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THURSDAY, NOVEMBER 11, 1869.

THE DULNESS OF SCIENCE

WE have all heard of the fox who, when he had lost his own tail, tried to prevail upon his comrades to dispense with theirs; and we think it must surely have been in a congress of the blind that the question was first started, "Is it dull to use your eyes and look about you?"

For, in fact, what is science but this? We come unexpectedly into a great mansion, of which we know nothing; and if it be dull to seek out the various inmates of the house, and to ascertain its laws and regulations, then is science dull; but if this be important and interesting, then so also is science interesting.

But, alas! the blind in this sense are numbered by myriads; and as they, for a time, almost threaten to carry their point, a few remarks upon the dulness of science, or rather, perhaps, the dulness of men, may not be out of place.

We have in our mind's eye at the present moment several notable specimens of blind men. One of these lives not very far from where we write—a most hopeless individual; we had better not inquire too narrowly concerning his occupation; he will be found somewhere in the purlieus of this great city. His one sense is the sense of gain. We remember once seeing through a microscope the animalcules of a drop of water, and we noticed that one of the largest of these had one end fixed to the side of the vessel, while its arms and mouth were busy gathering up and swallowing its smaller neighbours. Now, the man of whom we speak is only this animalcule magnified without the microscope. Ignorant of all laws, civil, religious, physical, moral, social, sanatory, he rots in his place until Dame Nature, in one of her clearing-out days, fetches at him with her besom the plague; and he is swept aside and seen no more.

Our country readers are no doubt well acquainted with Farmer Hodge. One day he happened to sit next the poet Coleridge, listening, with that reverence for his betters to which he had been early trained, to the marvellous sayings of the great man, and it was only when the apple dumpling made its appearance that he exclaimed, "Them's the jockeys for me!" Hodge, we fear, maintains no sort of relations with the universe around him. He farms in the same way in which his grandfather did, and has the most profound aversion for the steam plough.

He told Tennyson—

> "But summun' ull come ater meä mayhap wi' 'is kittle o' steäm,
> Huzzin' an' maäzin the blessed feälds wi' the Divil's oän teäm.
> Gin I mun doy I mun doy, an' loife they says, is sweet;
> But gin I mun doy I mun doy, for I couldn abear to see it."

Nevertheless, Hodge has some sense of his duty to his neighbour. Indeed, we learn from D'Arcy Thompson, that being once asked What is thy duty towards thy neighbour? he wrote as follows upon a slate:—

"My duty tords my nabers, is to love him as thyself, and to do to all men as I wed thou shall do and to me, to love, onner and suke my farther and mother, to onner and to bay the Queen, and all that are pet in a forty under her, to smit myself to all my gooness, teaches, sportial pastures and marsters, to oughten myself lordly and every to all my betters, to hut nobody by would nor deed, to be trew in jest in all my deelins, to beer no malis nor ated in yours arts, to kep my hands from pecken and steel, my turn from evil speaking, lawing and slanders, not to civet nor desar othermans good, but to laber trewly to git my own leaving, and to my dooty in that state if life, and to each it is please God to call men."

Ascending in the scale, we come next to our friend "Cui Bono;" a very good sort of man, very fussy, very philanthropic, and very short-sighted,—in fact, he sees nothing distinctly that is more than one inch from his face. He called upon us the other day to give us a little good advice: it was about the time when our astronomers were investigating the chromosphere of the sun. "What," he asked, "is the use of all this? will it put one penny in your pocket or mine? will it help to feed, or clothe, or educate your family or mine? Take my advice, sir, and have nothing to do with it." We did not reply to him; indeed we learned afterwards that he had just written an article on the subject in one of the journals. Next day he called upon us in a state of high jubilation; he had just seen a friend of his who had succeeded in making a useful application of some great discovery, which, being within the requisite *inch*, was clearly perceived by "Cui Bono"—"A very useful and practical discovery, sir, which will greatly alleviate human suffering; none of your hydrogen-in-the-sun business." And so the successful adapter got all the praise, while the wretched man of science who discovered the principle was left out in the cold.

Still ascending in the scale, we come to a man of strong mental eyesight, but without leisure to use it; one that it makes us grieve to see, inasmuch as he is capable of far better things. His ears are not altogether stopped to the mighty utterance that all nature gives, nor yet is he wholly ignorant, when at night he looks upwards, of that which the firmament declares; but its utterance is drowned in the tumult of a great city, while its starlight is quenched in the smoke. Our sentiment for such a man is that of pity; for indeed, what with the cares of this world and the deceitfulness of riches, he has a hard battle to fight.

But is it not melancholy to reflect how great a proportion of the energy of this country is devoted to the acquisition of gain, and how small a proportion to the acquisition of knowledge?

We have now arrived at the ranks of the affluent and the nobly-born, where, if anywhere, we might expect to find "tastes refined by reading and study, and judgments matured by observation and experience;" but how seldom is this the case? The mental eyesight is often weak to begin with, and often is it rendered still weaker by poring over classics without end. The unfortunate youth is then sent to make the tour of Europe. He is sent to Switzerland and the Alps to see all that is grand in nature, and to Rome and Paris to see all that is great in art, and he comes home wretched and disgusted, and no wonder. He has been made the unfortunate subject of a senseless experiment—an experiment much the same as that of turning a man with weak eyes into a picture gallery in order to improve them. His friends forget that appreciation of the beautiful and the true is the product of the coming together of two things—eyesight and nature. In fact, the result is much the same, whether a man with no eyes is carried out into a glorious landscape, or whether a man with good eyes is shut up in a dark room.

It is of this the poet speaks, when he says :—

"O Lady! we receive but what we give,
And in our life alone does Nature live;
Ours is her wedding-garment, ours her shroud!
And would we aught behold of higher worth,
Than that inanimate cold world allow'd
To the poor, loveless, ever-anxious crowd,—
Ah! from the soul itself must issue forth
A light, a glory, a fair luminous cloud
Enveloping the earth;
And from the soul itself must there be sent
A sweet and potent voice, of its own birth,
Of all sweet sounds the life and element!"

But let us hasten to our friend Philosophus, who is a man of quite a different mould. Once, when he was young, his tutor said to him, "Have the goodness, sir, to solve the following problem: 'A hemispherical bowl is filled with a heavy fluid, the density of which varies as the nth power of the depth below the surface; find the whole pressure and the resultant pressure on the semi-lune of the surface contained between two vertical planes passing through the centre of the bowl, and making with each other an angle 2β.'" But Philosophus thrust the paper violently aside, saying "I will have none of that," and in fact was extremely rude. You may be sure, therefore, that when he came to be a man he had a mind of his own, and carried out his own ideas. He told us lately that he had been studying the laws of energy. It is a mistake, he said, to suppose that these laws are difficult of comprehension; they are merely remote from our ordinary conceptions, and must be patiently pursued until you grasp them. He had studied them, he said, at all times and on all occasions—in the railway carriage, on the thoroughfare, in the study, on his bed, in the night watches; and now that he had come to perceive their exceeding grandeur, and beauty, and simplicity, they were a source of great and continual joy to him, and recompensed him more than a thousandfold for all the trouble he had taken. Philosophus lately told us certain truths which may, perhaps, be of service to the readers of NATURE. He said that, not far from London, there was a place where the spirits and understandings of men were annually ground to pieces in a huge machine made of the very best metal; ay, such is its temper, said he, that were it only made into good broadswords, it might enable us to cleave our way to the very heart of the universe. Again, he said: "No doubt the dulness of science is a cry of the blind; nevertheless, men of science are much to blame. It is their sense of beauty that leads them to Truth, whom they discover by means of the glorious garments which she wears. But she is immediately stripped of these, and dressed in an antiquated mediæval garb, worse than that of any charity-school girl, and equal to that of any Guy Faux: no wonder that in such guise her beauty is unperceived by those who cannot pierce the veil, and that as a consequence she is slightly esteemed."

There was another thing he told us—a thing of the highest importance. "The priests of Science," he said, "must consent to use the vernacular, before they will ever make a profound impression upon the heart of humanity; and when they have learned to do this, let them not fear the sneers of their deacons who will call their teaching sensational.

