37).

India, and I trust Dr. Hunter and Mr. Phil Robinson will excuse my saying they are both wrong *re* this name.

These hill-men have histories, if we could only get at them. This I find by having traced forty-six villages (now nine or ten different clans) as being offshoots of "Sang-nu," east-south-east of Sibsagar. Twenty-five generations ago they began to spread. S. E. PEAL

Sibsagar, Assam, May 5

Atmospheric Dust

ON Thursday, April 24, showers of discoloured rain fell at Inglewood, Sandhurst, Castlemaine, Kyneton, Daylesford, and the districts adjacent, that is to say, over an area of more than 2,500 square miles in extent. The heaviest showers—called by all who were out in them "showers of mud"—occurred at 7 o'clock p.m. and near midnight. The leaves of trees and shrubs, roofs of buildings, fences, and everything on which it could rest were more or less covered with red mud. The weather at Sandhurst for some ten days prior to this occurrence had been dry, and for a long period there had been a drought in New South Wales and in many parts northward. At several places in Victoria and New South Wales violent dust-storms occurred on the morning of the 24th immediately preceding the commencement of the rain. Some of the mud, of a bronze colour, collected by Mr. Edward Hurst of Sandhurst, was found by microscopical and chemical examination to be composed of quartz, oxide of iron, and mica; some taken from the rain-gauge stand at the School of Mines was, when dried, an almost impalpable powder of a pale reddish chocolate colour. It was seen to consist of ferruginous quartz and minute particles of black oxide of iron; and a smaller quantity collected at my private meteorological observatory—about three-quarters of a mile distant—was paler in colour, and consisted of quartz (much of it iron-free), alumina, sesquioxide of iron, and white and reddish-yellow mica. A small proportion of it was attractable by the magnet. The water collected in the rain-gauges when agitated was reddish-brown in colour, and the proportion of sediment was very large, leaving no room for doubt that the dust was brought down by the rain. Its composition and the times at which it fell lead me to believe that it came from the north and had travelled far.

R. BROUGH SMYTH

School of Mines, Sandhurst, Victoria, Australia, May 1

The "Red Glow" after Sunset

BEING out on Sandymount Strand last night, whence the western sky may be well observed, I noticed, about 8.45 p.m., the "red glow" over the yellowish sky where the sun had set. It was quite as distinct as during certain evenings at the end of last year. J. P. O'REILLY

Royal College of Science for Ireland, Stephen's Green, Dublin, June 12

The Earthquake

AS communications on this subject are still being received by NATURE, and as the records for London and its immediate vicinity have been few, it occurs to me to note the following facts:—At the time of the earthquake I was sitting in my study here. There are several heavy insect-cabinets in the room, and a loud "groan" proceeded from one or more of them, indicating "settling" from some cause or other. Furthermore, the door of the room would not lock on the evening of that day, although the lock had moved freely down to then. And a clock in a bed-room was found to have stopped without any apparent cause at the hour indicated for the earthquake; but as the discovery was not made until late in the evening, it was not possible to decide whether the stoppage had occurred in the morning or evening. As no sensation was *felt*, these matters would have held no significance had it not been for the news in the evening papers of that day. R. MCLACHLAN

Clarendon Road, Lewisham, S.E., June 13

Intelligence in Animals

THERE is at Walham Green a daily illustration of intelligence in a donkey which may interest those of your readers who collect such facts. Old Bob the waterman has been known for so many years that it is impossible to say how many. He is one of the few surviving carriers who take round for sale water in a tub on wheels, which is drawn by a donkey. Bob, the tub, and the donkey are one of the institutions of Walham Green. Years ago Bob used to guide his donkey to the pump near the church and then drive him round to his customers. How long the donkey was learning his rounds I do not know. Three years ago Bob used one shaft as a sort of movable crutch, and seemed to trust much to his donkey to go the right way. Now he appears quite blind, for a few days ago he was noticed going into the yard where the pump stands, when the donkey stopped. He asked a boy what his donkey had stopped for, and was told that a cart was in the way. It is interesting to note that the donkey conducts by his own intelligence all the business of water distributor, while Bob has sunk to the condition of mere pumper and of money collector attached to and led by the shafts, which latter duty might be done by an intelligent dog. M.

ADOLPHE WURTZ AND HIS CHEMICAL WORK

BY the death of Adolphe Wurtz on May 12 last, the world, and especially the scientific world, has lost one of its brightest and most energetic leaders,—a successful leader indeed, through perhaps the most difficult period of chemical history—the earliest years of the development of our "modern chemistry." His loss is felt all the more acutely, coming as it does so suddenly and so close upon that of his master and friend, Dumas, whose mantle had fallen upon him.

Charles Adolphe Wurtz was the son of a Protestant clergyman, and was born on November 26, 1817, at Wolfsheim, near Strasburg. He studied in the University of Strasburg in the Medical Faculty, in which he took the Doctor's degree with honours in 1843. He came to Paris in 1844, where he soon attracted the attention of Dumas, and after occupying several positions successively at the École Centrale and the Faculty of Medicine he became Professor at the Institute Agronomique of Versailles, and in 1853 succeeded to the duties of Dumas and Orfila as Professor at the Faculté de Médecine.

Wurtz united in himself all the better qualities of the Gallic and Teutonic character, in his activity of mind and untiring perseverance in the search for truth. He was elected a member of the Academy of Medicine in 1856, and in 1865 was awarded the prize of 20,000 francs for his chemical researches. He became Dean of the Faculty in 1866, and Professor at the Sorbonne in 1878, in which year also he gave the Faraday Lecture at the Royal Institution; the subject of which was the condensation of gases, and his hearers on that occasion will not readily lose the impression of his earnestness and vivacity, especially on the appearance of the liquefied gas (ammonia), and his exclamation, "Voilà ! voilà le liquide," &c.

His earnestness of purpose, conjoined with a most genial manner and expression, gave him very great influence over those students who worked with him; and a long list of names might be given of students who have done good service to the science under his guidance and encouragement.

But he not only encouraged the students who came to learn under him, but strove to spread a knowledge of science amongst the mass of the public, in which task he was eminently successful.

In addition to his onerous duties as professor, Wurtz was in 1881 elected permanent Senator, and rendered most valuable services to his country as recorded in his Reports of Commissions on the trichinosis outbreak and on scientific education.

While there are chemists the work and example of Adolphe Wurtz will serve as a beacon and guiding light to still wider and more important facts in our science.

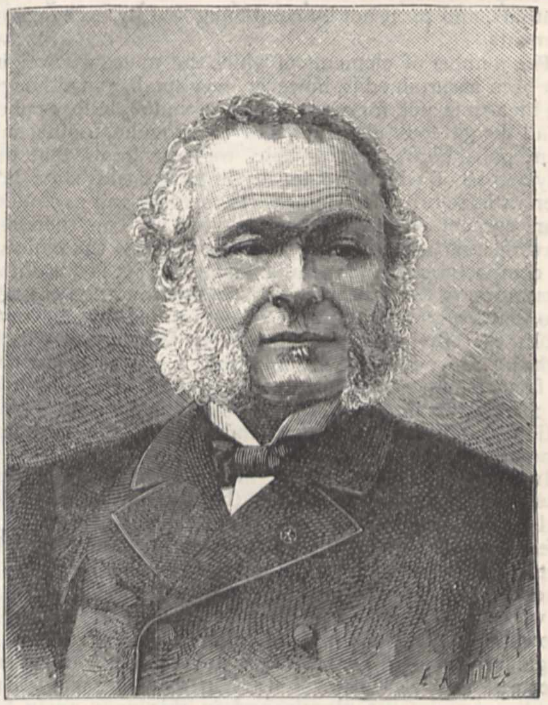
The Royal Society's Catalogue of Scientific Papers contains a list of no fewer than one hundred and four papers to which the name "Adolphe Wurtz" is alone attached; of these a large proportion recite particulars of researches which have furnished results of high theoretical importance, and which entitle their author to be reckoned as one of the chief contributors to the foundation of systematic chemistry. In him French chemists lose their chief leader; but their loss is also that of the scientific world at large. His logical clearness of thought, his breadth of view, and the precision of his statements secured Wurtz an influence wherever chemistry was taught; and at the present time, overwhelmed as we are in the chaos of facts brought to light with such astounding rapidity by the labours of chemists in all parts of the world, the loss of such a master-mind, of a man possessed in so high a degree of the power of coordination, is indeed grievous. His "Introduction to Chemical Philosophy," his "History of Chemical Theory," and his "Atomic Theory," of all of which English translations have been published, afford striking illustrations of the character of his teaching, and are unsurpassed as introductions to the study of the historical development of our science.

Wurtz's first paper, published in 1842, was "On the Constitution of the Hypophosphites," and, together with another on the same subject put forward a year or so later, forms not the least important of his contributions. Hypophosphorous acid had been discovered by Dulong and afterwards examined by Heinrich Rose, but their results were not in accordance; Wurtz therefore undertook the study of the acid. He established its composition and prepared and analysed a large number of its salts, and was thereby led to the conclusion that hypophosphorous acid contained two atoms of hydrogen which could not be displaced by metals, being, in fact, a monobasic acid; he also showed that of the three atoms of hydrogen in phosphorous acid only two were displaced in the formation of salts. This research was carried out in Dumas' laboratory; it may even now serve as a model of what such work should be.

In the course of his study of the hypophosphites, Wurtz was led to make what probably was his most interesting, although not his most important, discovery: that of copper hydride, Cu_2H_2. Even at the present day, although we have reason to believe that the alkali metals and palladium and platinum form compounds with hydrogen, copper hydride is the only hydride of a metal with which we are acquainted which has anything like definite and specific properties. It is obtained by acting on copper sulphate with hypophosphorous acid as a yellow or reddish-brown precipitate, which when heated readily decomposes into hydrogen and copper, and on treatment with muriatic acid yields cuprous chloride and twice the volume of hydrogen which is obtained on merely heating it. This reaction, as Brodie first pointed out, affords an almost conclusive argument for assuming that the hydrogen molecule is compound in its nature. Berthelot having called in question the existence of cuprous hydride, Wurtz in 1880 maintained the correctness of his original statements. It is to be hoped that this remarkable compound will ere long again attract attention, as it is more than probable that it will be of service as a reducing agent; its thermo-chemical investigation may be expected to furnish important information on the affinity of hydrogen atoms for hydrogen atoms: indeed it is remarkable that it has so long escaped attention from this point of view.

Wurtz paid much attention to the investigation of the cyanogen compounds, and in studying the cyanic ethers was led in 1847-49 to make the most brilliant of his discoveries, that of the compound ammonias. These bodies were obtained by the action of alkali on cyanic ethers, just as ammonia is formed from cyanic acid. In properties they were the precise analogues of ammonia, and on this account, and on account of the manner in which they were produced, Wurtz at once regarded them as ammonias in which an atom of hydrogen is displaced by an alcohol radicle such as methyl or ethyl, thus giving rise to the idea of the ammonia type. Hofmann's discovery, a few months later, of diethylamine and triethylamine, compounds resulting from the displacement of two and three atoms of hydrogen in ammonia by ethyl, and of the method of preparing amines by the action of the alcoholic iodides on ammonia, was a fitting corollary to that of Wurtz. The combined result of these two classical researches was that chemists have ever since accounted for the properties of the organic bases generally by regarding them as derivatives of ammonia, which they all so closely resemble in chemical behaviour.

Passing over numerous investigations of minor value, we come to a paper published in 1855, "On Simple and Mixed Organic Radicles," which at that time was of great importance, and well illustrates Wurtz's method of almost invariably choosing subjects the investigation of which was of special interest as bearing on the advance of chemical theory. This paper is also memorable as con-



ADOLPHE WURTZ (from *La Nature*).

taining the first description of the method now so commonly employed of preparing hydrocarbons by the action of sodium on the iodides and bromides of alcohol radicles, a method which some years afterwards was applied with such success by Fittig in elucidating the constitution of the homologues of benzene. Frankland and Kolbe had maintained that the hydrocarbons of the empirical composition of the so-called alcohol radicles which they had prepared were of the same composition in the free state as in combination: for example, that the hydrocarbon obtained from ethyl iodide, C_2H_5I, was free ethyl, C_2H_5. Gerhardt, Hofmann, Laurent, Brodie, and Wurtz, however, sought to show that they should be represented by a doubled formula: that the so-called ethyl, for instance, had the composition $C_4H_{10} = 2C_2H_5$. This Frankland strenuously opposed, mainly on the ground of the complete homology of the hydrocarbons in question with hydrogen, the formula of which was then almost universally written H. The arguments used were chiefly of a physical character. Wurtz put an end to the controversy by introducing an argument which at once appealed to the sympathy of the chemist, by showing that, if a mixture of the iodides of two distinct radicles, such as ethyl, C_2H_5, and butyl, C_4H_9, were submitted to the action of sodium, a hydrocarbon was produced which consisted of ethyl and butyl united together. There was no reason to suppose that when a single iodide was thus treated the radicle remained free, and Wurtz showed that the physical properties of the hydrocarbons produced from single iodides were such as to prove that they were formed by the union of two similar radicles, as on no other hypothesis could they be ranged in a series with the hydrocarbons resulting from the association of two dissimilar radicles. It was a logical extension of this discovery to double the formula of free hydrogen, a step which, indeed, Brodie had already advocated, and which Frankland had clearly maintained was an essential preliminary to the doubling of the formulæ of the organic radicles. Wurtz also pointed out that the idea that the hydrogen molecule is compound must be extended to other elements, and that generally the simple bodies, like compounds, are composed of groups of atoms, and react not by combining but by exchange of elements.

The number of elements of which the molecular weight has been ascertained is, however, very small, and although the idea thus put forward by Wurtz undoubtedly applies to all the gaseous elements, and to bromine, iodine, sulphur, phosphorus, and arsenic, we now know that the only *metals* of which the density in the gaseous state has been satisfactorily determined, viz. mercury and cadmium, form distinct exceptions to the rule; we can therefore draw no conclusions of any value as regards the molecular composition of the metallic elements. It is a striking illustration of the slowness with which knowledge extends into that lower stratum which is governed by the text-books, that the view put forward by Wurtz, and which, with the above-mentioned limitation, is so clearly justified by facts, is almost universally disregarded by hand-books of chemistry; in fact, there is a most astounding superstition among students of chemistry that the elements generally have diatomic molecules.

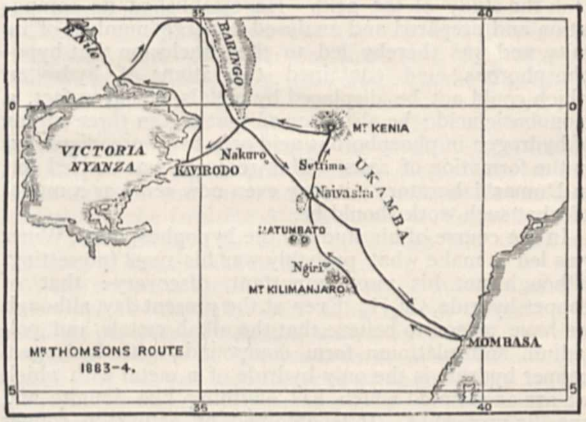
In 1855 Wurtz was led by the brilliant experimental results of Berthelot to discuss the formula of glycerin, and he was the first to point out that this body is to be referred to the type of three molecules of water; that, in fact, it can be regarded as an alcohol formed by the displacement of three atoms of hydrogen in three molecules of water by the radicle C_3H_5. Nearly all the alcohols known at that time could be referred to the type of a single molecule of water. Recognising the want of an intermediate series of alcohols, Wurtz was led in 1856 to the discovery of the glycols, and in this case again his work was of the highest value as a contribution to chemical theory.