F. R. S.

THE ATOMIC CONTROVERSY

IT is one of the most remarkable circumstances in the history of men, that they should in all times have sought the solution of human problems in the heavens rather than upon the earth. Sixty years ago a memorable instance of this truth occurred when Dalton borrowed from the stars an explanation of the fundamental phenomena of chemical combination. Carbon and oxygen unite in a certain proportion to form "carbonic acid;" and this proportion is found to be invariable, no matter from what source the compound may have been prepared. But carbon and oxygen form one other combination, namely, "carbonic oxide"—the gas whose delicate blue flame we often see in our fires. Carbonic oxide may be obtained from many sources; but, like carbonic acid, its composition is always exactly the same. These two bodies, then, illustrate the law of *Definite* Proportions. But Dalton went a step further. He found that, for the same weight of carbon, the amount of oxygen in "carbonic acid" was *double* that which exists in carbonic oxide. Several similar instances were found of two elements forming compounds in which, while the weight of the one remained constant, the other doubled, trebled, or quadrupled itself. Hence the law of *Multiple* Proportions. The question was—in fact, the question is—how to account for these laws. Dalton soon persuaded himself that matter was made up of very small particles or *minima naturæ*, not by any possibility to be reduced to a smaller magnitude. Matter could not be divisible without limit; there must be a barrier somewhere. No doubt, as a chemist, he would have rejected the famous couplet—

Big fleas have little fleas, upon their backs, to bite 'em;
And little fleas have smaller fleas, and so *ad infinitum.*

"Let the divisions be ever so minute," he said, "the number of particles must be finite; just as in a given space of the universe, the number of stars and planets cannot be infinite. We might as well attempt to introduce a new planet into the solar system, or to annihilate one already in existence, as to create or destroy a particle of hydrogen." All substances, then, are composed of atoms; and these attract each other, but at the same time keep their distance, just as is the case with the heavenly bodies. The atoms of one compound do not resemble those of another in weight, or size, or mutually gravitating power. But as they are indivisible, it is between them that we must conceive all chemical action to take place; and an atom of any particular kind must always have the same weight. The atom of carbon weighs 5; the atom of oxygen weighs 7. Carbonic oxide, containing one of each must therefore be invariably constituted of 5 carbon, and 7 oxygen: carbonic acid must in like manner contain 5 carbon, and 14 oxygen. Here, then, Dalton not only states that he has accounted for the two laws we have mentioned by making a single assumption; but he evidently intends his theory to be used as a criterion or control in all future analytical results, and already views it as the birth-place of chemical enterprise.

Such, and so great, was the atomic theory of Dalton; founded, certainly, on erroneous numbers, but containing in itself the germ of their correction; aspiring to the command in innumerable conquests; and setting itself for the rise or fall of the chemical spirit.

It is hardly necessary to make any detailed review of the history of the atomic theory. Berzelius made it a starting-point for researches which, on the whole, have been unsurpassed in their practical importance, and engrafted upon it his celebrated electrical doctrine. Davy and Faraday refused to admit it; Laurent and Gerhardt accepted it doubtfully, or in a much modified form. Henry declared that it did not rest on an inductive basis. There can be no doubt, however, that the atomic theory has been accepted by the majority of chemists, as may be seen on even a cursory inspection of the current literature of their science. Our present intention is to give such a summary of the atomic question as may be serviceable to those who take an interest in the discussion at the Chemical Society on Thursday last.

The modern supporters of the atomic theory agree with Dalton in the fundamental suppositions we have given above; but assert that they have a much stronger case. The phenomena of gaseous combination and specific heat have indeed changed the numerical aspect of the theory, but not its substance. The simplicity of all the results we have accumulated with respect to combining proportions is itself a great argument for the existence of atoms. They all, for example, have the same capacity for heat; they all, when in the gaseous state, have a volume which is an even multiple of that of one part by weight of hydrogen. But bodies in the free or uncombined state—such, in fact, as we *see* them—more commonly consist of many clusters of atoms (*molecules*) than of simple atoms. These molecules are determined by the fact that when in the gaseous state they all have the same volume. Again, select a series of chemical equations, in which water is formed, and eliminate between them so as to obtain the smallest proportion of water, taking part in the transformations they represent. It will be found that the number is 18; which necessarily involves the supposition that the oxygen (16) in water (18) is an indivisible quantity. To put this last point another way: hydrochloric acid, if treated with soda, no matter in what amount, only forms one compound (common salt). Now we know that the action in this case consists in the exchange of hydrogen for sodium. But if hydrogen were infinitely divisible, we ought to be able to effect an inexhaustible number of such exchanges, and produce an interminable variety of compounds of hydrogen, sodium, and chlorine; hydrochloric acid being the limit on the one side, and common salt (sodic chloride) terminating the other. No such phenomenon occurs; and, since matter must be infinitely or finitely divisible, and has been thus proved not to be the former, it must be the latter. Atoms, therefore, really exist; and chemical combination is inconsistent with any other supposition. Those who hold the contrary opinion are bound to produce an alternative theory, which shall explain the facts in some better way.

Now let us hear the plaintiff in reply.

The atomic theory has undoubtedly been of great service to science, since the laws of definite and multiple proportions would probably not have received the attention they deserve, but for being stated in terms of that theory. Yet we must discriminate between these laws, which are the simple expression of experimental facts, and the assumption of atoms, which preceded them historically, and therefore has no necessary connection with them. For it was the Greek atomic theory which Dalton revived. Nor has any substance yet been produced by the atomists, which we cannot find means to divide. If, moreover, we have no alternative but to admit the infinite divisibility of matter, even that is consistent with the simple ratios in which bodies combine; for two or more infinites may have a finite ratio. Therefore, the observed simplicity, if used as an argument, cuts both ways. Possibly we are mistaken in connecting the ideas of matter and division at all; at any rate, the connection has never been justified by the opposite side. Again, admitting the argument based on the formation of common salt, the atomic theory does not tell us why only one third of the hydrogen in tartaric acid can be exchanged for sodium; why, indeed, only a fraction of the hydrogen in most organic substances can be so exchanged. Yet, the explanation of the one fact, when discovered, will evidently include that of the other. On the whole, it appears that the atomic theory demands from us a belief in the existence of a limit to division. No such limit has been exhibited to our senses; and the facts themselves do not raise the idea of a limit, which Dalton really borrowed from philosophy. The apparent simplicity of chemical union we do not profess to explain, but to be waiting for any experimental interpretation that may arise. The atomists, in bringing forward their theory, are bound to establish it, and with them lies the *onus probandi*.

The above are a few broad outlines of the existing aspect of the atomic controversy, and may somewhat assist in forming an estimate of it. The general theoretical tone of the discussion last Thursday must have surprised most who were present. Our own position is necessarily an impartial one; but it will probably be agreed that between the contending parties there is a gulf, deeper and wider than at first appears, and perhaps unprovided with a bridge.

LECTURES TO LADIES.

WHAT is the meaning of the present stir about the "Higher Education of Women"? We have before us announcements of courses of lectures intended to be given during the coming winter to the ladies of Edinburgh, London, Glasgow, Manchester, and Bradford; and we believe that similar courses are to be delivered in several other towns. The organisations under whose auspices these lectures are to be delivered, seem all of them to have come into existence at nearly the same time. Edinburgh and Professor Masson, so far as we know, have the credit of having taken the lead in the movement; but this was only two winters ago, and none of the towns we have named were more than one year behind.

What is the cause of this sudden and wide-spread demand on the part of our countrywomen for access to a different and, presumably, a higher kind of intellectual culture than has hitherto been within their reach? Or rather, first of all, is the apparent demand a real one? Is it such as to indicate that a real step has been taken, or is likely soon to be taken, towards an improved method and a higher standard of female education in England? Or is it more reasonable to suppose that the interest now manifested in the subject will disappear in the same proportion as the novelty of it? For our own part,—after making what seems full allowance for the influence which the love of novelty, and the liking to do as other people are doing, have no doubt exerted in gaining for these "Ladies' Lectures" greater popularity, and a larger share of public attention than they would otherwise have obtained,—we believe that their rapid spread, and the success which has so far attended them, are mainly due to a serious effort on the part of the women of this country to improve their intellectual condition, coupled with the conviction of the inefficiency of the facilities for mental culture that have been hitherto open to them.

An explanation of the appearance just now of such efforts and convictions must be sought for among those facts of our present social condition which are making the Woman's Question in all its aspects one of the foremost problems of the time. It is obvious enough what some of these facts are, but we should have little confidence in an attempt to enumerate them all, and to estimate exactly their relative importance. But without undertaking to explain fully the movement under discussion, we think there are evident signs that it is a natural and spontaneous outcome of existing social and intellectual conditions, and not the result of artificial stimulus. If this view is correct, it is obvious that the importance of the movement must be judged of rather by what it indicates than by what it is,—by future results that may be hoped for, rather than by successes already achieved. Looked at in this way, it claims the serious attention and support of every one who desires the intellectual advance of the community, in order that the present opportunity may be turned to advantage, and that efficient plans of future action may be founded on the experiments now being tried with more or less of what must necessarily be temporary enthusiasm.

We venture to assume that in this, as in most other cases, the first condition of permanent success is that the object aimed at should be one in which it is worth while to succeed. If both lecturers and students are in earnest in trying to make these lectures really educational and serious, they cannot fail of producing valuable results. But this will require a good deal of determination on both sides. The most obvious, and perhaps the most serious, danger besetting the teachers, is the temptation—arising from an unconscious want of respect for their audience—to make their lectures *interesting*, instead of trying to impart the greatest possible amount of solid instruction. We confess that one or two very attractive-looking programmes that we have seen have suggested the thought, that possibly the lectures they announced might be equally well described as essays, such as constitute the more thoughtful kind of magazine articles; and that, if this were the case, it was not obvious what greater advantage would arise from their author reading them aloud to an assemblage of ladies than would result if the same ladies could be induced to read them to themselves at home.

But, though we have no reason to believe that such a criticism would be really applicable to any of the actual courses, it is none the less desirable that all concerned should be on their guard against the tendency for it to become so. Thorough teaching, and not entertainment, of however high a kind, is what we trust that every lecturer will strive to give, and every student to obtain. And, after all, the spirit and quality of these lectures will depend as much on the students as on the teachers. No doubt a thoroughly earnest teacher may do a good deal towards producing earnest pupils; but, in the long run, the kind of instruction given will be that for which there is a demand. Ladies who intend to join any of the classes now forming will not expect to get any benefit from them, unless they give up for them all other engagements, at least so far as to be able to attend with regularity. If they only go to the lectures when in want of other occupation, they had better not go at all. Moreover, we have not much faith in the educational value,—at any rate for residents in London,—of courses in which only one lecture is given in a week. There are few persons who can keep up any vivid interest in a subject which occupies their thoughts for only one hour a week; and we imagine that ladies, who are unwilling to spare the time for two lectures a week on a subject which they wish to study, will scarcely be found among the number.

In conclusion, we may remind our readers of two sets of lectures to ladies which begin this week in London: one of them at the South Kensington Museum, and the other, by Professors of University College, partly at St. George's Hall, Langham Place, and partly at University College. We heartily wish success to them all, and urge all our readers to do what they can to promote it.

GEOLOGY AND AGRICULTURE

WHEN man penetrated into Western Europe and Britain, he found the country clothed with dense forests interspersed with fresh-water lakes, peat-mosses, and bogs, relieved by few open glades, heaths, or moors. The native rocks could only be seen here and there, in crags and escarpments, sea-cliffs, river-banks, or mountain-heights; whilst herds of wild cattle, deer, and lesser game occupied the country, and afforded food to numerous beasts of prey.

In such a country, at first thinly populated, man could subsist by the chase alone, and a long period elapsed ere he added, first the horned sheep, and then the *Bos longifrons*, to his earliest domesticated animal, the dog, and thus entered on the pastoral stage of his existence.

The shepherd's life, however, although a great step in advance of that of the hunter, necessitates wandering from one point to another in search of fresh pasturage or water. The early shepherd was a nomad, while agriculture proper necessarily dates from the period of fixed residence; for, even admitting that early man might clear for himself—if not with his axe of stone, at least by the aid of fire—a tract of land suited for the growth of cereals, yet he would hardly toil for even such scanty return as he could gather from his little patch of corn, unless he had some kind of fixed habitation, and a recognised right of occupation.

In Britain the art of agriculture, and indeed of all the arts of civilisation, really commenced with the Roman occupation, but the Saxons and Danes who followed, though doubtless good soldiers, sailors, and fishermen, were scarcely less barbarous than the early Britons, and no advance was made in agricultural pursuits until after the introduction of Christianity, the members of the religious establishments, once so numerous, and into whose hands most of the landed property passed, having done much to improve the cultivation of land.

While the population was comparatively small, the amount of land under cultivation was also limited, only the better class of soils in the most fertile districts being chosen for corn, and the remainder used for pasturage or common-land; whilst large tracts of country, capable of producing abundant crops, were left wild, or still covered with woods: but as people congregated in centres of trade, the demand for corn arose and increased. Although, however, the farmer was thus encouraged to attempt the tillage of waste lands hitherto neglected, little improvement is noticeable in the method of farming until the beginning of the present century; for agriculture, like all venerable arts, has been—until very lately—strictly conservative; so much so, indeed, that many of its practices and precepts have come down to us but little altered since the days when Virgil wrote the Georgics.

But this century, so pregnant with change to all our industries, has not permitted agriculture to escape innovation; and notable among the signs of the time was the establishment, in 1838, of the Royal Agricultural Society, under whose auspices much has been done towards the removal of long-cherished and old-established prejudices, and the acceptance and adoption of numberless improvements.

The chemist has been, and indeed is still, hard at work for the agriculturist, analysing the soils on his farm, and advising him what artificial remedies to apply to improve their fertility, or to fit them for special crops. He has told him the reason why a rotation of crops is beneficial; because a green-crop, a root-crop, and a grain-crop each take different ingredients from the soil; and thus, by a knowledge of their requirements, he may apply to each that special ingredient—if not already in the land—at the period when it is required by the plant. Nor has Geology neglected to tender her aid to agriculture, by pointing out that there exists a direct relation between the soil of a given area and the subsoil upon which it rests; and that thus, by a knowledge of the geological features of a country, the farmer, in the selection of land, may not only be guided to the most permanently productive soil, but also to that which rests upon a subsoil calculated to enhance rather than depreciate its value.

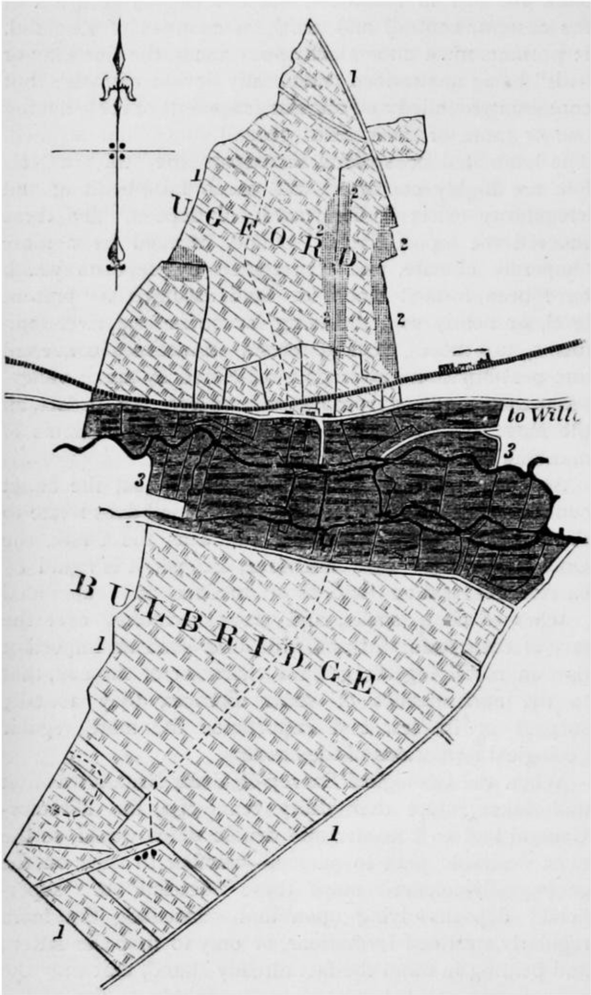
Anyone who will take the trouble to examine a geologically coloured map of the British Isles, will see at a glance the general distribution, at (or *near*) the surface, of all the various geological formations, from the Pliocene and Eocene in the east and south-east, to the Granites and Trap-rocks of the west and north, with the relative superficial extent of each. But let us take a nearer view. In Britain, as in almost every country in the world, and in all latitudes, superficial accumulations of clay, sand, and gravel occur, sometimes forming a mere coating of the rocks beneath, but often of very considerable thickness, and covering large areas. The earlier geologists classed the whole of these deposits under the general name of *Diluvium*, and attributed their irregular occurrence and wide distribution to the effects of one great and universal deluge. They have, however, of late years, received careful attention from many able geologists, and it is now ascertained that they sometimes contain fossils.