Space does not permit of reference to the numerous other investigations of Wurtz, many of which have exercised an important influence upon chemical thought at the time of their publication. Only one must be mentioned, as it may ultimately prove to have been the first step towards the elucidation of the nature of the process of digestion in plants and animals. The investigation referred to is that on the sap of *Carica papaya*. He showed that alcohol precipitates from this a body presenting the characters of a strong digestive "ferment," capable of dissolving moist fibrin in large quantities. Experiments made with papaine, as the so-called ferment is termed, appear to show that papaine begins by combining with the "ferment," and that the insoluble product then undergoes gradual change in contact with water, the "ferment" being liberated and thus becoming free to do new work. There is much to indicate that mineral acids act in this way, and it is to be hoped that the suggestion put forward by Wurtz will not long escape notice, and that his investigation may be extended.

AFRICAN EXPLORATION

LETTERS addressed to the Secretary of the Committee of the British Association for the exploration of Kilimanjaro have just been received from Mr. H. H. Johnston, dated from the British Residency, Zanzibar, May 13. After consultation with Sir John Kirk, Mr. Johnston had selected the Mombasa route for Kilimanjaro, and was expecting to depart for that port in about a fortnight's time. The country between Mombasa and Chaga was said to be quiet, and to present no serious difficulties in the way. Mr. Johnston had succeeded in obtaining the services of three of the same bird-skinners that had been employed by Dr. Fischer, and of a botanical collector trained under Sir John Kirk, of whose kindness and assistance he speaks in the highest terms. Mr. Johnston, in spite of the trying climate of Zanzibar, was in excellent health, and had strong hopes of the success of the expedition.

We are pleased to learn that Mr. Joseph Thomson has arrived safely at Zanzibar from the expedition he undertook to the Masai region. It will be remembered that Mr. Thomson left England in the end of the year 1882, his object being to proceed by Mount Kilimanjaro to the almost unknown country of the Masai, and to settle the question of the existence of a Lake Baringo to the east of Victoria Nyanza. Mr. Thomson left Zanzibar in the



spring of last year, but after proceeding some distance found the country so disturbed owing to the recent passage of a German explorer, Dr. Fischer, that he was compelled to return precipitately to Mombasa. In July last, however, he started again, and has evidently accomplished his work in a way quite worthy of his previous record. Passing round the north-eastern side of Mount Kilimanjaro, Thomson proceeded north to Lake Naivasha, halfway between Kilimanjaro and Mount Kenia; then on to the latter mountain, and by way of Lake Baringo to the shores of Victoria Nyanza. This latter lake he skirted as far as the outlet of the Nile, returning by a more northerly route, striking the west coast of Lake Baringo, and proceeding south and south-east by Ukambani to Mombasa. It is satisfactory to record that no lives have been lost except by illness. The telegram which the Geographical Society have received from Sir John Kirk does not, of course, enter into minute details, but from its general tone it is evident that Mr. Thomson will have an interesting and instructive story to tell when he returns. The telegram does not state positively that Mr. Thomson found a lake where Baringo is placed on our maps, but as Baringo is mentioned as having been touched at, it seems most probable that the information obtained from natives by the sagacious Wakefield is correct. All the country traversed by Mr. Thomson's expedition to the north of

Lake Naivasha is new ground, hitherto untraversed by any explorer. Dr. Fischer in his recent expedition reached only as far as the lake just mentioned.

A NEW ASTRONOMICAL JOURNAL[1]

AN astronomical serial, under the auspices of the Observatory of Paris, will be a welcome addition to the literature of the science, and may well be expected to occupy a prominent place on the list of such periodicals.

Admiral Mouchez, in his introductory note, alludes to the great impetus which has been lately given in France to the progress of astronomy by the establishment or resuscitation of observatories, aided as well by national funds as by contributions from the municipal authorities of the places where they are located. In a few years these various observatories will be completely organised, the *personnel* consisting in part of astronomical students who have obtained their acquaintance with the practical branches of the science in the Observatory of Paris. The director therefore aims at providing a medium in the *Bulletin Astronomique* whereby the work of French astronomers may be speedily made known, and where at the same time an analysis of the contents of the principal foreign periodicals, &c., may be available to them.

The *Bulletin* will thus present two distinct sections: the first will be composed of observations of current interest, ephemerides of planets and comets, and memoirs or notices on various questions in theoretical and practical astronomy. The second will comprise as complete a *résumé* as possible of astronomical intelligence and an analysis of the principal periodicals and newly-published works. Further, in a supplementary section it is intended to introduce articles on subjects relating to the sciences allied to astronomy, as terrestrial physics, geodesy, and meteorology, not excluding points of interest in the history of the science: contributions from foreign astronomers are invited.

In the first four numbers of the *Bulletin* are articles bearing upon sidereal, planetary, and cometary astronomy. There is a series of measures of double-stars in 1883, made by M. Perrotin at Nice in continuation of previous series which have appeared in the *Astronomische Nachrichten*. M. Perrotin has habitually used powers of 750 and 1000: objects not too frequently measured of late will be found in his list, which is to be continued. MM. Henry have a note upon the planet Saturn as viewed in the refractor of 0·38 m. at the Observatory of Paris, in which reference is made to a narrow bright ring limited by a dark line, outside the principal division, the breadth equal to that of the division of Cassini, which they consider to be a new feature. It is stated that the Encke division has completely disappeared; notwithstanding extremely favourable atmospheric circumstances, nothing was remarked upon the outer ring except the narrow bright zone just mentioned. MM. Henry invite communications on this subject from other observers provided with large telescopes. M. Baillaud publishes observations of *Mimas* made at Toulouse between October 24, 1876, and December 5, 1883. The telescope employed has an aperture of 0·83 m., the mirror being the work of MM. Henry, the mounting by Secretan. A power of 335 was usually employed; the observations for the most part consist of the times of elongations, but during the opposition of 1882-83 M. Fabre succeeded in observing several conjunctions with the minor-axis of the ring N and S. From these observations M. Tisserand has drawn several conclusions respecting the motion of the satellite, to which he directed attention in a paper submitted to the Paris Academy of Sciences on January 28, and printed in the *Comptes Rendus*. He fixes the mean daily motion at 381°·9934, and his observations are compared with calculation on this hypothesis, the orbit being supposed circular. But he infers that there is an inequality in the mean longitude, of which the period is about five years, and the coefficient approximately 8°; further he finds that the eccentricity does not exceed one-tenth. The longitudes of the perisaturnium, deduced from observations during five periods, may be fairly represented on the assumption of an annual motion of 447°. It is intended to observe *Mimas* at Toulouse as frequently as possible, and, so far as circumstances admit, the same observer will undertake them, it having been found that observations made by different persons with the same instrument are not strictly comparable.

In the February number of the *Bulletin* M. Schulhof has the earliest notification of his discovery of the periodicity of the third comet of 1858, upon which he enters into details in the number for April; the most probable period of revolution resulting from the few observations which were secured in America (the comet was not seen in Europe) is 6·61 years, and the limits somewhat insecurely assigned are 5·80 and 7·54 years. As in other cases, this comet approaches very near to the orbit of Jupiter, to which we may attribute the limited dimensions of the orbit, according to M. Schulhof. There are several communications on Pons' comet, physical and otherwise; amongst them a note by MM. Trépied and Rambaud, of the Observatory at Algiers, on the remarkable variation in the head of the comet, observed on January 19, and one by M. Rayet on the *aigrettes*, &c., remarked near the time of perihelion passage. M. Radau treats on the theory of the heliostats, and M. Bigourdan on a means of rendering more convenient the use of the equatorial. We find also in these numbers of the *Bulletin* a description and plan of the buildings of the Observatory at Marseilles, by M. Stephan; and a list of discoveries of small planets and comets made at that establishment: amongst the latter we note that the discovery of the first comet of 1867 on January 25 is attributed to M. Coggia; at the time it was announced to have been made by M. Stephan, at least in a letter from M. Tempel, then residing at Marseilles, to the *Astronomische Nachrichten;* as Mr. Searle has shown that the comet is one of comparatively short period (thirty-three years) and may therefore want a name, it might be well to settle the point as to who was the actual discoverer. There is a note on an Observatory to be erected at La Plata, the recently founded capital of the province of Buenos Ayres; a director has been already nominated in the person of M. Beuf, an officer of the French Marine, formerly in charge of the Observatory of Toulon; 100,000 francs have been allowed for the Observatory and instruments, with an annual subsidy of 24,000 francs. Such liberal encouragement of science does honour to M. Dardo Rocha, the Governor of the Province of Buenos Ayres, and it is due to him to add that he had previously done much for recent progress in the Argentine Republic.

As a specimen of the miscellaneous articles in the *Bulletin*, we may mention M. R. Radau's interesting account of the recent crepuscular phenomena, in which he has availed himself of the numerous facts relating thereto which have been published in NATURE. He does not profess to decide upon the cause of these phenomena, or to make choice between the explanations which have been offered, but we may quote his concluding paragraph: "Ce qui semble prouvé, c'est qu'il s'agit ici, très-probablement, de phénomènes de réflexion, dus à la présence de matières finement divisées dont la nature reste à déterminer; la lumière ainsi réfléchie n'est, sans doute, que la lumière ordinaire du soleil couchant, colorée par transmission à travers les couches basses, chargées de vapeurs."

The typographical execution of the *Bulletin* leaves nothing to be desired. The March number contains a photolithograph of the aspect of Saturn as viewed at the Observatory of Paris on the 4th of that month.

[1] *Bulletin Astronomique*, publié sous les auspices de l'Observatoire de Paris, par M. F. Tisserand, &c. (Paris: Gauthier-Villars, 1884.)

MEASURING EARTHQUAKES[1]

II.—RESULTS

IN this paper a short account will be given of the chief results of two and a half years' observations in the Seismological Observatory of the University of Tokio. The first instruments to be successfully used were the horizontal pendulum, or rather a pair of horizontal pendulums writing a multiplied record of two rectangular horizontal components of the earth's motion on a revolving plate of smoked glass, and also a very long common pendulum. The duplex pendulum, an astatic vertical-motion seismograph, and other instruments which have been mentioned in the former article, were added later.[1]

The earliest records were those of five small earthquakes in November 1880.[2] In the first of these the vibration of the ground lasted continuously for 1½ minutes, and no fewer than 150 complete oscillations could be counted in the record. The shaking began feebly, speedily rose to a maximum, fluctuated irregularly, and died out very gradually. The greatest movement from side to side was less than one-third of a millimetre. Both

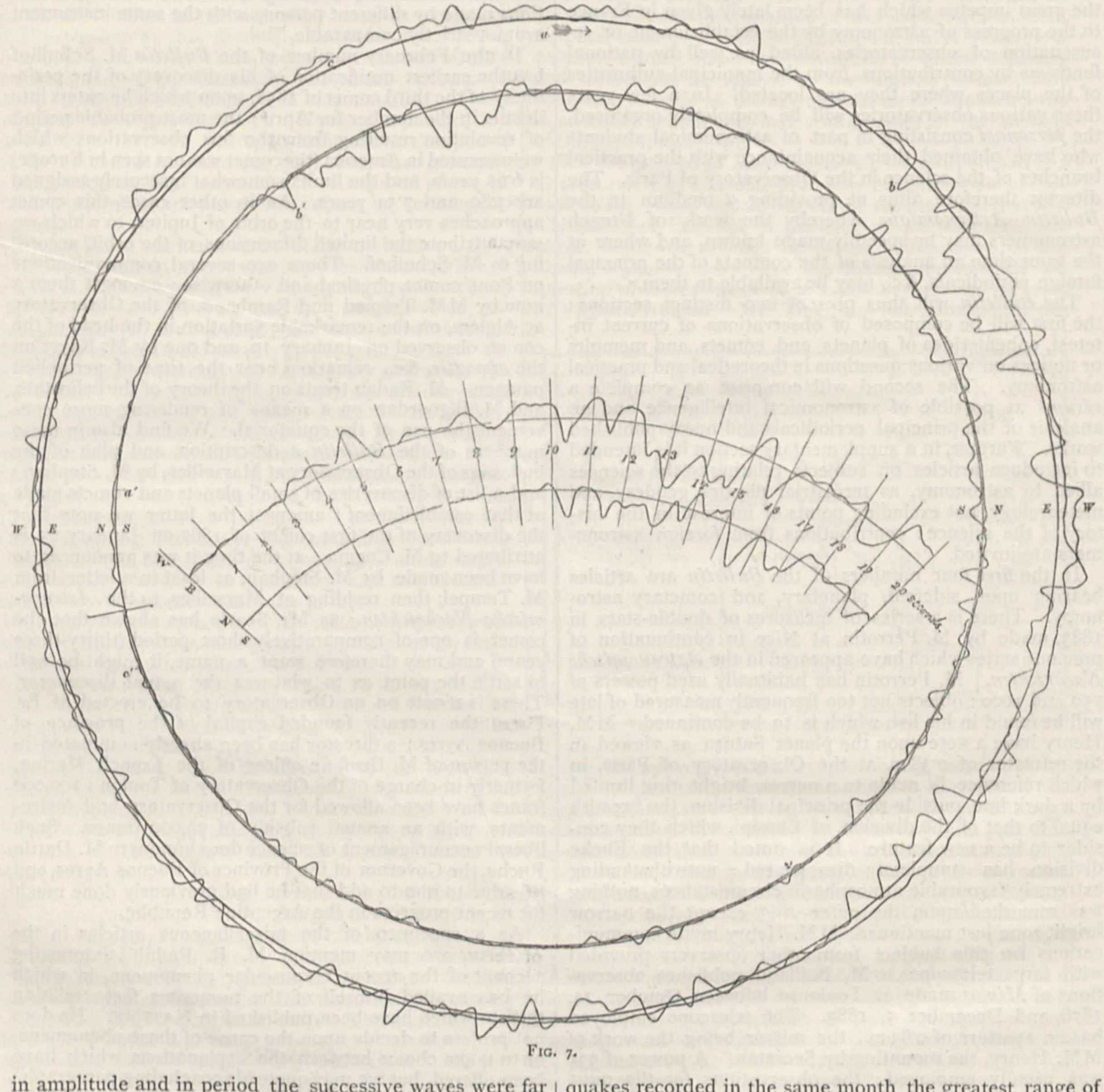


FIG. 7.

in amplitude and in period the successive waves were far from equal. A rough idea of the greatest velocity and greatest acceleration was, however, obtained by treating the greatest movement as a simple harmonic vibration, with a period of three-fifths of a second. This gave 1·6 mm. per second for the greatest velocity, and 16·4 mm. per second per second for the greatest acceleration, showing that bodies attached rigidly to the earth's surface must have experienced a horizontal force equal to about one-six-hundredth of their own weight. In three of the five earthquakes recorded in the same month the greatest range of motion was less than one-fifth of a millimetre. In all of them there were many and unequal vibrations, but in none was there any single impulse prominently greater than the other movements.

Later observations showed that these were fairly repre-

[1] Continued from p. 152.

[1] For a fuller account of the methods and results of these observations the writer may be permitted to refer again to his memoir on Earthquake Measurement, published as No. 9 of the *Memoirs of the Science Department of the University of Tokio*.