Thus, some are named "pre-glacial," as marking by their animal and vegetable remains a coldly-temperate climate, and comprise marine sands and gravels, the lignite clays, and the forest-bed, with its elephant-remains, which are seen cropping out on the Norfolk coast. Younger than these, and overlying them—in Norfolk at least—come the accumulations of the "glacial" period itself, marked by the Arctic character of its fauna, its ice-worn erratic blocks, and its vast deposits of boulder-clay, often 100 feet in thickness, and covering large areas in the eastern, central, and northern counties of England. It presents most anomalous appearances, the fine clay or "till" being unstratified and mostly devoid of fossils, but containing rounded and angular fragments of rock, having one or more of their sides ground down and striated. The laminated beds which accompany the "till" in Norfolk are highly contorted, and much false-bedding and irregularity exists in their mode of deposit. To these succeed the "post-glacial" period, marked by a more temperate climate, and represented by deposits which have been formed since the land assumed its present level, or nearly so; including lacustrine and river-sediments, turf-moors, ancient forests—sometimes converted into peat-bogs, and now again reclaimed by man; valley-sediments, resulting from meteoric causes, and, in fact, all the most modern surface-deposits, including remains of man and his works.

Although what we have already said about the direct connexion between the soil and the sub-soil does relate to the regularly stratified deposits, such as the Chalk, the Oolite, Lias, New Red sandstone, &c., yet it is found by careful observation that those modern and superficial patches of clays, sands, and gravels scattered over the face of the country far and wide, take such an important part in modifying the general character of the soil, that to the agriculturists of some districts, they actually surpass in interest and importance the more regular geological formations of the country.

When the Geological Survey of Great Britain was first undertaken, more than thirty years ago, the Director-General had to consider and decide which would be the most desirable plan to pursue,—whether to show on the geologically-coloured maps these "detrital" or "superficial" deposits, lying upon and concealing the more regularly stratified formations, or only to map the latter; and bearing in mind the fact already stated, that only the most vague notions existed in the minds of the earlier geologists as to the age or origin of these later deposits, and that they were commonly looked upon as the result of the deluge; it is easy to see that there were at that time good grounds for their omission. It can, however, readily be shown that, from an economic point of view, these deposits deserve to be mapped, in the interest of the farmer, with as much accuracy as the older rocks have been for the miner.

The advantages to be derived by the farmer from the mapping of all surface-deposits—irrespective of age or mode of occurrence—are exemplified in the pages of the last number of the Journal of the Royal Agricultural Society, in which the system commenced many years ago by the Council of that Society, and carried out so ably on their behalf by Mr. Joshua Trimmer, of making reports upon the agricultural geology of lands in various districts of England, has been again resumed. In this instance, most of the reports are the result of personal inspection of the districts by Mr. H. M. Jenkins, the recently elected Secretary of the Society; who, fresh from his labours as Secretary to the Geological Society of London, has given, in addition to an insight into the methods employed for improving the land, very clear and accurate sketches of the geology of each farm over which he has gone, illustrated in each case by a shaded map, expressing



1 Chalk. 2. Tertiary. 3. Alluvium (water-meadows).

SUBSOIL MAP. Scale—Two inches to a mile.

the nature of the subsoil, and its bearing upon both the lithological nature of the soil, and its retentiveness of moisture—this latter point having a most important bearing upon its fertility.

In illustration of the various conditions under which the surface soil is cultivated, we may refer our readers, first of all, to the recently issued number of the journal referred to. We there find, in an essay on Forest-farming, by Mr. Jenkins, that "the site of the ancient forest of Sherwood furnishes some of the best examples in England of successful farming, under circumstances of great natural difficulty. The subsoil consists of a sandy conglomerate, and is covered by a very light sandy loam of poor and hungry character. Little is yielded by it alone; and the farmer looks upon it more as a vehicle whereby he can convey fertilising materials to his crops, than as a producer of their natural food." Here we have a natural condition of virgin barrenness, forced into fertility by the most advanced appliances of agricultural science; and from this basis of natural poverty we may diverge, on the one side, into fields which, once naturally fertile, and possessing a rich store of accumulated wealth, have been impoverished, and even *denuded*, of their wealthy mantle of soil at any rate, by a very recent degradation; and, on the other side, we may find examples where the wealth and fertility of a district are being continually increased by atmospheric causes. Mr. Jenkins gives us instructive examples of both sets of conditions, in one case both occurring on the same farm, viz. at Eastburn in the Yorkshire Wold: on one portion of the farm "the higher ground exhibits a soil gradually *increasing* in strength and depth as one ascends the hill;" while upon another portion of the farm, the thickness of the soil follows a rule precisely opposite to that just noticed: "instead of the depth and strength of soil increasing with the height, the opposite is now the case. The only essential physical difference in the two cases seems to furnish the explanation of this anomaly, namely, that we now have to deal with a *wet* valley of very slight slope, the soil on the sides of which consists of the mud (or warp) deposited by the stream in times gone by; whereas, in the other case, the valleys are dry, and their slopes have been denuded of any alluvial soil which may formerly have covered them, by an agency which has also deepened the valleys and increased the pitch of their sloping sides." All these practical descriptions, the result of actual survey, show clearly that the formation of soils is not always attributable to the same cause; for we have in them clearly indicated three natural processes by which the surface-conditions have been produced—viz. (1) Soil formed from the subsoil immediately beneath; (2) Soil formed by the denudation of soil and subsoil at higher levels; and (3) Surface denuded of soil by degrading influences. The first two processes are *formative*, while the third is *destructive*; and thus in this, as in every other portion of nature's economy, we at last learn that antagonism produces equilibrium.

H. WOODWARD

VEGETABLE PALÆONTOLOGY

Traité de Paléontologie Végétale. By Prof. Schimper. (Paris, 1869. London: Williams and Norgate.)

IF asked to indicate the most suggestive discoveries in Geological Science that have been made within the last ten years, we should unhesitatingly point to that of the Eozoön,—to the unfathoming of the mysteries of the floor of the ocean,—and to the unearthing, in high Arctic regions, of forests of Dicotyledonous trees, not merely analogous in size, habit, and conditions of life, but specifically closely allied in structure to the forest trees of middle and southern Europe, Asia, and North America. The first of these discoveries carries back the history of life on the globe over a period indefinitely anterior to that which so long marked its starting-point; the second reveals a condition of life far lower than any hitherto discovered, if not the primordial condition of organized matter itself, and is the clue to the history of the chalk, the most complicated in its relations and the richest in animal remains of all known formations; whilst the third, the most simple in its outlines and the most intelligible in its facts, has hitherto checkmated every attempt to reconcile the stubborn conclusions of astronomers, in so far as these relate to the recent history of the globe, with the palæontology of a period comparatively but little antecedent to our own in a geological point of view.

Thus it is that Geology, which in its infancy was the offspring of mineralogy, chemistry, and mechanical laws, has fallen while still young under the step-fatherhood of Biology; even the superposition of strata meaning nothing, if not supported by Palæontology, since the fact that an upper stratum of rock containing organic beings of simpler structure than that it overlies is held to be sufficient proof of their original positions having been reversed, notwithstanding all appearance to the contrary. Biology, in short, supplies the weights, wheels, and pendulum of the geological clock, of which Zoology has hitherto marked the hours, and Botany, at uncertain intervals, the minutes.

Lately, however, owing chiefly to the exertions of Heer, Massolongo, and Saporta, following the footsteps of Unger, Braun and Goeppert, Botany has gained a little of its lost ground in the race with Zoology for precedence as the handmaid of Geology. The number of species collected and arranged in the cabinets of Zürich, Vienna, Breslau, &c., has been prodigious; lucky discoveries of structural specimens have thrown clear light on the affinities of whole groups of obscure fragments; and the constant association of certain leaves with certain fruits, seeds, and flowers has led to many more very probably correct, or at least approximate, identifications. As usually obtains with a science under such conditions, the publication of new species on mistaken and uncertain grounds, or on no grounds at all, has proceeded rapidly, whilst the acquisition of a real knowledge of the objects themselves has been slow. Superficial naturalists, who think they know an oak, a laurel, or a fig-leaf when they see it, but who neither really do know these, nor the multitude of other vegetables whose leaves imitate them, have boldly made fossil species of such genera; shielding themselves under the belief that, let botanists doubt as they please, they cannot contradict.

For years this state of things has gone on; the Devonian, Carboniferous, Eocene, Miocene, and Pliocene floras have been the prey of adventurous systematists; while with the exceptions of Brongniart and Lindley no naturalist eminent for his knowledge of exotic forms of vegetation has attempted a general work on fossil plants; and that these great men simultaneously broke down, is notorious. Thirty-two years have elapsed since the suspension of the "Fossil Flora of Great Britain" by Lindley and Hutton, and of the "Histoire des Vegetaux Fossiles," by Brongniart. In this interval, but one other general work of the same nature has appeared, the "Genera et Species Plantarum fossilum," by Unger, a careful compilation by a very accomplished palæontologist of Vienna; but many excellent treatises on the vegetation of individual formations have been contributed by able men, amongst whom rank especially—on the Continent, Heer, Unger, Ettingshausen, Massolongo, de Gaudin, de Sismonda, Otto Weber, de Ludwig, Goeppert, Saporta, and de Watelet, and the author of the work now under notice,—in England, Bunbury, Binney, Williamson, and Carruthers, —and in America, Lesquereux, Dawson, and Hall. The time, therefore, has fully come for a complete review of the Fossil Flora of the globe, and it has fortunately fallen into hands which in very many respects are the best fitted for carrying it out with success.

Dr. W. Ph. Schimper is Professor of Geology in the Faculty of Science at Strasbourg, and Director of the Museum of Natural History in that city, an institution which is, we are told, largely, if not wholly, indebted to his liberality and energy for its present value and condition. Dr. Schimper is further a correspondent of the Institute of France, and of the Linnæan Society of London; the best living Muscologist, and the author of a monograph of the Fossil Plants of the Vosges, and of a work on the Palæontology of Alsace. In furtherance of his object, which is not a mere compilation, but an original work, in which each order, genus, and species is to be considered in its totality as well as in its details, and to be treated of in a large and general manner, he has visited the principal museums of the Continent, and twice or oftener those of England, making a lengthened sojourn on each occasion.

It remains to add a sketch of the general arrangement of the work, which is lucid and practical. The whole will be comprised in two thick octavo volumes, accompanied by 100 lithographic plates in quarto. Of these the first volume, of 738 pages, and 50 plates, is on sale, at the extremely moderate price of 50 francs, and appears to be exceedingly well done. The commentaries on many of the involved and obscure, though prevalent orders, as Equisetæ, are in particular well worthy of an attentive study; and as a specimen of the condition of the science as Dr. Schimper finds and leaves it, and of the extreme difficulty of the subject, we give an analysis of the contents of one tribe of this order; namely, the Calamiteæ. Of these he retains the nine following genera:—

1. *Calamites*, with seven supposed good species, under which species of three other genera are brought, with twenty-six synonyms, of which fourteen belong to one species alone; and there are, besides, nine doubtful species of the genus.

2. *Calamocladus*, with five species, under which are brought plants previously referred to no fewer than *nine other genera* (two species having respectively seven and eight synonyms).

3. *Calamostachys*, with five species, some of which have been referred to three other genera.

4. *Huttonia*, a monotypic genus.

5. *Macrostachya*, with one species, rejoicing in seven synonyms, of which four are generic.

6. *Bornia*, with three species, of which one has six synonyms.

7. *Sphenophyllum*, with seven species, having thirty-two synonyms amongst them, besides three doubtful species.

8. *Annularia*, with six species, having twenty synonyms, and including plants previously referred to six other genera.

The ninth genus, *Aphyllostachys*, is altogether doubtful.

It needs indeed a bold systematist to attack such a chaos as this reveals, and an able one to deal with it effectively and well.

The work will consist of three parts :—(1) an introduction ; (2) a botanical classification of all known fossil plants ; (3) a synopsis of them in geological sequence ; with a Bibliographical Index.

The introductory part is very full, and is comprised in ten chapters :—

Chap. I.—Historical sketch.
Chap. II.—On the state of preservation of fossil plants.
Chap. III.—Distribution of fossil plants in different formations.
Chap. IV.—Different modes of preservation.
Chap. V.—Principles to be followed in the determination of ossil plants.
Chap. VI.—Of the changes which have taken place in the vegetable kingdom from its first appearance up to the present time.
(§ 1.) Disappearance of species ;
(§ 2.) The renewal of floras by the appearance of new types.
Chap. VII. General *coup d'œil* of the floras of different geological periods.
(1.) First epoch. Reign of the Thalassophytes.—(2.) Second epoch. Reign of the vascular Cryptogams.—(3.) Third epoch. Reign of the Gymnosperms. Appearance of Monocotyledons.—(4.) Fourth epoch. Reign of the Angiosperms. (*a*) First period ; Apetalous plants. (*b*) Second period ; Dialypetalous plants. (*c*) Third period ; Gamopetalous plants.
Chap. VIII.—Application of vegetable palæontology to the climatology of the old world.
Chap. IX.—Application of vegetable palæontology to geology.
Chap. X.—General classification of stratified rocks.

Of the above chapters, the sixth, which deals with the renewal of floras by the appearance of new types, will be the first to be read by many, naturally eager to ascertain the views of so able and so unprejudiced a naturalist as Prof. Schimper, on the subject of the Origin of Species. In this matter his views are explicit, and he sums up his reasons for adhering to the doctrine of evolution in the following terms :—

In spite, then, of the deficiency of palæontological documents, we cannot mistake the general line which Nature has followed through the various geological epochs, from the first appearance of organic beings to the period of their present development. This line may be termed one of evolution, because it marks a progressive change from inferior to superior, from simple to compound, precisely similar to that of every individual with a complicated organisation. All agree that the latter is the result of a continued series of metamorphoses. Every organised being begins as a simple cell ; the embryo itself being a complex organism derived from the generating cell ; wherefore there are naturalists who trace the individual back to the cell. We know, in fact, that each living vegetable cell can give birth to a new individual, of which it is in a certain sense the first representative. Many species of vegetables and animals do not rise above this simple cell ; as soon as this has given birth to a second cell, the latter becomes in its turn a fresh individual. Whenever the derived cells remain united, so that a sort of solidarity is established amongst them, the being which is born from this agglomeration is a complex being. It will be so much the more perfect, it will occupy a step so much the higher in the scale of organisms, as the differentiation of functions produced by the metamorphosis of the cells is more complete, and the organs applicable to these functions are more independent of each other.