[2] Described in the *Transactions of the Asiatic Society of Japan*, vol. ix. p. 40.

sentative of a very large proportion of the earthquakes which occur so frequently in the Plain of Yedo. Earthquakes of this class do no damage to buildings, but they are strong enough to make their presence felt by the shaking and creaking of houses, and even, in the night, to startle residents out of sleep. Lamps and other pendulous bodies are frequently set into considerable oscillation through the long continuance of the disturbance, the period of some consecutive vibrations of the ground being nearly uniform and equal to the free period of the lamp. The shaking lasts rarely less than one and sometimes as much as ten minutes.

In some cases, however, the amplitude of the earth's motion is considerably greater; occasionally it rises to 5 and even 7 mm. With such an amplitude as this, and with the ordinary frequency which the earthquake waves have, the shock is more or less destructive—walls are cracked and chimneys are overthrown. The writer's observations do not include any earthquake of first-rate violence, but they show by several examples that in the alluvial soil of Tokio a sufficiently alarming and even damaging earthquake may occur, in which the range of horizontal motion is less than a single centimetre.

In the Yedo earthquakes the vertical motion is generally much less than the horizontal, and, as a rule, forms an unimportant part of the disturbance.

Fig. 7 is a copy, reduced to about half size, of the record of one of these more considerable earthquakes (on March 8, 1881), traced by a pair of horizontal pendulums on a revolving plate. The inner circle shows the N.S. component, and the outer circle the E.W. component of the displacement. The records begin simultaneously at the points marked *a′* and *a* respectively, and extend in the direction of the arrow over nearly two complete revolutions of the plate. At the point marked *c* in the outer circle, when the earthquake oscillations were slowly dying away, the writer (who happened to be present) withdrew the plate, to prevent the later portions of the record from confusing the earlier portions. By this time the earthquake had lasted for two minutes and a half, and some 200 vibrations had been registered. The motion, as recorded, was exaggerated in the ratio of 6 to 1; hence in the diagram as it appears here the displacements are nearly three times the natural size.

For the sake of exhibiting some interesting features of this earthquake more clearly, the records of the two components during the first twenty seconds of visible motion have been reproduced in the centre space of the diagram in such a manner that simultaneous parts of both are on the same radius. The short radial lines mark seconds of time. It will be seen that for three seconds the motions were very minute; then the E.W. seismograph became pretty sharply disturbed, but the other component was scarcely visible until the tenth second from the beginning.

During the tenth and eleventh seconds the phases of the two components agree in the main, but they soon diverge; and in the fifteenth second, when the motion is greater than at any other part of the whole disturbance, they differ by about a quarter of a period. Hence at that time points on the earth's surface were vibrating not in a rectilineal path but in *loops*. This is strikingly shown by Fig. 8, which shows the path (exaggerated in the ratio of 6 to 1) of a point on the earth's surface, during three seconds at this epoch in the disturbance. Starting from *p* at 13·7 seconds from the beginning of the earthquake, a surface particle described the tortuous path shown in the figure, and reached *q* three seconds later. Similar rapid changes of phase-relation occur throughout the rest of the disturbance, and in the slowly dying oscillations with which the earthquake drew to a close the writer noticed one of the pointers moving vigorously when the other was nearly at rest, and *vice versâ*.

The evidence, first clearly given in this earthquake, of the non-rectilineal character of the ground's motion, was confirmed by very many later observations. In fact in every case where the records were sufficiently large and well-defined to admit of a satisfactory comparison of the phases of the two components, the same thing was exhibited. And not only in those cases, but even in very minute earthquakes, instruments having two degrees of horizontal freedom, such as the duplex pendulum, showed in the most direct manner that the earth's movements consisted of a multitude of twists and wriggles of the most fantastic character.

An excellent example of a still sharper earthquake is given in Fig. 9—a record (reduced to half size) given by two horizontal pendulums with a multiplying ratio of four to one on a plate which was turning once in fifty-four seconds. The beginning of motion can be detected on the outer circle at *a*. At *b* and the corresponding point *b′* it increases somewhat suddenly, and during the next few seconds we have the principal motions, followed during many minutes by a long trail of lesser irregular oscillations, in which a marked lengthening of period may be detected towards the close. To allow the phase-relation during the principal part of the shock to be examined, lines (numbered 1 to 16) have been drawn by the aid of templates through corresponding points in the two records. An examination will show that the phase-relation changes: in fact when the two components are combined the movements are found to be loops, agreeing very closely with the larger loops of Fig. 10, which is a "static" record of the same earthquake given by the duplex pendulum. In a

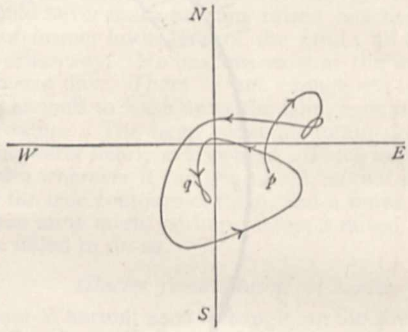


FIG. 8.

part of Fig. 10 the motions are so numerous and so much distributed over all azimuths, that the film of lamp-black has been completely rubbed away from a portion of the plate which received this record.

It frequently happens in the record of an earthquake that the motions which are first recorded are rapid vibrations, of short period and small amplitude, which are immediately followed by larger and less frequent movements. Sometimes, indeed, the former appear as a ripple of small waves superposed on larger ones. But in all cases where the short-period waves can be detected they die out early, and the later part of the earthquake consists of relatively long-period waves alone. Records of this class are exceedingly suggestive of the arrival of first a series of normal waves (that is, waves of compression and extension), constituting the rapid tremor, and then a series of transverse waves (that is, waves of distortion), forming the principal motions of the earthquake.

In fact it is difficult to explain the rapid changes of phase in the two components, or, in other words, the curved character of the horizontal movement, which most if not all the recorded earthquakes exhibit, otherwise than by supposing that the principal movements are transverse waves occurring in a plane not very much inclined to the horizon, and this conclusion is supported by the smallness of the vertical component.

It is true that the appearances presented by the diagrams could be accounted for by assuming the presence, together, of normal and transverse waves, with a nearly horizontal direction of propagation; but in that case we should expect to find normal waves occurring alone at the beginning of the earthquake with much greater amplitude than they actually have. Other still less probable solutions might be referred to; but it is safe to say that the evidence furnished by these observations goes far to prove that the earthquakes of the Plain of Yedo consist chiefly of distortions, not compressions, of the ground, and emerge at Tokio in a direction not very far from vertical.

In the older seismology it was generally assumed not only that an earthquake consists mainly of one impulse, but that the motion of the ground has a definite direction, and that that is the same as the direction of propagation of the wave. All three assumptions were false. An old piece of seismic apparatus, based on these ideas, was a group of columns of various heights standing on a plane horizontal base. These were intended to show the direction and "intensity of the shock" by falling over. It is clear enough, however, that no appliance of this kind can give intelligible results from earthquakes of such complexity as those described above. The very word

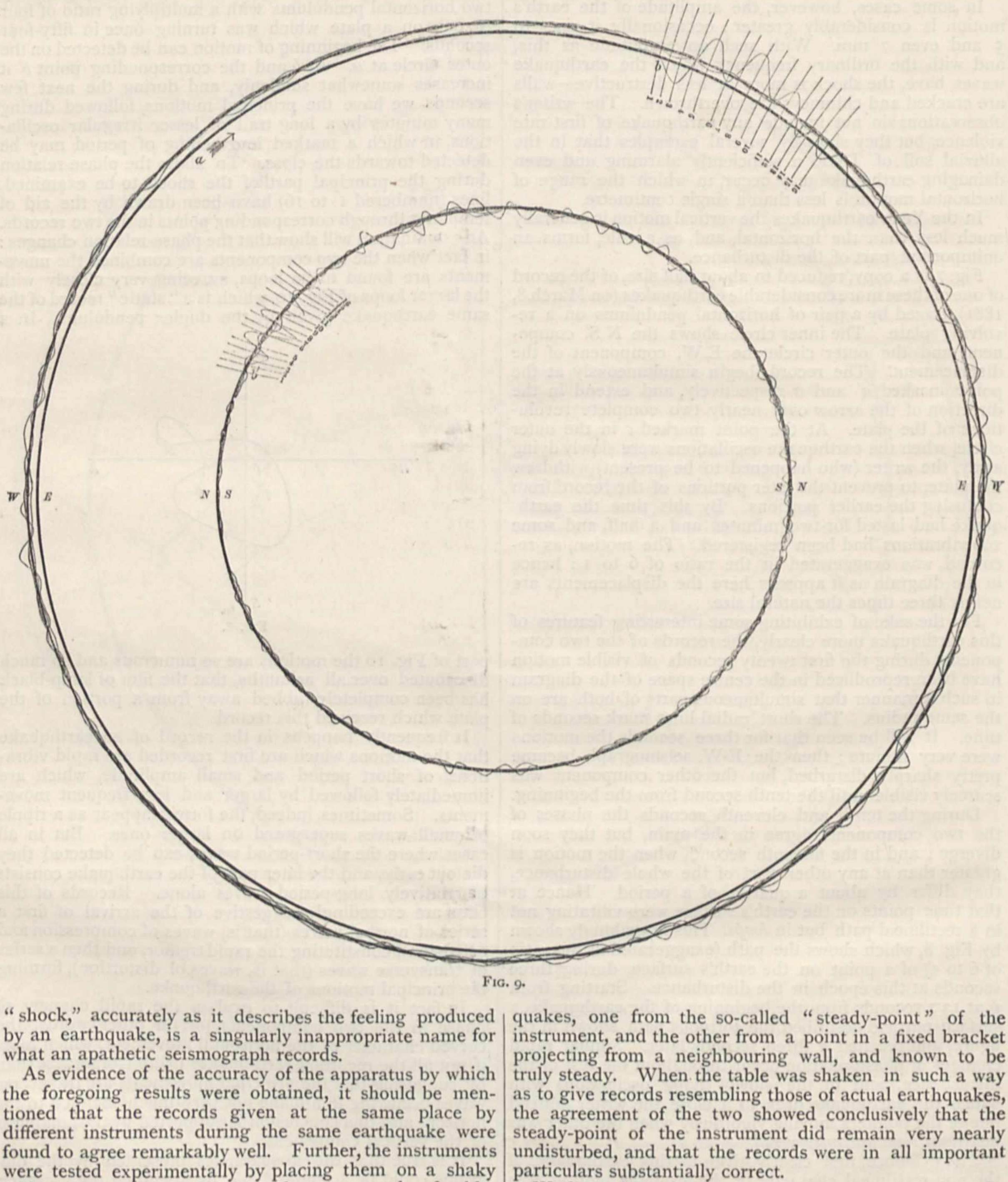


Fig. 9.

"shock," accurately as it describes the feeling produced by an earthquake, is a singularly inappropriate name for what an apathetic seismograph records.

As evidence of the accuracy of the apparatus by which the foregoing results were obtained, it should be mentioned that the records given at the same place by different instruments during the same earthquake were found to agree remarkably well. Further, the instruments were tested experimentally by placing them on a shaky table, and obtaining, side by side, two records of table-quakes, one from the so-called "steady-point" of the instrument, and the other from a point in a fixed bracket projecting from a neighbouring wall, and known to be truly steady. When the table was shaken in such a way as to give records resembling those of actual earthquakes, the agreement of the two showed conclusively that the steady-point of the instrument did remain very nearly undisturbed, and that the records were in all important particulars substantially correct.

We have then the means of accurately observing the nature of the surface motion at an earthquake observatory. But this of itself tells us nothing of the speed and direction of transit of the disturbance, particulars which are only to be learnt by connected observations made at several stations. Any one earthquake, as a whole, lasts far too long and begins too gradually to admit of the measurement of time-intervals between its arrival at different points, but if we can identify any single vibration in the records given at several stations—spread over a moderate area, and connected telegraphically with each other—the problem admits of a fairly easy solution. A recording seismograph at each station will give a complete record of the earthquake as it appears there, and if, during its progress, time signals be sent from one station and marked on all the revolving plates, it will be possible to

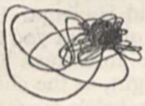


FIG. 10.

determine the differences in time of arrival of *the same phase of the same wave* at the successive stations in the group. From this, if the stations be sufficiently numerous, the speed and direction of transit, and even the origin of the disturbance, may be found with more or less precision. But all this depends on our being able to recognise at the various stations some one wave out of the complex records deposited at each, and, especially in view of the curvilinear nature of the motion, it would be hazardous to say without trial whether this can be done. To ascertain whether it can be done, and if so to organise groups of connected stations to carry out the scheme roughly sketched above, should be the next step in observational seismology.

J. A. EWING

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NOTES ON A FEW OF THE GLACIERS IN THE MAIN STRAIT OF MAGELLAN MADE DURING THE SUMMERS OF 1882-83 *IN H.M.S. "SYLVIA"*

THE western part of the main Strait of Magellan, to which my remarks are confined, lies between rugged and abrupt mountains, of rock mainly crystalline, but in parts of slate.

The highest peaks are not over 4500 feet high, and the height of the snow-line is about 2700 feet. The land is cut up into small areas by numerous and tortuous channels, and, on the southern side certainly, no large masses of land exist. The mountain ridges are mostly sharp and steep, and afford but little area for snow to lie in quantities, but wherever a mountain slope is moderate, there it accumulates, and forms *névé*, which may or may not descend to lower levels.

From this it will be seen that the glaciers spoken of are small, only one snow-field, the "Northbrook," being of any size. Much larger glaciers of course exist in these regions, but were not in my beat, lying either to the south about Mount Darwin and Mount Sarmiento, 7000 feet high, or to the north on the mainland bordering the western channels.

Some ice-masses are ridiculously small, one I remarked, at the end of summer, on a ledge a little below a very sharp ridge 2700 feet high, was not probably larger than 10,000 tons. It lay entirely bare of snow on the southern or shady side of the ridge, and was of blue ice.

It is evident that it is the enormous amount of the supply of material which accounts for the existence of glaciers from such small origins, and in fact the deposition of snow is going on all the year round for the majority of hours out of the twenty-four. The winds are eternally from the western quarter, are usually fresh, and, arriving moist from the Pacific against the rampart of mountains, rush up their western slopes into the colder regions, where constant condensation takes place. During my stay—about eight months—the summits of the higher snow-fields (3500 to 4500 feet) were only seen twice or thrice, so continually are the mists around them.

The daily duration of rain at the water-level during the *Sylvia's* stay of about eight months west of Cape Froward was eleven hours out of every twenty-four. The quantity corresponded to a yearly fall of 180 inches.

Though the mean temperature for the year is low, the range, summer and winter, is very small, so that flowering plants which grow on the borders of the glaciers and on exposed hills perish in England, from inability to withstand the sudden changes and lowness of the winter temperature.

The inference would seem to be that a Glacial period need not so much depend upon extreme cold as on an unlimited condensation with an equable temperature, low enough at moderate altitudes to form snow.

The glaciers are nearly entirely devoid of erratic blocks or surface moraines. Coming, as they do, over everything, down a hill-side, there is seldom an overhanging mountain to discharge blocks; where there is, the rock is so solid that the very slight changes of temperature (for the sun has no power here) is not sufficient to disintegrate it. Even the glaciers therefore that descend nearly to the sea are quite clean and spotless to the very end.