Has Nature followed this plan in her organic kingdom ? From all that we know, I believe that we are justified in such a conclusion. The only unicellular fossil plants with which we are acquainted are the Diatoms, which have left their siliceous shells in the most ancient of fossil beds. The cellular plants of the family of Algæ are doubtless rare in the palæozoic formations ; with the exception of some little epiphytal fungi, no terrestrial cellular plants have been discovered, either in palæozoic or in mesozoic beds ; this class is even but meagrely represented in the tertiary flora, which has nevertheless much affinity with that of the present day. Nevertheless, these scanty remains suffice to convince us that, if the cellular plants which were to prepare for the arrival of vascular plants have not left numerous and striking traces, they have none the less existed, and doubtless since the earliest periods. The first vegetation on the lands which had just appeared above the waters must have been composed of cellular plants, of Confervæ, of *proembryos* or *prothalliums* of a lower or higher order of Cryptogams, as may be seen at the present day on recently reclaimed land.

The terrestrial vegetation of the Silurian epoch and of the commencement of the Devonian having left no trace, it is impossible for us to judge what were the forms of the plants which then covered the reclaimed land. All that we know is, that the primeval ocean was peopled by a numerous fauna during thousands of centuries before the appearance of vascular cryptogamic acrogens : similarly, if the Thalassophytes of those distant epochs had left no trace, their existence would be none the less infallibly proved by that of the animals whose food they formed.

The rapid glance which we are about to give of the general character of the floras which have succeeded each other on the surface of the earth, from the Devonian period up to the present time, will show better than any reasoning the progressive march which they have followed, and the close links by which they are united to each other.

J. D. HOOKER

HARCOURT AND MADAN'S PRACTICAL CHEMISTRY

Exercises in Practical Chemistry. By A. G. Vernon-Harcourt, M.A., F.R.S., Sec. C. S.; and H. G. Madan, M.A., P.C.S., Fellow of Queen's College, Oxford. Crown 8vo., pp. 350, 66 woodcuts ; 7*s.* 6*d.* (Oxford : Clarendon Press, 1869.)

WE are glad at last to welcome a really scientific work on Practical Chemistry. Professor Harcourt and Mr. Madan have earned the warm thanks of all interested in the teaching of the science by the publication of their volume. Almost all former works on practical chemistry have been contented either to act the part of illustrated catalogues of chemical apparatus, or else they consist of cut and dried receipts for following out a system of qualitative analysis by reference to a complicated series of paragraphs, ingeniously arranged to bewilder the unfortunate student as much as possible, or they place in his hands tabular statements of reactions which have to be worked through almost always without rhyme or reason.

Mr. Madan's Ten Commandments, or "Memoranda," placed at the commencement of the volume, might well be printed in letters of gold in every laboratory, and repeated as the morning lesson of each first year's student. "Cleanliness," he begins, "stands at *the head* of the *chemist's* scale of virtues." No better advice can be given: if a student can work neatly, he is almost sure to work well. Only rarely can the "messy" beginner be trained to habits of exact experimentation and accurate thought. The second ordinance is equally important : "Do not work in a hurry. What is expended in time is often gained in power and grasp of a subject. Yet, on the other hand, learn to be economical of time." The main object of a certain class of students seems to be to get "through" with their experiments, no matter how clumsily they manipulate, or how small and incomplete may be their knowledge of what the experiment teaches. They are satisfied to have "done the thing," and if they do not obtain the required result, they either think that something in nature has gone wrong, or that the author of the book is fibbing, and they are the last to imagine that they are themselves to blame; it is sufficient for them to have tried—or rather not tried—and they pass willingly to the next operation, most probably again to court defeat. To these the only cure is to act upon the advice, "Do not hurry." Another class of persons, to whom the second part of these "Memoranda" specially applies, are those who confine all their powers to waiting; thus they watch the slow filtration of a single gelatinous precipitate, and with a kind of dreary pleasure either dream away their time, or (more commonly) annoy their more diligent neighbours, thinking that nature is invariably slow to move, and that patience is the only virtue they need to cultivate. These must be made to learn that economy of time is a necessary part of the chemist's duty, and that he, "in spite of the proverb, may do more than one thing at a time by allowing things to do themselves." The chemist's third commandment is fairly given as, "Be economical of materials." Who that has seen beginners work does not value this recommendation? Many seem to think that the more they deluge the substances they have to examine, first with acids, and then with alkalies, the more likely are they to discover the philosopher's stone, or to find their needle in the bottle of hay! How long some students take to find out that every molecule of acid or alkali, added above the required quantity, serves only as a blind to their reactions, and is in reality a most wilful adulteration of their material, with perhaps several thousand times its weight of dirt! "Never begin an experiment," says Mr. Madan, in his fourth article, "until you have looked over all the preparations for it, to make sure that you have everything within reach;" and we would make this advice apply not only to test-tubes and gas-jars, but to the mental preparation also. No experiment ought to be made until the student knows what he is going to do. He must either read a description of what he is to do, or he must see the experiment performed by his teacher; and, above all, he ought to be aware of the theoretical explanation of the changes he is about to witness. The writer for one does not think that laboratory instruction cannot be valuable, unless the student has already acquired a certain knowledge of the subject by attendance on lectures; but the theoretical instruction must then of necessity accompany the practical tuition. The very first experiment which the beginner may make—viz. that of heating oxide of mercury in a test-tube—must be the occasion for an explanation of the laws of definite combination by weight, for a statement of the numerical exactitude of all chemical change. Exercises must at once be given, and continue to be given, in illustration of these laws; and thus from the first the student must be made to grasp the facts of the exact nature of the science. He must be disabused at once of the notion of some who, when they enter the laboratory, "look upon chemistry as a mere amusement, as a means of getting up a few explosions, creating a few unsavoury smells, producing a few striking changes of colour." Unless practical chemistry is taught with these aims, in a manner calculated to afford an exact mental discipline, it is worse than useless. If the student does not cultivate habits of attention, close observation, and patient inquiry, he can gain nothing from laboratory work; on the contrary, he becomes negligent and impatient, he does not care to look for what is going on, and instead of gaining immensely, as he ought, in habits of self-reliance, he loses all confidence, finds physical science a delusion and a snare, and returns (if he has any taste for learning at all) to the more congenial path of literature.

The volume in question will much aid those who teach with this view, and it will afford still more active help to those who, possessing no teacher, have to learn for themselves.

The descriptions of the simpler operations of glass-working in the beginning of the volume, and of the construction of tube apparatus, are clearly given; and these pages are, of course, especially interesting to the self-educated student. The exercises on solution, precipitation, filtration, and distillation, are described with care, and the examples well chosen. It is very difficult to know how far such descriptions should go as regards details. The description of the manufacture of lime-water is as clear as that preparation ought to be. But is such detail needed where a word of explanation can be given? This shows the impossibility of writing a book on practical manipulation exactly fitted for all classes of students.

In the second section, on preparation and examination of Gases, we miss the theoretical explanations which, as we have said, must accompany the practical and manipulating directions; nor do questions, numerical or otherwise, accompany the exercises. This is to be regretted: a book especially written for those who work alone should contain a series of examples such as we find in many of the smaller manuals. With this exception this portion of the book is as good as need be. A chapter on the preparation of Reagents in use in the laboratory is especially valuable to the self-taught student. The solutions are made according to system; and in the preparation the student is familiarised with the metrical system of weights and measures: whilst under each heading the tests for the purity of the reagent are given; thus:—

Barium Chloride ($BaCl_2$ in 20 c.c.). Dissolve 12·2 grms in 80 c.c. of water, and dilute to 100 c.c.

The purity of the salt may be tested as follows. Place about 5 c.c. of the solution in a test-tube, heat it nearly to boiling, and add a slight excess of dilute hydrogen sulphate. While the precipitate of barium sulphate is subsiding, get ready a filter (of Swedish paper), wash it two or three times with warm water, then filter off the barium sulphate and evaporate the filtrate to dryness on a clean watch-glass. No solid residue should be left.

The authors, in their introduction to Qualitative Analysis, commence with the study of the acid radicles instead of the metals. This is, perhaps, the more scientific order of procedure than that beginning with the reactions of the metals; but we must take leave to doubt whether it is so simple, or so likely to conduce to the clear understanding of the reactions as the other older and more usually employed method.

The nomenclature used throughout the work possesses one amongst many advantages over the others (unfortunately too numerous) now in use, in that it is identical with that now employed in Germany. Surely it is a matter of some importance to assimilate as much as possible scientific nomenclature in all languages.