I could never make out any raised beaches, nor other signs of former lower level of the land; all the evidence is the other way. No beaches exist at the water-level of the present day. There is not enough sea in these confined channels to wash away the land, even if it was of a softer nature. The steep rocky mountain-sides dip clean into the water nearly everywhere. Thick moss covers the hill-sides wherever it can get a hold, so that it is not easy to see the true contours of them, and a more experienced eye than mine might perhaps detect a raised beach where I have failed to do so.

Glacier from Mount Wharton

Mount Wharton, 4400 feet high, on the south shores of Long Reach, sends down what I consider a rather remarkable glacier, despite its small size.

The upper part of the mountain, of a tolerably gentle slope, is of an area of about four square miles. This terminates everywhere in steep precipices, over which in different directions the blue ice, which can be seen lining the edge, tumbles, and forms *glaciers remaniés* in hollows at lower levels in several places. On the south-eastern side only is a steep slope, down which, after a series of ice-falls, a leg of glacier, one-third of a mile wide, and one mile and a half long, extends to within 150 feet of the sea-level, and a quarter of a mile from the shore. At its end it abuts against a hill, and from the fact of the ground sloping away on either side from this glacier leg, it appears that this slope is a ridge, down which the glacier comes, as it were, astride. Where it strikes the hill, it divides, and sends a final short leg towards the sea on either side of the peninsula formed by the hill.

The slope of the lower part of the glacier is 15°, and it is much crevassed, and squeezed into pinnacles and ridges, so that, when tolerably clear of snow, it looks like frozen waves.

There is no moraine on it, and, wherever I could see, it lies on the solid rock, but a few stones are carried along at the bottom of the ice, and, at its end, where it abuts against the hill, the latter is a mass of loose rounded stones (very few angular ones), up to the limit occasionally reached by the glacier, which is well and curiously marked by a narrow belt of trees, growing on the edge of the tumbled stone moraine. Behind them the hill is of solid rock, bare or moss-covered (see illustration).

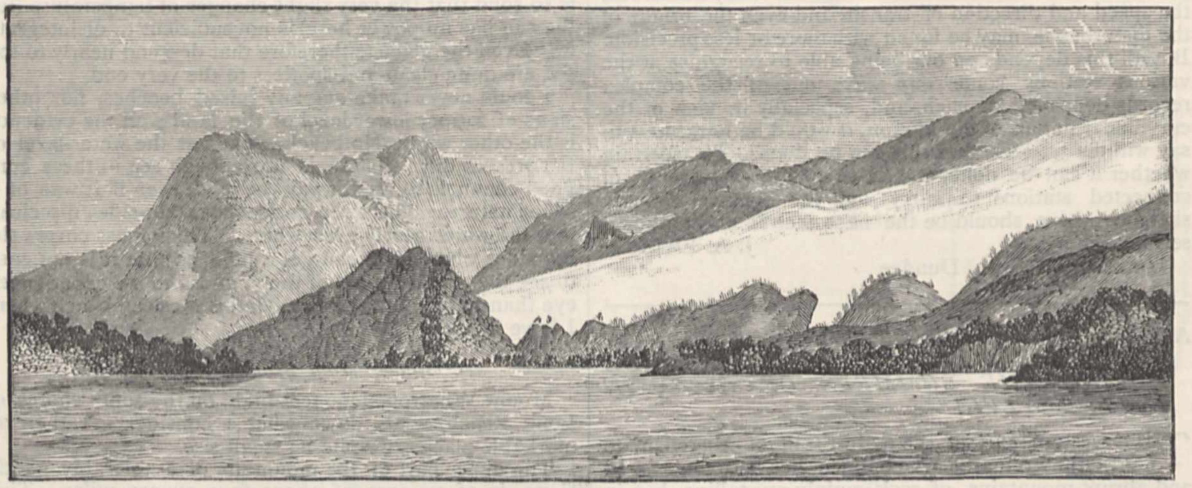
The side limit of the glacier, where it sometimes flows down the slope on its right and left, is also marked by a similar line of trees, the intervening space of about 300 yards being partly strewn with loose stones and coarse gravel, and partly perfectly bare, highly polished, striated rock. This rock has a somewhat remarkable appearance, as it is composed of a fine dark stone (a metamorphosed slate?) with intrusive parallel veins of white crystalline rock. The bands of black and white are very even in width, and there is as much of one rock as the other, so that, as the strike of the veins is in the same direction as the flow of the glacier, they look, at a little distance, like gigantic striæ.

I marked the foot of this glacier in December 1882, and found by March 1883, after the summer, that it had retreated 30 yards. After the winter, I fully expected to find that it had again advanced, but in December 1883 the edge of the ice was 50 yards farther back than in the previous December. They reported a very mild winter at Sandy Point, but I was not prepared to find the glacier retreating throughout the year, as it was manifestly at its full limits not many years ago.

I could not procure any evidence as to its rate of motion. The sides are so broken up, by great pieces falling off and slipping down the slope, that it is almost impossible to get at the main body of the ice to put a mark in.

The head of West Havergal Bay, into which the glacier stream falls, is filled with a level bottom of sand with about 10 fathoms of water over it. This has a very steep edge to the deeper part of the basin. I imagine this to have been the delta formed by the glacier stream, when the land was at a slightly higher level. It is very rare in the Straits of Magellan to have anything but uneven, rocky bottoms to these deep basins, and they are generally steep to the edge of the shore. I have only found these sandy flat bottoms in the vicinity of glaciers, and as a sandy flat always forms around the *embouchure* of the glacier streams, a subsidence of the land would account for the existence of flats under water.

The hill-sides around Havergal Bay, where bare, show glaciation to a height of about 700 feet above the present sea-level. I think the land must have been higher when the ice was at this height, as the channel just below some of these marked hills being 60 fathoms deep, it would require the glacier to be 1000 feet thick, which seems to me hardly possible with such a small area for the production of *névé* as there is now, even supposing a greatly increased fall of snow and a much lower average of temperature than at present.



Havergal Bay, Strait of Magellan. End of Glacier from Mount Wharton.

I visited one of the *glaciers remaniés* on the north-west side of Mount Wharton. It lies in a hollow about 1500 feet above the sea, and at the foot of cliffs 1000 feet high or more, and is three-quarters of a mile long by 400 yards wide. It is an excellent example of regelation, as the fragments which form it must be dashed to small pieces in their fall. It was at the end of summer, and only insignificant bits were coming over the cliff from the ice-field above. These fell on the *glacier remanié* broken into minute fragments with a patter as of heavy hail. Larger masses would be similarly broken, and yet the ice-mass was as clear and compact as if it had never been disturbed.

There were signs here on all sides, in the striations and *moutonnée* shape of all the rock above it, that this re-organised mass was once much larger; and 500 feet below, on a tolerably level part of the otherwise steep hill-side, bordering the stream that issues from the glacier, were low lines of moraine that were evidently once at the lower part of its sides.

A snow-field on a flattish mountain 3100 feet high, near Mount Wharton, has no proper glacier, but the ice falls over precipices and forms *glaciers remaniés*.

Glacier from Mount Wyndham

Mount Wyndham, on the opposite side of the Strait to Mount Wharton, sends a glacier down a valley, but has no surface moraine nor blocks. Its length is about two miles and a half, and the width, at the bottom, half a mile. Like others, it is very steep, and its surface is broken into pinnacles with deep crevasses. As I never saw the landward side of Mount Wyndham, I cannot exactly say what other glaciers may take their rise in it, nor what the size of the snow-field may be, but it probably does not exceed more than four or five square miles.

The foot of the glacier is not more than 100 feet above the sea, and is half a mile from the head of Glacier Bay, in a broad flat between the mountain slopes. A thick belt of tangled forest intervenes. This glacier is much shrunk also, a wide space of ground, covered with rounded stones, sand, and gravel, extending all round the foot to the edge of the trees in front, and the hills at the sides.

Signs of glaciation are abundant about this glacier, at far higher levels than it now reaches. Glacier Bay itself has been filled with it. This is a deep basin (70 fathoms deep) with islands stretching across its entrance. Rock Island, the largest of these, is *moutonnée* to the top, 560 feet, and the striæ are plain to see on its smooth precipitous sides. Several perched blocks stand on the mountain-sides about, but as I did not visit these, I cannot say whether they may not have simply come from the heights above, though their precarious positions would indicate not.

Outside Rock Island is another area of even, sandy, and muddy bottom, in from 10 to 6 fathoms water, with a steep edge to the deep water of the Strait, similar to that at the head of Havergal Bay. This, I take it, must have been formed by the glacier stream, and was once its delta when the land was higher.

A sandy flat, mixed with rounded stones, now surrounds the glacier stream where it falls into Glacier Bay, and only wants a subsidence of the land to convert it into a counterpart of Havergal Bay. I do not know how else to account for this flat outside Glacier Bay, which was as unexpected as it was welcome, since it forms one of the best anchorages in the Straits, where even bottoms for the anchors are at a premium.

Northbrook Glacier

A snow-field in King William's Land between Northbrook Sound and Beaufort Bay is the largest in these parts, but I do not know much of it. It lay unfortunately just outside my work, and was so uniformly covered with clouds that I only saw the summit once.

It has probably an area of from fifty to seventy square miles. It is a flattish mountain about 4500 feet high. The ice descends on all sides in a succession of ice-falls, exhibiting lines of blue ice, most beautiful to see, about two or three miles long. Only when within 800 or 1000 feet of the sea is a true glacier formed.

These glaciers at the head of Northbrook Sound reach to within 100 feet or so of the shore level. In Beaufort Bay I rather think they reach the water. In Northbrook Sound the glacier at a mile from the coast, is about a mile and a half wide, but it is shortly after broken by a protruding hill, and divides into two legs, each half a mile wide. This glacier was also much shrunken. It brings down no moraine, and flows over solid rock.

W. J. L. WHARTON

NOTES

THE Council of the Mathematical Society have awarded the first De Morgan Gold Medal to Prof. Cayley, F.R.S.

M. PASTEUR has been awarded a gold medal by the Société Centrale pour l'Amélioration des Races des Chiens for his work on rabies.

THE jury of the International Horticultural Exhibition at St. Petersburg have awarded a gold medal to Dr. Regel, Director of the St. Petersburg Botanical Garden. The other awards for scientific work were to Dr. Gobi, the Russian algologist, for his remarkable herbarium; to Mr. Hartnack, for his microscope; and to Countess Zichi for her picture representing the *Serapias*. A gold medal was awarded to the Japanese University of Tokio for its collection of fruits.

M. JAMIN has been elected Perpetual Secretary in the Section of Physical Sciences of the Paris Academy in succession to the late M. Dumas.

DR. ADAM PAULSEN has been appointed Director of the Danish Meteorological Institute in succession to the late Dr. Hoffmeyer. Dr. Paulsen was the Chief of the Danish Polar Expedition to Godthaab.

PROF. W. GRYLLS ADAMS, as President of the Society of Telegraph Engineers and Electricians, will hold a *conversazione* in the Museum, Physical Laboratory, and Art Galleries of King's College on Thursday evening, July 3, from nine to twelve o'clock.

BY invitation of the Executive Council of the International Health Exhibition, a conference of the Society of Telegraph Engineers and Electricians will be held in the Conference Room of the Exhibition, South Kensington, on Friday, July 4. The chair will be taken by Prof. W. Grylls Adams, F.R.S., President of the Society, at 11 o'clock a.m., when the following paper will be read and discussed: "On Electric Lighting in Relation to Health," by R. E. Crompton, member. An adjournment for luncheon will take place at 1.30, and at 2.30 the following paper will be read and discussed, viz.: "The Physiological Bearing of Electricity on Health," by W. H. Stone, M.A., M.B. Oxon, F.R.C.P., member.

A LARGE number of guests, including ladies, assembled by invitation of the President of the Royal Society at a *conversazione* held at Burlington House on Wednesday last week.

ARRANGEMENTS have been made by the Council of the Scottish Meteorological Society for the completion this season of the Observatory of Ben Nevis. The first portion of the Observatory was, it may be remembered, opened in October last, and since the observers went into residence continuous hourly observations have been made of the conditions of the atmosphere at the top of the Ben, with special reference to temperature, pressure, humidity, and motion. From the discussion of these, and what were daily made by Mr. Clement L. Wragge in the summers of 1881 and 1882, by the Secretary, Mr. Buchan, the Council have been fully confirmed in the high expectations they had formed concerning the value of a high-level station, both in its bearing upon general meteorological problems, and also with reference to possible forecasts for the British Islands. The problem, however, is great and many-sided, and is one which can only be solved after much patient investigation and labour. The additions to be made to the Observatory will just double its size, and enable the three observers—who during the winter have been considerably cramped in their one apartment—to work under more comfortable conditions. On the south of the present doorway there is to be erected a shelter for tourists. On the north side of the existing building there is to be erected a new sitting room or office, 15 feet by 13 feet, while off this apartment there will be two bed-rooms, each 9 feet by 7 feet. The office will be lighted by two windows; and in each bed-room there will be one window. Opening from the east side of the office is a short passage leading to an octagonal tower, the walls of which will be 6 feet in thickness, and its internal diameter 8 feet. The tower, which will be 25 feet high, will be divided into three apartments, the lower being a dark chamber for photographic purposes, the centre one a spare room, and the upper a depository for observing instruments. The stonework of the tower is carried up to the height of the ceiling of the second chamber. The upper room is a superimposed wooden cabinet, the exposed parts of which are covered with lead. The floor of this apartment is carried out over the stone walls and firmly fixed to the tower below by iron rods, and to the roof above by strong wooden braces, so that it cannot possibly be upset. In the upper chamber are four windows, one facing each of the cardinal points of the compass, and at one of these is a ladder leading down to the roof, so that, should the doorway be blocked by snow, this would form a means of exit for the observers; the ventilating and smoke pipes, which are contained in one casing, are carried up through the roof of the tower, while, rising 6 feet above the ventilator, will be two anemometers, specially constructed by Profs. Chrystal and Crum Brown, for continuously recording the direction and velocity of the wind. These instruments will be self-registering, the apparatus for this purpose being in the chamber below, where it will be accessible at all times. On the eastern face of the tower a door has been left, so as to provide for future extension for magnetic and seismic observations. The estimated cost of the completion of the Observatory in the manner now explained will be 800*l*., which is, however, irrespective of a heavy item of charge for conveying on horseback the materials to the top of the hill. It is understood that the cost of equipment and maintenance of the Observatory heretofore has been heavier than was anticipated. The directors intend shortly to make a fresh appeal for funds to the public, which will no doubt be as liberally responded to as was their last.

THE first annual conference of the National Association of Science and Art Teachers will be held in the Liverpool Institute, Mount Street, Liverpool, at half-past two on Saturday, June 21. Prof. Silvanus P. Thompson, D.Sc., will preside. The following arrangements have been made for the day's proceedings:—Meeting in the vestibule of the Free Museum, William Brown Street, at 10.30 a.m. The members and delegates will view the museum, library, and art gallery. At 12.5, train to Bootle from L. and Y. station, for Alexandra Dock, to view the National Liner *America*. Return per train to Liverpool, for refreshments and inspection of Liverpool Institute and School of Art. Business meeting at 2.30 p.m. Paper by Prof. Thompson at 7 p.m.

PROF. STRICKER of Vienna has in the press a work on which he has been engaged for some time. Under the title "Physiologie des Rechts" he has applied modern scientific methods to the investigation of ethical problems. The aim of the book is to examine the correlative conceptions of right and law in the light which is cast on them by the conceptions of development and of society as something more than a mechanical aggregate of independent units. The first part of the inquiry is psychological. The second treats of the relations of ethics to jurisprudence, dealing with the question of connection of right with might as part of the general problem of evolution. The third discusses the question of punishment and responsibility. The book is to be published by Toeplitz and Deuticke of Vienna.

WE have on several occasions drawn attention to the good work which is being done by the Royal Victoria Coffee Hall, Waterloo Bridge Road. The entertainments provided are healthy, instructive, and popular; among other items in the programme are lectures by some of our best known men of science. The undertaking is in want of funds to further extend operations, and those willing to contribute to a really good cause should communicate with Miss Cons at the Hall.

THE death is announced of the eminent scientific geographer, Dr. G. von Boguslawski; his "Handbuch der Oceanographie" has only just been published.

TORTOISES and snakes are intimately associated together in Chinese mythology and records of natural history, and hence one of the commonest emblems current in China, and a very favourite ornament, is a tortoise encircled by a snake. During the Chow Dynasty (B.C. 1122-255) these animals were chosen as emblems of martial security against attack, from the defences which nature has given them in the shell of the one and the scales of the other, and to the present day flags bearing a device in which they both appear as emblematic of this idea are usually carried by troops in the field. But it is further commonly stated as a fact that the greatest affection exists between these two creatures. Is there any ground for this last assertion? A passage in a letter lately published in the *China Mail* from a correspondent in Shanse seems to give a certain colour of probability to it. He says that one evening as he was walking on the bank of a certain river he saw a tortoise swimming across the current. Having his rifle with him he fired at the creature, upon which the tortoise dived under water, and a snake, cut in two by his bullet, floated on the surface. From the writer's account the snake appears to have been crossing the river on the back of the tortoise.

WE trust that the effort being made by the Sunday Society to obtain the opening of the Health Exhibition on Sundays will be successful. In the memorial of the Society to H.R.H. the Prince of Wales and the Executive Council of the International Health Exhibition, a letter is given from Sir Joseph Hooker to Prof. Tyndall, in which the former insists strongly on the beneficial results to the working-classes of the opening of Kew Gardens on Sunday. In this letter Sir Joseph Hooker says:—"If there is one matter that gratifies me more than another in respect of the administration of the Kew Gardens and Museums by the Government, it is the opening them to the public on Sundays. On no day of the week have we more interested visitors or more of that class which we should wish to see profiting by the instructive contents of this Institution. The Museums especially are crowded, and when it is considered that the exhibits in them are not of articles that strike the eye or gratify the senses of colour or form, the interest they excite is almost to be wondered at. The artisan classes are great frequenters of these Museums with their wives and families, and it is pleasing to see the delight with which the children recognise such articles as the sugar-cane, the coffee-plant, and its products, and the various implements used in their preparation, manufacture, &c. I should add that this interest in the instructive character of the Gardens is largely on the increase, and is manifest to the most careless observer. It is further accompanied by a marked improvement in the conduct of certain classes which were formerly troublesome in many ways and a nuisance to quiet visitors. It speaks volumes for the moral effect of the Sunday opening when I add that such classes no longer exist at Kew. Whether it is that such no longer come, or that coming they now behave themselves, is immaterial: the moral gain is great. During the last two years we have had in each year a million and a quarter of visitors, of whom the greater proportion are Sunday afternoon arrivals from every quarter of the Metropolis and its surroundings. Let the numbers speak for themselves:—1882, Sunday visitors, 606,935; week-days, 637,232; 1883, Sundays, 616,307; week-days, 624,182." Equally beneficial results, we are convinced, would follow the opening of the Health Exhibition on Sundays.

THE World's Industrial and Cotton Centennial Exposition, sanctioned by an Act of Congress of February 1883, and to be opened at New Orleans, December 1, proposes to bring together a magnificent international collection of plants and shrubs, in the largest conservatory ever erected, 600 feet in length, 194 feet in centre, with glass tower 90 feet in height, where Mexico and Central America will be the principal exhibitors. Six lakes will be contained in the grounds, round which will be groves of cedar, pine, pomegranate, magnolia, lemon, palm, orange, cocoa-nut, banana, &c. But the United States Bureau of Education in a preliminary circular calls attention to the very large and varied collection which will be found there of educational appliances of every description; plans of schools and methods of teaching all classes of scholars from the deaf and dumb or imbecile to the technical or university student; books in all their parts and stages; stationery, and materials for drawing, extending to photography; maps; instruments and apparatus mathematical, medical, and musical. The Bureau gives the managers of the Exposition credit for considering the improvement of schools as among the most beneficial results to be gained by their efforts.

THE Presidency of the Social Science Association for the ensuing year has been accepted by Mr. G. J. Shaw-Lefevre, M.P., First Commissioner of Works. The preparations for the Annual Congress, which is to take place at Birmingham from September 17 to 24, are being vigorously pushed forward by the different Local Committees, and a largely attended and successful meeting is anticipated. It is sixteen years since the Association met for the second time in Birmingham, and twenty-seven years since it held, in 1857, its first meeting, which also took place in that town.

WE learn from a communication of Dr. Glasenap to the Russian newspapers that there are in Russia the following private observatories: at Pervin, near Torjok, in the Government of Tver, belonging to General Maievsky; at Bunakovka, in the Government of Kharkoff, belonging to Prince Liven; and at Odessa, belonging to M. Gildesheim. A Polish gentleman, M. Wuczihowski, is building a private observatory at Belkave, near Breslau; and a Russian gentleman, W. P. Engelhardt, has a fine observatory at Dresden. The last is provided with an equatorial which has a 12-inch refractor, and is one of the most perfect telescopes. The equatorial is provided also with a 4-inch telescope with a large spectroscope. There is also a 6-inch searcher for comets, with a wide field of sight, and a selection of the best physical instruments.

THE Rev. John Stevenson is preparing for publication, by subscription, through Messrs. Blackwood and Co., a "Flora of British Fungi (Hymenomycetes)," with illustrations by Worthington G. Smith, F.L.S. The author states that he has the co-operation of the most eminent mycologists. It may be added that the value of the "Flora" will be greatly enhanced by embodying the views of Fries, contained in his "Monographia Hymenomycetum Sueciæ," a work which cannot now be obtained, only 100 copies having been originally printed. The issue of the work will depend on a sufficient number of subscribers being received by an early date, in which case the first volume will be published without delay.

A GENERAL meeting of the Mineralogical Society will be held in the library, Museum of Science and Art, Edinburgh, on Tuesday, June 24, at 12 o'clock noon. The following papers will be read:—Forms of silica, by John Ruskin, D.C.L., Slade Professor at Oxford (communicated by the Local Secretary for Scotland); application of the periodic law to mineralogy, by Thomas Carnelley, D.Sc., F.C.S., Professor of Chemistry, Univ. Coll. Dundee (communicated as above); the origin of the andalusite schists of Aberdeenshire, by John Horne, F.R.S.E., H.M. Geol. Survey; on the occurrence of prehnite and other zeolites in the rocks of Samson's Ribs and Salisbury Crags, by Andrew Taylor, F.C.S., A.G.S.E. (communicated as above); on a new locality for zoisite, by W. Hamilton Bell, F.G.S.E. (communicated as above); on diatomaceous deposits in Scotland, by Prof. W. I. Macadam, F.C.S., Hon. Sec. G.S.E.; notes on the albertite beds of Strathpeffer, Ross-shire, by William Morrison, M.A., Academy, Dingwall (communicated as above); kyanite localities in the north, and staurolite from Presholme, Enzie, Banffshire, by Thomas Wallace, High School, Inverness; the crystallography of bournonite, by H. A. Miers, B.A., British Museum, Nat. Hist. Dept.; notes on the metallic veins of the Upper Hartz, Germany, by H. M. Cadell, B.Sc., H.M. Geol. Survey (communicated as above); Scottish localities for actinolite, by Rev. W. W. Peyton; on a peculiar development of crystals of tourmaline from Lockport, N.Y. County, U.S., by R. H. Solly, F.G.S.

FATHER DENZA, Director of the Meteorological Observatory of the Turin Exhibition, is taking steps for organising observations on board the Godard captive balloon, which ascends to an altitude of from 200 m. to 300 m. The principal scientific features of the Turin Exhibition are:—(1) The collection exhibited by Prof. Sylvestri, Director of the Etna Observatory, and containing a number of specimens of amber collected on this mountain. (2) The methods employed by M. de Rossi, head of the newly-created Seismographic Service for issuing warnings of earthquakes and describing the observed phenomena. M. de Rossi has issued a catalogue of 200 pages octavo describing the principal objects exhibited, the instruments tried, the methods adopted, and the results arrived at. (3) An historical Borgho, exhibiting mediæval costumes, buildings, instruments, furniture, and methods of working. A number of people of both sexes wearing the costumes attend to this part of the Exhibition.

THREE Ministers inaugurated in state, on June 14, the National Exhibition of Rouen, which will be international for electrical purposes. In the official speeches allusion was made to the Universal Commemorative Exhibition which is to be held in Paris in 1889. The site selected is the celebrated Park of St. Cloud, and a Crystal Palace is to be built on the ruins of the old Imperial palace.

UNDER the auspices of the Norwegian Association for the Promotion of Fisheries an establishment for the hatching of cod and soles' ova has been prepared near Arendal in the Christiania Fjord. From the excellent results already obtained it has been decided to found another hatching station near Christiania.

A LARGE copper basin consisting of small pieces riveted together and several wooden kegs containing "bog butter" were recently found at a depth of 7 feet in a peat-moss, Kylealsin, Skye. The kegs are each hollowed out of a solid block of wood, and show traces of burning all over the surface. The largest measures 1 foot 7 inches in height and 3 feet 6 inches in circumference.

THE additions to the Zoological Society's Gardens during the past week include a Vervet Monkey (*Cercopithecus lalandii* ♂) from South Africa, presented by Mr. J. Bulteel; a Bonnet Monkey (*Macacus sinicus* ♀), a Macaque Monkey (*Macacus cynomolgus* ♂) from India, presented by the Committee of the Latimer Road Mission; two Black-eared Marmosets (*Hapale penicillata* ♂ ♂) from South-East Brazil, presented by Mr. J. H. Bentley; two Vulpine Phalangers (*Phalangista vulpina*) from Australia, presented respectively by Mr. McClellan and Mr. Jay; a Marsh Ichneumon (*Herpestes galera*) from South Africa, presented by Mrs. Frank; two Angolan Vultures (*Gypohierax angolensis*), a White-necked Stork (*Ciconia episcopus*), an African Tantalus (*Pseudotantalus ibis*) from West Africa, presented by Mr. Thomas J. Alldridge; a Spur-winged Goose (*Plectropterus gambensis*) from West Africa, presented by Mr. J. B. Elliott; two Mute Swans (*Cygnus olor*), European, presented by Mr. H. Welch Thornton; two Angulated Tortoises (*Chersina angulata*) from North Damara Land, presented by Mr. F. R. Hemming; a Slow-worm (*Anguis fragilis*), a Common Viper (*Vipera berus*), British, presented by Mr. T. E. Gunn; a Bonnet Monkey (*Macacus sinicus* ♂) from India, four Muscovy Ducks (*Coirina moschata*), five Royal Pythons (*Python regius*) from West Africa, deposited; an Echidna (*Echidna hystrix*), a Brush Turkey (*Tallegala lathami*) from New South Wales, two Red-cheeked Colys (*Colius erythromelon*) from South Africa, four Bronze-winged Pigeons (*Phaps chalcoptera* ♂ ♂ ♀ ♀) from Australia, a Great-billed Parrakeet (*Tanygnathus megalorhynchus*) from Ceram, a Mealy Amazon (*Chrysotis farinosa*) from South America, four White Storks (*Ciconia alba*), European, a Kingfisher (*Alcedo ispida*), British, purchased; a Collared Fruit Bat (*Cynonycteris collaris*), a Japanese Deer (*Cervus sika* ♀), six Chiloe Wigeons (*Mareca chiloensis*), four Chinese Blue Magpies (*Cyanopolius cyanus*), bred in the Gardens.

OUR ASTRONOMICAL COLUMN

RECENT IMPROVEMENTS IN ASTRONOMICAL INSTRUMENTS.—Acting under the directions of the Secretary of the Navy, Prof. Newcomb last year visited the principal Observatories on the continent of Europe for the purpose of collecting information relating to the most recent improvements in astronomical instruments and methods of observation; and in a Report which has been laid before Congress and printed he has embodied the main results of his journey. The establishments visited were the Observatories of Paris, Neuchâtel, Geneva, Vienna, Berlin, Potsdam, Leyden, and Strasburg, and the workshop of Messrs. Repsold at Hamburg. Prof. Newcomb acknowledges the cordial reception he met with from the directors and astronomers of the various observatories, and the facilities everywhere afforded him for the execution of his mission. Most interest attached to the great refractor constructed for the Observatory at Vienna by Howard Grubb of Dublin, which was completed in 1881, but, owing to various delays, had hardly been brought into active operation at the time of Prof. Newcomb's visit in April 1883. Nevertheless he was able to compare it in several respects with the great Washington telescope, which is of only one inch less aperture. He considers that "as a piece of mechanical engineering it reflects great credit upon its designer and constructor." The chief drawback he remarked, the reasons for which were not evident either to him or to Dr. Weiss, the Director of the Observatory, consisted in the failure of the friction-rollers for easing the motion in declination; this motion was found much more difficult than in the case of the Washington telescope. Prof. Newcomb also points to the absence of any rough setting either in right ascension or declination, and the impossibility of seeing the pointing in declination except when the observer was at the eyepiece. With regard to the objective he considers, from such observations as he was able to make, that, "if any defects exist, they are so minute as not to interfere in any important degree with the finest performance of the instrument," and its proper figuring is rightly considered the most difficult task in the construction of a large telescope. In the workshops of Messrs. Repsold at Hamburg Prof. Newcomb had the advantage of meeting M. Otto Struve, and discussing with him the arrangements for mounting the 30-inch refractor intended for the Imperial Observatory at Pulkowa, the most striking feature in which is the absence of friction-rollers from the declination axis; he describes the system of wheelwork destined to obviate the difficulty of turning so large an instrument either by hand or a rope attached to the two ends of the axis, as at Washington and Vienna, owing to the amount of the friction. The eyepiece micrometers, as now constructed by the Repsolds, are commended for their rapid and convenient use. Amongst his general practical conclusions Prof. Newcomb expresses the opinion that in the mounting of instruments of the larger size, in order to secure necessary stiffness with the least weight, the axes should be hollow. He does not consider that it is worth while to attach friction-rollers to the declination axis, unless further experiment should show that they can be rendered more effective than in the Vienna equatorial. The old system of attaching a single finder to that side of the telescope which is opposite the declination axis, he remarks, is insufficient in the case of a large instrument, owing to the necessity of setting the opening in the dome not only to the telescope but to the finder, and suggests the desirability of adopting the plan in the Vienna instrument, which has two finders, the one above and the other below the telescope when in the meridian—a plan obviating all difficulty. The Report further explains the principle of the equatorial *coudé*, or elbow-shaped equatorial, of the Paris Observatory. The Strasburg meridian-circle, "commonly considered to embody the latest conceptions in astronomical mechanics," is noticed in some detail; Prof. Newcomb thinks a degree of stability has been secured in it which has never before been reached, and he was at much pains to obtain data for comparing the instrument with the meridian-circle at Washington; its general design he describes as similar to that of the great meridian-circle at Harvard College Observatory, which was constructed by Troughton and Simms of London. The reader must be referred to the Report for other particulars bearing upon meridian instruments.