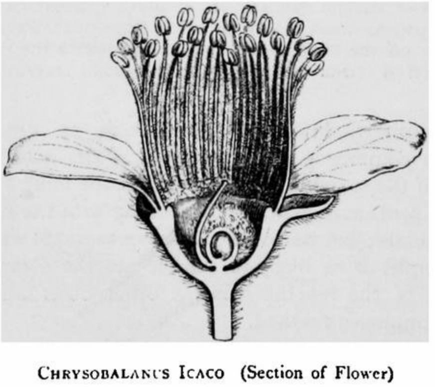
H. E. ROSCOE

BAILLON'S HISTORY OF PLANTS

Histoire des Plantes. By H. Baillon. Vol. I. 8vo, 488 pp. With 503 figures by Faguet, price 21*s*. (Paris and London: Hachette and Co.)

THIS is a fine book—a very fine book, one might say; nevertheless, not wholly satisfactory. Turning over its pages we feel a sense of power wasted in an attempt to bring together too much in a digested form,—far more indeed than any one cares to find in one work. The book, if it goes on, will be a sort of Botanical Encyclopædia, suited rather for adepts and advanced students than for the general reader. No one thinks of turning to an Encyclopædia for the best and most exhaustive information upon anything, and so it will be in this case. M. Baillon brings together Organogeny, Structure, and Taxonomy, including a description of every genus of Flowering Plants. Now this is too much for any single mind to work out. M. Baillon is a man still young and vigorous, and of wonderful assiduity; and if he live, it is quite possible he may bring his work to a close. And it will be no mean monument, though not without its warning, especially to those whose ambition impels them to aim too much at leaving behind a name in large characters rather than deeply cut. As yet, however, our author is hardly out of shallow water. Nearly all the groups which he has touched upon have been quite lately worked up systematically by other eminent botanists, and their material has doubtless afforded him a good bottom.

This first volume consists of a series of Monographs of the following Natural Orders: Ranunculaceæ, Dilleniaceæ, Magnoliaceæ, Anonaceæ, Monimiaceæ (including Calycantheæ), and Rosaceæ. We do not find any general clavis or table of sequence of the Orders, but, from the order followed so far, it would seem as though the characters of the primary divisions of Dicotyledons, usually accepted as most convenient by systematists, depending on the absence or presence of adhesion between the inner and outer whorls of the flower, were regarded as subordinate to characters based simply on cohesion or its absence between the carpels forming the pistil. All the Orders enumerated, and those in the first part of Vol. II. already published, are essentially apocarpous. Four of



CHRYSOBALANUS ICACO (Section of Flower)

them have perfect flowers and hypogynous insertion of the floral whorls; one (Monimiaceæ) is mainly imperfect and monochlamydeous; and Rosaceæ are perfect and perigynous. Now a new system is very apt to be a great bore. Nobody knows what is coming next, nor where to look for a thing; and in the present state of knowledge, in such secondary matters as the mere sequence of Orders, it is better to sacrifice the expression of a supposed affinity by a new juxtaposition in linear series, for the sake of a uniformity with accepted plans of arrangement, which have been tested many years, are widely used in the

CHRYSOBALANUS ICACO

best books, and which adventurers are too glad to fall back upon when they have sense to know when they get out of their depth.

However, waiving all this, let us do M. Baillon the justice to say that he here puts on record many original observations of great value: he is very clear, and, like many of his countrymen, has a neat way of putting things: his pictorial illustrations (in woodcut) are admirable and well-selected, as the accompanying examples will show; and, as we have said above, he is making a very fine book.

By way of sample of the work, let us take a small Natural Order: Magnoliaceæ, the Family of the Magnolias and Tulip-trees. First of all we have the Order divided into what M. Baillon calls *Series*, which, in the main, answer to the Tribes or Sub-orders of other writers. *Canelleæ* we notice is one of these: a group maintained of ordinal value, by Messrs. Bentham and Hooker, near to Bixineæ, on the ground of their syncarpous ovary and parietal placentation,—characters which M. Baillon estimates as analogous, in respect of their departure from the Magnolioid type to the similar conditions of *Monodora* in relation to other Anonaceæ. A good description, with capital figures, is given of what the author treats as type-species of the genuine Magnolias, the beautiful *M. grandiflora*. He has been at considerable pains to examine for himself the curious changes undergone by the ovule in maturation, publishing an account of it in "Comptes Rendus," lxvi. 700, apparently ignorant of Prof. Asa Gray's exceedingly clear and detailed account of the same, given twelve years ago in the Journal of the Linnean Society, ii. 106. The old genera *Talauma*, *Manglietia*, and *Michelia* are all sunk in *Magnolia*, which genus, with *Liriodendron*, constitutes the series Magnolieæ. The three former genera are very briefly disposed of, and whether specimens of each have been examined, is by no means clear. After describing successively the structural features of each Series, M. Baillon gives us a short historical summary of the Natural Order, then he discusses the points in which all, or nearly all, of the genera agree. The only three absolutely constant characters are: the woody stem, the alternate leaves, and the presence of albumen in the seeds. A triad, equally constant, we may remark, in many other Natural Orders, just as flour, suet and salt, may be common to every different sort of pudding. Eight characters are generally prevalent, the exceptions being few or solitary; these refer to the form of the receptacle, concave only in two genera, which same pair are the only exceptions to the otherwise constantly double perianth; polypetaly; direction of the micropyle of the ovule; apocarpy and placentation; stipulation. These we might speak of as the currants, and peel, and spices, and brandy, and what not, which, judiciously blended with the constituents afore-named, give special character and pre-eminence to plum-pudding. Technical diagnoses of the five Series follow. Then we have the histology of the wood and bark; a discussion of the affinities of the order; a paragraph on its geographical distribution; an account of the properties and uses of various species; and lastly, technical descriptions in Latin, of each genus, as maintained by M. Baillon. These technical descriptions, if given at all, should be accompanied by a distinct generic synonymy. It is too much to expect every one to turn back to pages so and so, and unravel it for himself, where the mention of it may read as merely incidental.

D. OLIVER

FICK ON THE TRANSFORMATION OF FORCE

Die Naturkrafte in ihrer Wechselbezichung. By Adolf Fick. (Würzburg, 1869. London: Williams and Norgate.)

PROFESSOR FICK, who has recently been moved from Zurich to Würzburg to fill the chair of Physiology there, vacant through the untimely death of Von Bezold, is well known not only to physiologists by his many excellent researches, but also to a far wider circle through the now well-known experiments on muscular physics carried out by himself and Wislicenus. In these six popular lectures he attempts to carry an intelligent and attentive audience, not possessing special scientific knowledge, swiftly through the great story of the transformation of force, showing them, in a quiet, lucid way, how the parts are played on those two great stages, the macrocosm of the universe and the microcosm of the human body.

The first four lectures are given up entirely to the consideration of the correlation of purely physical forces. Starting from simple facts about heat, the author works his way through heat as a mode of motion, through concrete conceptions of molecular movements in changing bodies, to the general doctrine of the transformation of force and the numerical relations between one force and another.

In his fifth lecture, treading upon his own ground, he shows that the microcosm is but a stage where forces shift and change; and that no exact researches have at present in any way shown the necessity of believing that in the living body there exists any new force besides those at work in the world around. He is careful to point out that no thoroughly satisfactory balance sheet of the forces that come to and go out from a living body has yet been shown, so difficult is the task; but, though the details have yet to come, the general principle gains daily confirmation. Human force is but a transformation of chemical force, and man steals oxygen to do his work. Plants unburn what the animal burns; and so the heat of the sun brings back oxygen to the world.

And this leads the lecturer in his last lecture to the question, How does the sun get his heat? After quoting and discussing Mayer's hypothesis of the feeding of the sun with meteors, and pointing out the next question, "Whence comes the force which drives the meteors?" he finishes by dwelling on Clausius' theory of the constant loss of force in the shape of heat that cannot be weaned back to any other mode of motion, and on the general conclusions that may be drawn from it. These we prefer to give in his own words:—

If, then, when mechanical force passes into heat, *some* of that heat can never be brought back to be mechanical force, and if the change from mechanical force to heat be ever going on, all the force in the universe must at last take on the form of heat. But if that be so, then at last all differences of temperatures must disappear, and everything end in a universal Death. The whole chain of Cosmic events must therefore be looked upon not as formed of cycles, so that, cycle sweeping round upon cycle, the universe stands for ever the same, but as being a process of Evolution striving towards an End.