THE ASPECT OF URANUS.—In a note communicated to the Paris Academy of Sciences on June 9, MM. Henry state that, observing on very fine nights with the 15-inch refractor, they have satisfied themselves of the existence of two gray belts, straight and parallel, and placed almost symmetrically with respect to the centre of the disk of Uranus, and that, by measures of their direction, they have found an inclination of about 41° to the direction of the orbits of the satellites; they assume that the planet's equator is in the direction of the belts. Astronomers will probably look for confirmation of such an anomaly to our larger instruments.

THE CONTINUITY OF THE PROTOPLASM THROUGH THE WALLS OF VEGETABLE CELLS

AMONG the numerous generalisations of modern botany there are perhaps few that promise to have more important consequences than the recent statements to the effect that the protoplasmic contents of the cells of plants are not entirely shut off from one another by the cell-walls, but that arrangements exist of such a kind that more or less delicate strands of protoplasm pass through from one cell to another, piercing the cell-walls either at numerous points at certain thinner spots, or simply here and there.

Th. Hartig in 1837 distinguished certain constituents of the bast of phanerogams which we now know as sieve-tubes. Investigated later by the same observer and by Mohl, Nägeli, Sachs, and Hanstein, the question as to whether the septa between the cylindrical constituents of these tubes are really perforated, or simply studded with thin pits, was set at rest by the demonstration that strands or cords of protoplasmic substance pass through definite pores or passages in the septa or cell-walls. This discovery then became common property, abundantly confirmed, and is now practically demonstrated by students in every properly conducted botanical laboratory: it remained somewhat isolated for many years, however.

In 1880 the botanical world was startled by Tangl's discovery that the cells of the endosperm of certain seeds (*Strychnos*, *Areca*, &c.) present a similar feature—that delicate filaments of protoplasm traverse the cell-walls through fine perforations, and so place the protoplasmic contents of the cells in direct continuity one with another.

In 1882 Gardiner showed that a similar continuity of the protoplasm exists between the cells of the motile organs of certain sensitive plants, and there can be no doubt that the communication thus established through the cell-walls is instrumental in causing the propagation from cell to cell of the stimulus which induces the movement. It thus becomes established that the cell-walls of plants can no longer be regarded as entirely separating off the contents of one cell from those of another; but that, in many cases at any rate, the idea of the individuality of the vegetable cell becomes as difficult to maintain as did that of animal cells after the first struggles which resulted in the overthrow of the old cell theory.

Since 1882, Gardiner has succeeded in extending his results, and has shown that the cells of numerous other parts of plants are in continuity in the same manner, by strands of protoplasm passing through the cell-walls. These researches are, moreover, confirmed by Russow for certain cells of the parenchyma of bast and medullary rays; and there seems little need of hesitation to accept generally the view that the cells of plants are not closed sacs as was formerly believed, but are provided with passages through their walls, through which fine filaments of protoplasm communicate. Such at least results from the observations so far, and especially those of Gardiner, on the endosperms of a large series of plants. It may now be stated, however, that this is not the only evidence to be quoted in support of the above generalisation. In addition to the observations of Nägeli, Pringsheim, and others, pointing out that the protoplasm frequently adheres to the cell-walls so closely at certain places that it may be pulled out into strands, or even break away, leaving portions on the walls, Gardiner has also made observations which confirm this, and which strongly favour the view that the protoplasmic strands are held fast at the points where they traverse the cell-walls. Bower has also observed similar phenomena in the withdrawal of the peripheral protoplasm in plasmolysis.

Moreover, it has been pointed out that in the case of cells with very thick walls, the thin pits are normally found to meet on opposite sides; the same is the case with the radiating strands in *Volvox*, and where two opposite strands reach the common cell-wall at different angles, they nevertheless meet at a point.

So far, however, there is no evidence to show whether the continuity of the protoplasmic strands is maintained from the earliest stages, or is established later. This, however, is a very important question in connection with this subject, since the answer to it will materially affect our views as to the nature of the cell. If the cell-walls produced in vegetative division are not complete septa, but membranes filling up the interstices between continuous strands of protoplasm, then the continuity of the protoplasm through the wall of vegetable cells is simply to be regarded as an expression of the fact that the entire plant or organ is practically one whole—one mass of protoplasm cut up into chambers which communicate with one another, and bounded by a membrane on the exterior. If, on the other hand, the communications between the protoplasm of neighbouring cells are only established after a complete septum has been formed, then it may or may not be that the above view holds, —so far as the continuity of the protoplasm of mature cells is concerned, it affords no conclusive proof against the very generally accepted idea that the plant consists of cell units aggregated into colonies, tissues, &c.

Turning for a moment to certain investigations which throw light on this matter from totally different directions, it will be seen that there is much to be said for the view lately stated by Sachs, and first hinted at by Hofmeister, that a much closer relation of cell to cell exists than can be well explained by the theory that a plant is a sort of cell republic, consisting of aggregated cell units.

Strasburger's well-known investigations on the process of cell division have led to the remarkable and startling result that the septum or partition-wall, formed when a cell divides, is in general a solid membrane built up by the aggregation of certain particles (microsomes) which become arranged into a plate (the cell-plate) at the equator of the dividing mass of protoplasm. These microsomes are conducted to this equator, and there mobilised by certain delicate fibrillæ in the protoplasm; these fibrillæ form the well-known spindle-like figure, and are continuous across the equator. If the microsomes travel along the fibrillæ from either side, and are fitted together between them, it seems difficult to doubt that the continuity of the protoplasm observed later simply depends upon the persistence of this primitive continuity, and such appears to be the case.

The proof that the primitively continuous fibrillæ remain continuous throughout does not yet exist however; and although it is so likely, it cannot be forgotten that protoplasm possesses a marvellous power of boring through and dissolving even adult cell-walls, as is evident in the exit of zoospores or the entrance of parasites through cell-walls, the formation of pollen-grains, &c.

But we have not yet exhausted the evidence for the view that the continuity of the protoplasm through the cell-walls of fully developed organs exists from the first.

The investigations of Strasburger, Schmitz, and others, on the protoplasm and nucleus of vegetable cells, have yielded the results that, in the first place, many cells believed to be devoid of nuclei really possess these structures, and often in enormous numbers; and, secondly, that many cases of division occur where a delicate cell-wall is formed in the equatorial plane between the two dividing nuclei, but only to disappear later. In many other cases no recognisable septum is formed at all. The internodes of *Chara* and the zoosporangia of *Achlya* may be cited as examples. In *Vaucheria*, *Caulerpa*, &c., again, we have plants each of which is practically a single cell with numerous nuclei: these nuclei divide as the cell grows, but no cell-walls are formed —the plant remains "unicellular."

If in such cases a septum were formed each time a nucleus divides, the protoplasm of the *Vaucheria*, *Caulerpa*, &c., would become divided up into cells; and if the septum in each division were incomplete only in so far that it allowed the fibrillæ of protoplasm which carry and arrange the microsomes to remain continuous through it, we should have essentially the condition of things demonstrated by Hanstein, Tangl, and especially by Gardiner.

But it would in such a case be imperative to express the facts in accordance with the primitive state of affairs—the protoplasm of the hypothetical plant would be cut up into compartments or cells, communicating throughout. Now it is just this view which Sachs has lately brought forward so clearly and ably. A multicellular plant does not grow and become complex because it consists of numerous aggregated cells which increase and divide; but it becomes multicellular because it grows larger, and partition walls are placed in the mass partly for mechanical purposes, partly to insure physiological distribution of labour.

It is impossible, Sachs thinks, to hold the view that *Vaucheria*, *Caulerpa*, and such plants have arisen by the degradation of ancestors which formed cell-walls. It is also suggestive that the nuclei in such "unicellular" plants are more closely packed at the growing apex of the vesicle; for we may thus understand how the growing point of an organ with a single large apical cell only differs in degree from one with numerous small apical cells.

The consideration of all these matters leads to the conviction that the cell-theory so long taught may have to be modified even more than it has been during the last ten or twelve years; and that once more we are being driven back to that centre of all biological phenomena—the properties of protoplasm, multiple and various in degree and in kind as they are.

In conclusion, we cannot omit drawing attention to the improved and refined methods employed by the careful and skilled botanists of the younger school; and it is to be hoped that those who pass over the ground again will be at least equally well equipped. It is not only reagents that are necessary in such matters—critical power is indispensable as well as pure chemicals, as any one may convince himself by the study of the recent memoirs referred to, including the careful papers from Gardiner's hands. One more point may well be insisted upon here: the exhaustive study of a series of facts invariably brings them at length into relation with other facts, and where neither series is alone sufficient to base a scientific induction upon, converging groups of observations may result in the establishment of very important generalisations, leading to the recognition of still larger consequences. There can be no question of the intrinsic value of the observations on the continuity of protoplasm, apart from the information they give in connection with physiological matters; but it is certain that they gain immensely in scientific importance when looked at in the light afforded by recent discoveries as to the behaviour of the nucleus and protoplasm in cell division.

NATIONAL WORK AND HEALTH

THE work of the International Juries was formally inaugurated at the Health Exhibition on Tuesday by H.R.H. the Prince of Wales. The principal address was given by Sir James Paget, who chose as his subject "The Relation between National Health and Work," especially as it may be shown in a few of the many examples of the quantity of work which is lost to the nation either through sickness or through deaths occurring before the close of what may fairly be reckoned as the working time of life.

Sir James Paget went on to say:—I think it may be made clear that this loss is so great that the consideration of it should add largely to the motives by which all people may be urged to the remedy of whatever unwholesome conditions they may live in. It is a subject which is often in the minds of the real students of the public health, but the public itself is far too little occupied with it.

In view of the national health and welfare, the pattern healthy man is one who lives long and vigorously; who in every part of his life, wherever and whatever it may be, does the largest amount of the best work that he can, and, when he dies, leaves healthy offspring. And we may regard that as the healthiest nation which produces, for the longest time and in proportion to its population, the largest number of such men as this, and which, in proportion to its natural and accumulated resources, can show the largest amount and greatest variety of good work.

Here let me insert, as an interpretation clause, that in all this and what is to follow the word "man" means also "woman," and "he" also means "she"; and that when I speak of work I mean not only manual or other muscular work, but work of whatever kind that can be regarded as a healthy part of the whole economy of the national life. And I shall take it for granted that a large portion of all national welfare is dependent on the work which the population can constantly be doing; or, if I may so express it, that the greater part of the national wealth is the income from the work which is the outcome from the national health.

It is a common expression that we do not know the value of a thing till we have lost it; and this may be applied to the losses of work which are due to the losses of national health. There are very few cases in which these can be estimated with any appearance of accuracy; but I am helped to the best within our present reach by Mr. Sutton, the Actuary to the Registry of Friendly Societies. In his office are the returns, for many years past, of the sickness and mortality among the members of a very large number of these Societies; and, among other things, there is recorded the number of days on which each member, when "off work" on account of sickness, received money from his Society. Hence Mr. Sutton can estimate, and this he has been so good as to do for me, the average number of days' sickness and consequent loss of work among several hundred thousands of the workmen and others who are members of these Societies. From the entire mass of these returns, he deduces that the average number of days' sickness, per member, per annum, is very nearly a week and a half; and this agrees, generally, with the estimates made in other Societies by Mr. Neison and others. But the averages thus obtained include the cases of members of all ages, and among them many cases of chronic sickness and inability to work during old age. In order, therefore, to get a better idea of the actual annual loss of work through sickness, he has taken the published experience of the members of the large group of Friendly Societies known as the Manchester Unity of Odd Fellows; and then, on the fair assumption that the rates of sickness of the whole population during the working years of life would not be far different, he has calculated the following tables, showing the average annual rates of sickness of each person, enumerated in the Census of 1881, as living between the ages of 15 and 65:—

Ages.	Number of Males: Census of 1881 (England and Wales).	Weeks' Sickness per annum, according to the experience of the Manchester Unity.	Average Sickness per individual per annum (in weeks).
15-20	1,268,269	844,428	·666
20-25	1,112,354	820,183	·737
25-45	3,239,432	3,224,134	·995
45-65	1,755,819	4,803,760	2·736
All ages from 15-65	7,375,874	9,692,505	1·314

Ages.	Number of Females: Census of 1881.	Weeks' Sickness per annum, according to the experience of the Manchester Unity.	Average Sickness per individual per annum (in weeks).
15-20	1,278,963	851,701	·666
20-25	1,215,872	896,685	·737
25-45	3,494,782	3,476,146	·995
45-65	1,951,713	5,368,229	2·751
All ages from 15-65	7,941,330	10,592,761	1·334

Briefly, it appears from these tables that the average time of sickness among the male population during the working years is a small fraction more than 9 days each in each year—and that among the female population it is yet a small fraction more; the excess arising from the larger proportion of persons at the later ages. The result is that among males there is a loss of 9,692,505 weeks' work in every year, and among females a loss of 10,592,761 weeks. Thus we may believe that our whole population between 15 and 65 years old do, in each year, 20,000,000 weeks' work less than they might do if it were not for sickness. The estimate is so large that it must, on first thoughts, seem improbable; but on fair consideration I believe it will not seem so. For the members of the Manchester Unity who are in the working time of life the reckoning is certainly true, and it is founded on the experience of between 300,000 and 400,000 members. In respect of health they may represent the whole population at least as well as any group that could be taken. They are not very strictly selected, they are not picked lives, yet they are such as are able, when they are in health, to earn good wages or good salaries, and, as their prudence in joining this association shows, they are comparatively thrifty and careful persons. They do not, at all events, include many habitual drunkards, cripples, or utter invalids, or those who, through natural feebleness or early disease, or mere profligacy, cannot earn enough to become members or maintain themselves in membership. Neither do they include many of the insane or imbecile and idiotic, of whom there are, in our population, nearly 70,000 doing no work, and losing not less than 3,500,000 of weeks' work in the year.

It would be tedious to tell the grounds on which the estimate may be deemed too high, for just as many and as good could be told on which it might be deemed too low. And it is rather more than confirmed by some estimates of the annual sickness in other and very different groups of persons.

In the Army, at home, the average number of days' sickness in each year is, for each soldier, about 17; and as the number of the troops in the United Kingdom is more than 80,000, we have here a loss of about 200,000 weeks' service in each year.

In the Navy, on the home stations, the average number of days' sickness in each year has been in the last five years for each man nearly 16; so that for the total of about 20,000 men there is a loss of 45,000 weeks' service in each year.

The amount of sickness in the services thus appears much higher than in the Friendly Societies. This is due, in great part, to the fact that a soldier or a sailor is often put off duty for a day or two for much less illness than that for which a civilian would "go on his club." Still, the one estimate may confirm the other; for the sickness in the Army and Navy is that of picked men, who were selected for the services as being of sound constitution, and who are in what should be the best working years of life: and if it includes many cases of sickness for only a day or two, it excludes nearly all cases of more than a few months, such as make up a heavy proportion of the average sickness in the Friendly Societies and in the general population.

And I may add that the estimate from these Societies, that 9 days in the year may justly be thought a fair estimate of the working time lost by sickness, is confirmed by the records of sickness among the 10,000 members of the Metropolitan Police Force; for among these, including cases of long illness such as are also in the Societies, the average is more than 9 days in the year.

I think, then, that we cannot escape from the reasons to believe that we lose in England and Wales, every year, in consequence of sickness, 20,000,000 of weeks' work; or, say, as much work as 20,000,000 of healthy people would do in a week.

The number is not easily grasped by the mind. It is equal to about one-fortieth part of the work done in the year by the whole population between 15 and 65 years old. Or, try to think of it in money. Rather more than half of it is lost by those whom the Registrar-General names the domestic, the agricultural, and the industrial classes. These are rather more than seven millions and a half in number, and they lose about 11,000,000 of weeks; say, for easy reckoning, at a pound a week; and here is a loss of 11,000,000*l.* sterling from what should be the annual wealth of the country. For the other classes, who are estimated as losing the other 9,000,000 weeks' work, it would be hard and unfair to make a guess at the loss in any known coin; for these include our great merchants, our judges and lawyers, and medical men, our statesmen and chief legislators; they include our poets, and writers of all kinds, musicians, painters, and philosophers; and our Princes, who certainly do more for the wealth and welfare of the country than can be told in money.

Before I speak of any other losses of work or of wealth due to sickness, permit me, as in parenthesis, to point out to you how very imperfectly their losses are told or even suggested by our bills of mortality. These, on which almost alone we have to rely for knowing the national health—these tell the losses of life; and more than misery enough they tell of; but to estimate rightly the misery of sickness and the losses of all but life that are due to it, we need a far more complete record than these can give.

Take, for example, such a disease as typhoid fever—that which Mr. Huxley has rightly called the scourge and the disgrace of our country. It has of late destroyed in England and Wales, among persons in the working time of life, nearly 4000 in the year. Its mortality is about 15 per cent., so that if in any year 4000 die of it, about 23,000 recover from it. Of these the average length of illness is, on the authority of Dr. Broadbent, about ten weeks. Here, therefore, from one disease alone, and that preventible, we have an annual loss of 230,000 weeks' work, without reckoning what is lost with those who die. And the same may be said of nearly all the diseases that are most prominent in the bills of mortality. The record of deaths, sad as it is, tells but a small part of the losses of happiness and welfare that are due to sickness. It is as if, in a great war, we should have a regular return of the numbers killed, but none of the numbers sick and wounded, though these, more than the killed, may determine the issue of the war.

Let me now tell of another loss of work and of money through sickness and early death. In all the estimates I have yet referred to, no account is taken of those who are ill or die before they are 15 years old. They are not reckoned as in the working-time of life, though in some classes many thousands of them are. [In the domestic, agricultural, and industrial classes of the Registrar-General nearly half a million of them are included.] And yet the losses of work due to sickness among children must be very large. Consider the time which might be spent in good productive work, if it were not spent in taking care of them while they are ill. Consider, too, the number of those who, through disease in childhood, are made more susceptible of disease in later life, or are crippled, or in some way permanently damaged; such as those who become deaf in scarlet fever, or deformed in scrofula or rickets, or feeble and constantly invalid, so that they are never fit for more than half work or work which is only half well done. These losses cannot be counted, but they must be large; and there are others more nearly within reckoning; the losses, namely, which are due to the deaths of those who die young. It may justly be said that all that they have cost during their lives is so much money sunk; so much capital invested and lost. If they had lived to work, their earnings would have been more than sufficient to repay it; but they have died, and their cost is gone without return. The mortality of children under 15 in 1882 was nearly a quarter of a million: what have they cost? If you say only 8*l*. a piece, there are more than 2,000,000*l*. sterling thus lost every year. But they have cost much more than this, and much more still is lost by the loss of the work they might have lived to do.

I will add only one more illustration of these losses, which is always suggested by looking at tables of mortality. The deaths of persons between 25 and 45 years old, that is during what may be deemed the 20 best working years of life, are annually between 60,000 and 70,000; in 1882 they were 66,000. Think, now, of the work lost by these deaths; and of how much of it might have been saved by better sanitary provisions. If one looks at the causes of their deaths, it is certain that many might have been prevented, or, at least, deferred. Say that they might have lived an average of 2 years more; and we should have had in this year and last an increase of work equivalent to that of at least 6,000,000 weeks; as much, in other words, as 6,000,000 people could do in one week.

More instances of losses of work by sickness and premature death might easily be given, but not easily listened to in this huge hall. Let these suffice to show something of our enormous annual loss, not only of personal and domestic happiness—that is past imagining—but of national power and wealth. Surely we ought to strive more against it.

But, some may ask, can these things be prevented? are they not inevitable consequences of the manner of life in which we choose or are compelled to live? No; certainly they are not. No one who lives among the sick can doubt that a very large proportion of the sickness and the loss of work which he sees might have been prevented; or can doubt that, in every succeeding generation, more may be averted, if only all men will strive that it may be so.

Let me enumerate some of the chief sources of the waste as they appear to one's self in practice, or as one looks down a table of mortality.

Of the infectious fevers, small-pox might be rendered nearly harmless by complete and careful vaccination. Typhus and typhoid, scarlet fever and measles, might, with proper guards against infection, be confined within very narrow limits. So, probably, might whooping-cough and diphtheria.

Of the special diseases of artisans there are very few of which the causes might not be almost wholly set aside. Of the accidents to which they are especially liable the greater part, by far, are due to carelessness.

Of the diseases due to bad food and mere filth; to intemperance; to immorality; in so far as these are self-induced, they might, by self-control and virtue, be excluded. And with these, scrofula, rickets, scurvy, and all the widespread defects related to them, might be greatly diminished.

It can only be a guess, but I am sure it is not a reckless one, if I say that of all the losses of work of which I have spoken, of all the millions of weeks sadly spent and sadly wasted, a fourth part might have been saved, and that, henceforth, if people will have it so, a still larger proportion may be saved.

We may become the more sure of what may be done by looking at what has been done already. Let me show some of it; it will be a relief to see something of the brighter side of this picture.

In a remarkable paper lately read before the Statistical Society, Dr. Longstaff says:—"One of the most striking facts of the day, from the statistician's point of view, is the remarkably low death-rate that has prevailed in this country during the last eight years." In these years the annual death-rate has been less than in the previous eight years, in the proportion of two deaths to every 1000 persons living. The average annual number of deaths has been 50,000 less in the last than in the previous eight years. Doubtless many things have contributed to this grand result, and it is not possible to say how much is due to each of them; but it would be unreasonable to doubt that the chief good influence has been in all the improved means for the care of health which recent years have produced. This is made nearly certain by the fact that the largest gains of life have been in the diminution of the deaths from fever, and of the deaths in children under 15 years old; for these are the very classes on which good sanitary measures would have most influence.

The annual number of deaths from typhus, typhoid, and the unnamed fevers, has been about 11,000 less than it was about 20 years ago. The annual number of deaths of children under 5 years old has been about 22,000 less than it was; and that of children between 5 and 15 has been upwards of 8,000 less.

These are large results, and though they tell of only deaths, yet they bear on the chief subject I have brought before you—the working power of the nation; for, however much of the average we might assign to improved methods of medical treatment of fever, yet the diminished number of deaths means a very large diminution in the total number of cases. The deaths during the working years of life were 6,500 less; and, this being so, we may hold that, if the average mortality was, say, 25 per cent., the diminution in the total number of cases must have been at least 25,000; and if we may believe, as before, that each of these involved ten weeks of sickness, we have, in these fevers alone, a clear saving of 185,000 weeks' work in every year.

And so with the diminution of the mortality among children, there must have been a greater diminution in the number of costly and work-wasting illnesses, and a large saving of money that would otherwise have been sunk. And not only so: but many of the children saved in the last eight years will become bread-winners or care-keepers; and who can tell what some of them will become? or what the world would have lost if it had lost them?

Let me add only one more reckoning. In a paper last year, at the Statistical Society, Mr. Noel Humphreys said "that if the English death-rate should continue at the low average of the five years 1876-80, the mean duration of male life in this country would be increased by two years, and that of female life by no less than 3·4 years as compared with the English Life-table." And he showed further that "among males 70 per cent. and among females 65 per cent. of this increased life would be lived between the ages of 20 and 60 years, or during the most useful period."

I should like to be able to tell the value in working-power of such an addition to our lives. It is equal to an addition of more than 4 per cent. to the annual value of all the industry, mental and material, of the country.

But some will say—admitting that it is desirable, seeing how keen the struggle for maintenance already is, can more than this be done? and the answer may be and must be, much more. In this, as in every case of the kind, every fruit of knowledge brings us within reach of something better. While men are exercising the knowledge they possess, they may be always gaining more. This Exhibition has scores of things which are better helps to national health than those of the same kind which we had twenty years ago, and with which the gains already made were won. If I were not in near official relation with the jurors I would name some of them: there are truly splendid works among them.

But do not let me seem to disparage the past in praising the present. It is difficult to speak with gratitude enough of what has been done, even though we may now see ways to the yet better.

Any one who has studied the sources of disease during the last thirty years can tell how and where it has been diminished. There is less from intemperance, less from immorality; we have better, cheaper, and more various food; far more and cheaper clothing; far more and healthier recreations. We have, on the whole, better houses and better drains; better water and air, and better ways of using them. The care and skill with which the sick are treated in hospitals, infirmaries, and even in private houses, are far greater than they were; the improvement and extension of nursing are more than can be described; the care which the rich bestow on the poor, whom they visit in their own homes, is every day saving health and life; and, even more effectual than any of these, is the work done by the medical officers of health and all the sanitary authorities now active and influential in every part of the Kingdom.

Good as all this work has been, we may be sure it may become better. The forces which have impelled it may still be relied on. We need not fear that charity will become cool, or philanthropy inactive, or that the hatred of evil will become indifference. Science will not cease to search for knowledge, or to make it useful when she can; we shall not see less than we do now, and here, of the good results of enterprise and rivalry, and of the sense of duty and the sorrow for shame that there should be evil in the land.

What more, then, it may be asked, is wanted? I answer, that which I have tried to stir: a larger and more practical recognition of the value and happiness of good national health; a wider study and practice of all the methods of promoting it; or, at least, a more ready and liberal help to those who are striving to promote it. In one sentence, we want the complete fulfilment of the design of this Exhibition, with all the means towards health and knowledge that are shown in it, and with its handbooks, lectures, conferences, and the verdicts of its juries.

We want more ambition for renown in health. I should like to see a personal ambition for renown in health as keen as is that for bravery, or for beauty, or for success in our athletic games and field-sports. I wish there were such an ambition for the most perfect national health as there is for national renown in war, or in art or commerce. And let me end soon by briefly saying what I think such health should be.

I spoke of the pattern healthy man as one who can do his work vigorously wherever and whatever it may be. The union of strength with a comparative indifference to the external conditions of life, and a ready self-adjustment to their changes, is a distinctive characteristic of the best health. He should not be deemed thoroughly healthy who is made better or worse, more or less fit for work, by every change of weather or of food; nor he who, in order that he may do his work, is bound to exact rules of living. It is good to observe rules, and to some they are absolutely necessary, but it is better to need none but those of moderation, and, observing these, to be able and willing to live and work hard in the widest variations of food, clothing, and all the other sustenances of life.

And this, which is a sign of the best personal health, is essential to the best national health. For in a great nation, distributed among its people, there should be both muscular and mental powers suited to the greatest possible variety of work. No form or depth of knowledge should be beyond the attainment of some among them; no art should be beyond its reach; it should be excellent in every form of work. And, that its various powers may have free exercise and influence in the world, it must have, besides, distributed among its people, abilities to live healthily wherever work must be or can be done.

Herein is the essential bond between health and education; herein is one of the motives for the combination of the two within the purpose of this one Exhibition; I do not know whether health or knowledge contributes most to the prosperity of a nation; but no nation can prosper which does not equally promote both: they should be deemed twin forces, for either of them without the other has only half the power for good that it should have.

It is said, whether as fact or fable, that the pursuit of science and of all the higher learning followed on the first exercise of the humanity which spared the lives of sick and weakly children; for that these children being allowed to live, though unfit for war or self-maintenance, became thinkers and inventors. But learning is not now dependent upon invalids; minds are not the better now for having to work in feeble bodies; each nation needs for its full international influence both health and knowledge, and such various and variable health that there should be few places on earth or water in which some of its people cannot live, and multiply, and be prosperous.

If, therefore, we or any other people are to continue ambitious for the extension of that higher mental power of which we boast, or for the success of the bold spirit of enterprise with which we seek to replenish the earth and subdue it; if we desire that the lessons of Christianity and of true civilisation should be spread over the world, we must strive for an abundance of this national health, tough, pliant, and elastic, ready and fit for any good work anywhere.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

CAMBRIDGE.—The Senior Wrangler, Mr. W. F. Sheppard, scholar of Trinity College, is a native of Australia; the Second Wrangler, Mr. W. P. Workman, also a scholar of Trinity, is the son of a Wesleyan minister.

The Natural Sciences Tripos, Part 1, contains the names of fifty-three men, of whom thirteen are placed in the first class; in addition six are allowed an ordinary degree, and six are excused the general examination. Two ladies attained a first class, four a second, and one a third.

In the Natural Sciences Tripos, Part 2, the first class includes the names of Messrs. Adami (Physiology) Christ's College; Chree (Physics), King's; Green (Botany, Physiology), Trinity; Head (Physiology), Trinity; Laurie (Chemistry), King's; Phillips (Botany), St. John's; Shipley (Zoology), Christ's; and Threlfall (Chemistry, Physics), Caius. The subjects mentioned are those for distinction in which the candidates are placed in the first class.

Mr. C. Potter will give lectures on Systematic Botany with field excursions and practical work, in the long vacation, beginning July 8.

SOCIETIES AND ACADEMIES

LONDON

Mathematical Society, June 12.—Prof. Henrici, F.R.S., president, in the chair.—Mr. G. S. Ely, Fellow of the Johns Hopkins University, Baltimore, was elected a member.—The chairman announced that the Council had awarded the first De Morgan gold medal to Prof. Cayley, F.R.S.—A note on the induction of electric currents in a cylinder placed across the lines of magnetic force, by Prof. H. Lamb, was read in abstract.—Mr. J. Hammond gave some results of a paper which is shortly to appear in the *American Journal of Mathematics*.

Linnean Society, June 5.—Wm. Carruthers, F.R.S., vice-president, in the chair.—Messrs. J. Starkie Gardner, F.G.S., and J. H. Leech were elected Fellows of the Society.—Mr. J. Harris Stone exhibited and made remarks on specimens and photographs, viz. portion of the wood and of a remarkable wart (as large as a cocoa-nut) from the famous dragon-tree, *Dracæna draco*, of the Canaries; photograph of the young dragon-tree planted by the Marquesa de Sawyal, and now growing on the site of the old celebrated tree of Oratova; photograph of the dragon-tree of Icod-de-los-Vinos in Teneriffe; and a photograph of the Peak of Teneriffe, showing how the "Retana" grows on the Cañadas.—There was shown, on behalf of Mr. R. Morton Middleton, a small branch of *Cotoneaster microphylla* grown at Castle Eden, Co. Durham, and a good example of fasciation in this plant.—Dr. R. C. A. Prior afterwards drew attention to specimens of the rare *Potentilla rupestris* from Craig Breidhin, Montgomeryshire, and of *Rumex sanguinens*, from the neighbourhood of Bristol, both freshly gathered by Mr. T. Bruges Flower, F.L.S.—A paper by Mr. G. Claridge Druce was read, in which he describes a new variety of *Melampyrum pratense*, L., and which he suggests should be known as var. *hians*.—Prof. J. Martin Duncan read a paper on a new genus of recent Fungida allied to the fossil form *Micrabacia*; the genus being based on a specimen of coral obtained from shallow water in the Corean Sea.—A communication was made by Mr. Arthur R. Hunt, on the influence of wave-currents on the fauna inhabiting shallow seas. The author refers to various physical data, among others quoting Prof. Stokes and Mr. T. Stevenson, the latter stating that a current of 0·6819 of a mile per hour will carry forwards fine gravel, and that of 1·3638 roll along pebbles an inch in diameter. From this and other facts Mr. Hunt argues that wave-currents do materially influence the marine fauna inhabiting shallow water, not only those of the tidal strand, but likewise those inhabiting the deeper sea-bottom. He adduces instances of animals living among or on rocks, and of those frequenting sand or other deposits, enumerating species of star-fish, mollusks, shrimps, crabs, and fish. He says that even the flat-fishes (Pleuronectidæ) seem to have changed their original forms and habits for the purpose of being able to live in shallow waters agitated by waves. Referring more particularly to species of *Cardium*, he endeavours to show how, under the influence of wave-currents, the variation of species may be promoted and even their local extinction brought about.—A paper was read, on the Longicorn Beetles of Japan, by Mr. H. W. Bates. In a former paper (in 1873), on the same subject, the author treated of 107 species, but now adds many new genera and 129 more species, or a total of 236 specific forms as at present known to belong to the Japanese fauna. This great accession is due to the later collections of Mr. Geo. Lewis, who made a second visit to the islands in 1880–81. Mr. Bates, reasoning from this fresh material, is inclined to modify his previously-stated views as to the predominance of a supposed tropical element in the Longicorn group in question; the relative number of absolutely new genera now turning the scale in favour of Palæarctic or Nearctic affinities.—The last zoological communication taken was on three new species of *Metacrinus*, by P. Herbert Carpenter, with note on a new *Myzostoma*, by Prof. von Graff. Mr. Carpenter describes *Metacrinus rotundus* from Japan, dredged there by Dr. Doderlein of Strasburg, and *M. superbus* and *M. stewarti*, two remarkable forms obtained by the Telegraph Company on picking up a cable near Singapore. The *Myzostoma cirripedium* was found on the Japan Crinoid.

Chemical Society, June 5.—Dr. Perkin, F.R.S., president, in the chair.—It was announced that a ballot for the election of Fellows would take place at the next meeting.—The following papers were read:—On β-napthaquinone, by C. E. Groves. In a preliminary notice read before the Society some time since (*Chem. News*, xliii. 267) the author mentioned that he had carefully repeated some experiments of Liebermann. In the present paper full details are given of the preparation of amido-β-naphthol hydrochloride from β-naphthol orange by reduction with stannous chloride and with alkaline sulphides. This reaction is very inferior in simplicity and economy to the process originally proposed by Stenhouse and the author. Several improvements in the original process are suggested, and the author gives an account of some products obtained by the action of reducing agents on the nitroquinone.—On a by-product of the manufacture of aurin (part ii.), by A. Staub and Watson Smith. The authors have prepared a perfectly pure specimen of this product, phenylorthooxalic ether; they conclude that it plays no part as an intermediate product in the formation of aurin. Analogous compounds with α- and β-naphthols were prepared, but no compound with resorcinol could be obtained.—On calcium hydrosulphides, by E. Divers and Tetsukichi Shimidzu. When hydrogen sulphide is passed through milk of lime, the lime dissolves; by adding more lime, a solution is finally obtained, which, after decantation and cooling, deposits colourless prismatic crystals of the hydrosulphide; by the action of water on this body, calcium hydroxyhydrosulphide is formed. The authors find that hydrogen sulphide decomposes calcium carbonate. They have also studied calcium monosulphide and the formation of the thiosulphate from the hydrosulphide and the pentasulphide.

Anthropological Institute, May 27.—Prof. Flower, F.R.S., president, in the chair.—The election of F. C. J. Spurrell was announced.—Mr. H. O. Forbes read a paper on the Kubus of Sumatra. The Kubus are a nomadic race inhabiting the central parts of Sumatra. In their wild state they live in the deep forest, making temporary dwellings, consisting of a few simple branches erected over a low platform to keep them from the ground, and thatched with banana or palm leaves. They are extremely timorous and shy, so that it is a very rare thing for any of them to be seen, and if suddenly met in the forest by any one not of their own race, they drop everything and flee away. They cultivate nothing, and live entirely on the products of the chase. Their knives and the universal spear with which they are armed are purchased from the Malays, with whom they trade. They are of a rich olive-brown colour, and their jet-black hair, apparently far less straight than that of the village Malays, was always in a dishevelled state and in curls. The average height of the males was about 1·59 m. and that of the females 1·49 m.—Dr. Garson read a paper on the osteology of the Kubus.—Mr. Theodore Bent read some notes on prehistoric remains in Antiparos, and exhibited several specimens of pottery, some rudely carved marble figures, and a skull, from cemeteries in that island.

Institution of Civil Engineers, May 20.—Sir J. W. Bazalgette, C.B., president, in the chair.—The paper read was on the passage of upland water through a tidal estuary, by W. R. Peregrine Birch, M.Inst.C.E.

CAMBRIDGE

Philosophical Society, May 12.—Mr. Glaisher, president, in the chair.—The following were elected Honorary Members:—On the Foreign List—A. Baeyer, Professor of Chemistry at Munich; Anton Dohrn, Director of the Zoological Station at Naples; Carl Gegenbaur, Professor of Comparative Anatomy in the University of Heidelberg; G. Mittag Leffler, Professor of Mathematics in Stockholm; E. F. W. Pflüger, Professor of Physiology in the University of Bonn; Gustav Quincke, Professor of Physics in the University of Heidelberg; H. A. Rowland, Professor of Physics in the Johns Hopkins University, Baltimore, U.S.A.; Julius Sachs, Professor of Botany in the University of Würzburg; H. G. Zeuthen, Professor of Mathematics in Copenhagen. On the Home List—R. Stawell Ball, Astronomer-Royal for Ireland; W. T. Thiselton Dyer, Assistant Director of the Royal Gardens, Kew; J. Whitaker Hulke, ex-President of the Geological Society.

May 26.—Mr. Glaisher, president, in the chair.—Prof. E. Ray Lankester was elected an Honorary Member. Mr. S. L. Hart, St. John's College, was elected a Fellow.—The following communications were made:—On some irregularities in the values of the mean density of the earth as determined by Baily, by Mr. W. M. Hicks. The author showed that the numbers obtained by Baily for the mean density of the earth depended on the temperature of the air at which the different observations were made; and he exhibited a table showing that as the temperature increased from 40° F. to 60° F. the deduced mean densities fell continuously from 5·734 to 5·582. He considered several possible causes of error, but showed that they were either inadequate to explain the irregularities, or tended in the opposite direction. The only further suggestion that occurred to him was that Baily's personal equation was a function of the temperature, leading him, as his temperature rose, to estimate distances more liberally.—On some physiological experiments, by Dr. Gaskell.—On a method of comparing the concentrations of two solutions of the same substance but of different strength, by Mr. A. S. Lea.—On the many-layered epidermis of *Cliia nobilis*, by Mr. W. Gardiner.—On the possible systems of jointed wickerwork and their degrees of internal freedom, by Mr. J. Larmor.

DUBLIN

University Experimental Science Association, June 3.—Dr. Tarleton, F.T.C.D., in the chair.—G. F. Fitzgerald, F.T.C.D., F.R.S., on Prof. Osborne Reynolds' mechanical illustrations of heat-engines.—J. Joly, B.E., on the eruption of Krakatoa.—The Cambridge Instrument Company's reflecting galvanometer was exhibited by Prof. Fitzgerald, and a portable calorimeter designed for approximately determining the specific heats of minerals, by J. Joly.—An apparatus for determining the latent heat of vaporisation was exhibited by F. Trouton. The chief gain in the use of the apparatus is, that to effect a determination by its means it is not requisite to know either the boiling-point of the liquid or the specific heat of the body in either the liquid or gaseous condition. Both of these are very irregular and extremely difficult to determine at temperatures approaching the boiling-point. The use of calorimeters is also avoided, often a source of serious error. In the vessel in which the liquid is placed there is a spiral of platinum or other substance unattacked by the liquid. On passing a current of electricity (the difference in potential being insufficient to decompose the body if a compound) through the spiral, heat is generated, and the liquid vaporised if at the boiling-point. According as the body is vaporised it is conducted away to a condenser, collected, and weighed. All sensible loss of heat is prevented by surrounding the vessel by a larger one full of vapour obtained by boiling some of the liquid itself in the bottom of the outside vessel under the same pressure as in the inner one; so that, if in any experiment the weight is determined of the liquid vaporised while a known quantity of electricity passes, the heat required to vaporise unit weight of the body can be deduced, the resistance of the spiral being also known. As the electrical measurements are difficult to make sufficiently accurate, it is simpler to compare the latent heat of the body with that of a liquid of which the latent heat is known. This may be easily effected by employing a second apparatus similar to the first, in which the liquid taken as the standard (say water) is put. The same current is passed through both spirals, so that the ratio of the latent heats may be deduced on weighing the quantities vaporised, if the ratio of the resistances of the spirals is known. This, if both liquids boil at nearly the same temperature, may be obtained by a previous experiment where one of the bodies is put into both apparatuses, the ratio of the resistances being that of the weights of the substance to be vaporised.

EDINBURGH

Mathematical Society, June 13.—Mr. A. J. G. Barclay, vice-president, in the chair.—Mr. William Peddie read a paper, illustrated by models, on the graphical representation of physical properties; and Mr. David Traill one on geometry from first principles.

PARIS

Academy of Sciences, June 9.—M. Rolland, president, in the chair.—Remarks on the apparent contour of the planet Venus, based on the study of the photographic plates obtained at Puebla during the recent transit of Venus, by MM. Bouquet de la Grye and Arago.—Note on heavy ordnance in connection with the large gun (16 cm.) lately supplied to the Spanish Government by the Société des Forges et Chantiers de la Méditerranée, by M. Dupuy de Lome.—Memoir on the presence of manganese in plants and animals, and on the part played by this substance in the animal system, by M. E. Maumené. Tea and tobacco are found to contain the largest quantities of metallic manganese, which is on the whole injurious to animals, and constantly rejected by them, hence it should no longer be employed medicinally.—On the aspect of Uranus and the inclination of its equator, as observed at the Paris Observatory during the first days of the present year, by MM. Paul and Prosper Henry.—Note on the symmetrical functions of the differences in the roots of an equation, by M. J. Tannery.—Description of a dynamo-electric machine on a new principle, a model of which has been constructed by MM. A. Damoiseau and G. Petitpont. For this engine it is claimed that it does double the work of those now in use.—On the property of silver to absorb oxygen gas at high temperatures, by M. L. Troost.—Note on the action of the sulphuret of copper on the sulphuret of potassium, by M. A. Ditte.—On the solubility of the bromides, iodides, and chlorides of potassium, sodium, calcium, and other halogenous salts, by M. A. Etard.—Observations on some colloidal substances, by M. E. Grimaux.—Synthesis of pyridic hydrides, results of two years' researches with β-lutidine and β-collidine (boiling at 196° C.), derivatives of cinchona and brucine, by M. Oechsner de Coninck. These somewhat incomplete results are now published in consequence of the remarkable facts recently disclosed by MM. Hofmann and Ladenburg.—On tribenzoylmesitylene, by M. E. Louïse.—On crystallised colchicine, by M. A. Houdès.—Experiments on manure artificially prepared with a view to determining the amount of loss of nitrogen sustained during the process of fermentation, by M. H. Joulie. The loss of nitrogen was found to be about 20 per cent., a proportion inferior to what takes place in practice.—Note on the minerals associated with the diamond in the newly-discovered diamantiferous district of Salobro, province of Bahia, Brazil, by M. H. Gorceix.—Anatomy of the Echinoderms; on the organisation of the Comatules, by M. Edm. Perrier.—On the constitution of the Echinoderms, by M. C. Viguier.—Objections to the theory that the Sahara was a marine basin during the Quaternary period, by M. G. Rolland. From more recent surveys in various parts of this region the author concludes that since the Tertiary period the Sahara was mainly dry land, while at the close of the Miocene all North Africa had been upheaved, and since then during the Pliocene and Quaternary the South Mediterranean coast-line has undergone no important modifications.—On the lesions of the nerve-ducts of the spinal marrow in sclerotic affections, by M. J. Babinski.—M. Jamin was elected Perpetual Secretary in the Section of Physical Sciences in place of the late M. Dumas.

BERLIN

Physical Society, May 23.—Prof. H. W. Vogel reported on the final practical results of his researches conducted for many years on the means of photographing coloured objects in their natural shades. Sensitive plates are known to be affected only by the more refrangible rays, the less refrangible remaining inoperative. Hence, of coloured objects quite unnatural pictures are obtained, even the darkest shades of blue appearing as white; yellow and red, however bright and dazzling, as black; and so on Starting from the idea that the sensitive collodium is affected only by such rays as are absorbed by it, Prof. Vogel had years ago been occupied with the attempt to render his plates sensitive to less refrangible rays, by alloying the silver coating with a substance capable of absorbing these rays. The results corresponded at once with this *a priori* assumption. In fact, plates so prepared invariably produced an effect in the solar spectrum wherever the absorption bands of the alloy were found. It was impossible, however, to obtain like results with artificial colours. Many colouring substances which, when blended with the collodium, beautifully reproduced the yellow of the solar spectrum, were ineffective against the artificial and infinitely fainter yellow of painters. Prof. Vogel was induced constantly to resume these attempts by the progress made both in the preparation of photographic appliances and in the discovery of new organic substances possessing a power of absorption more intense and lying nearer to the yellow of the spectrum. He has thus at last succeeded in obtaining in eosine, and more especially its various derivatives, colouring substances which scarcely possess more than a broad absorption band in the yellow, and which led to the desired result. When these bodies were mixed in due proportion with the dry gelatine plates, the yellow of the coloured objects already appeared quite clear on the photograph; but the blue was still always brighter. No satisfactory result was obtained until Herr Vogel had inserted between the object and the camera a yellow glass, which partly absorbs the blue rays while leaving the yellow unimpaired. He now obtained photographs in which the blue, as well as the green and yellow, and partly even the red parts of the coloured objects, presented to the observer's eye the same vivid effects as the original. A series of photographs exhibited by Herr Vogel side by side with the original pictures attest the good results with which this method may be carried out in practice.—Prof. Landolt referred to the controversy between MM. Pasteur and Jungfleisch, the former of whom had obtained from the optically inactive racemic acid dextro-gyrate tartaric acid by the culture of Penicillium. This he explained by supposing that the mould assimilates the other constituent of the inactive racemic acid, that is, the lævo-gyrate tartaric acid, leaving the other constituent over, whereas Mr. Jungfleisch accounts for the elimination of the dextro-gyrate tartaric acid simply by its greater solubility. In support of Pasteur's view Prof. Landolt now adduced the experiment with amygdalic acid made last year by Dr. Lewkowitsch in his laboratory. Inactive amygdalic acid was by him, also by means of Penicillium, converted into dextro-gyrate amygdalic acid, which, jointly with the lævo-gyrate amygdalic acid formed from amygdaline, constituted inactive amygdalic acid, such as is obtained from prussic acid. Herr Landolt further reported that in his laboratory it had recently been demonstrated that tyrosine and leucine are optically active. Hence, according to the still unshaken theory of van t'Hoff, these substances must contain unsymmetrically united atoms of carbon.

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