We are come to this alternative: either in our highest, our most general, our most fundamental scientific abstractions, some great point has been overlooked; or the universe will have an end and must have had a beginning; could not have existed from Eternity, but must at some date not infinitely distant have arisen from something not forming part of the chain of natural causes, *i. e.* must have been *created*.

M. FOSTER

OUR BOOK SHELF

Theoretical and Applied Mechanics, *for Schools, Colleges, Candidates for University Examinations, &c.* By R. Wormell, M.A., B.Sc. (London: Groombridge and Sons.)

WE are glad to see London University graduates recruiting the ranks of educational writers. Mr. Wormell states in clear and concise language the principles of elementary Statics and Dynamics, in close accordance with the syllabus of requirements for passing the examinations for the B.A. and B.Sc. degree at the London University. He gives hardly more nor less than this, but avoids at the same time an error into which most of our writers on the subject fall, viz. the overcrowding of their books with problems, which the purely didactic portion of the book does not enable even the gifted student to solve. Mr. Wormell adds to his test a great variety of really instructive *solved* problems, which will go far to help the student in finding the solutions of those given with the numerical answers alone. We have no doubt that this excellent little work will be a great success, but we should like the elementary principles of dynamics more amply illustrated. The introduction of the principle of limits on several occasions is highly commendable: the student should make its acquaintance early, but we believe in the old methods of proof to bring the matters more home to students, although they start, in a scientific view, from an inconsistency.—B. L.

Geodesy.—*Studien über höhere Geodasie.* By Dr. C. Bremiker. (Berlin, 1869.)

FROM great scientific undertakings, such as geographical expeditions, or geodetical, geological, and magnetic surveys of large areas, mankind generally derives, besides the utility of the work itself, a vast amount of contingent benefit. The result forms not only a landmark of scientific progress, but the work serves also for applying and testing a number of antecedent theoretical or practical discoveries, for separating what is sound from the unsound, and finally it rouses contemporaneously the mental energy of those more or less intimately connected with it to new exertions.

Of such a wide bearing is the great European arc-measurement now in progress, in which for the first time the curvature of parallels of latitude will be simultaneously determined with that of the meridians, and the question will be decided whether the figure of the earth, as represented by the surface of the ocean, is really an ellipsoid of rotation, or whether a triaxial ellipsoid will have to be substituted for it. Of the mathematical, physical, and geodetical investigations, which the progress of this great work has already created, Dr. Bremiker's ranks among the foremost. It discusses the methods of reduction with reference to deviation of the plumb-line, latitude, azimuth, difference in longitude, latitude, and azimuth, small angles, deduction of triangles; and employs everywhere practical and interesting formulæ. The mathematical attainments necessary for understanding this excellent little work are not too high, and we feel certain that nobody who takes an interest in higher surveying will read it without extending his experience and knowledge. B. L.

Our Bodies. By Ellis A. Davidson. (London: Cassell, Petter, and Galpin.)

WE cannot highly commend this little book, though we would wish to speak well of its author. He is evidently a thoroughly good and earnest teacher; and we have no doubt his oral lessons are far better than his written book, which may be described as "Goody Lessons in Physiology, written in words of either one or of more than five syllables." It consists of many terribly stony technicalities floating in a mass of very pappy information. On one page we find children warned, on physiological grounds, not to crack hard nuts with their teeth, and on another a description of the *axis-cylinder* of *nerves*, the *white Substance of Schwann*, and the *canaliculi* of bone. When will popular teachers of physiology and anatomy find out that these sciences are best taught free from technical hard nuts which splinter the enamel of the mind and worse? In not a few respects, too, we observe that "our bodies" of Mr. Davidson are not the same as *our* bodies.

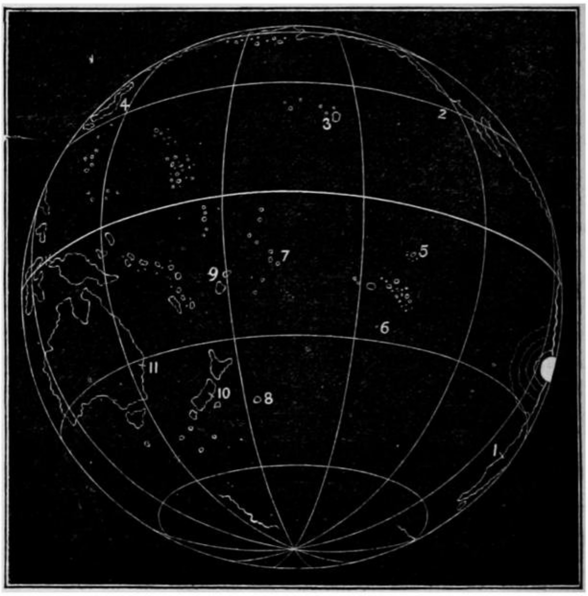
The Intelligence of Animals.—*From the French of Ernest Menault.* (London: Cassell, Petter, and Galpin.)

THE intelligence of animals may be studied in a scientific or in an anecdotal manner. M. Menault has chosen the latter method. We have not been led to form a very high opinion of his physiology or of his general philosophy; but he has compiled a most entertaining volume, crammed with most amusing stories about all kinds of animals, from ants to ourang-outangs. It is illustrated with numerous pictures, some of which are as good as the stories.

EARTHQUAKE WAVES IN THE PACIFIC

UNLIKE their great rivals, the Himalayas, which seem to have upreared themselves to a position where they can remain at rest, the Andes are disturbed from time to time by tremendous throes, whose effects are sometimes felt over a full third part of the earth's surface. To this class belonged the earthquake of August 13-14, 1868, and in many respects it was the most remarkable of all the great earth-throes which have desolated the neighbourhood of the Peruvian Andes. As in the great earthquake which overthrew Riobamba in 1797, a tremendous vertical upheaval seems simultaneously to have affected a region of enormous extent. But terrible as were the direct effects of the first vertical shock and the others which followed, it was the action of the earth-throe on the ocean which caused the greatest devastation. It is hardly necessary to recall to the reader's remembrance the fearful effects experienced at Chala, at Arica, and at other places along the Peruvian shore; for few, doubtless, have forgotten how a countryman of our own described the ominous retreat of the ocean, and the overmastering fury with which it rushed back and swept far inland, destroying at once the shipping it carried with it, and the buildings which it encountered in its course.

So fearful a disturbance of the seas around the Peruvian shores could not but generate a widely-extended oscillation of the waters of the great Pacific Ocean. Yet



it is impossible to hear, without surprise, of the enormous waves which reached the far-off shores of the islands which lie scattered over that enormous ocean-tract. The accounts which came gradually in of waves which had swept past Honolulu and Hilo, into the ports of Yokohama and Lyttleton, and had even disturbed the waters which surround the East Indian Archipelago, seemed at first scarcely explicable as the direct results of a disturbance occurring so many thousands of miles from those places.

But when the accounts are carefully compared together, they are found to point most clearly to the South American shores as the true centre whence the great wave of disturbance had spread over the whole surface of the Pacific. Professor von Hochstetter* has brought together all the accounts which seem to throw light on the progress of the great earthquake-waves from Arica. For the most part, unfortunately, the waves visited the islands and ports of

* Petermann's "Geographische Mittheilungen," part vi. 1869.

the Pacific by night; but still enough evidence remains to exhibit with sufficient clearness the course which the disturbance followed.

Let us first endeavour to form a clear conception of the scene of this great manifestation of Nature's powers. The Pacific Ocean is not commonly chosen as the subject of a single map, and the maps in our ordinary atlases are not calculated to give clear ideas respecting the true shape and dimensions of an ocean which is undoubtedly the most remarkable physical feature of the whole terrestrial globe. I have endeavoured to remedy this defect by the accompanying chart, which represents a perspective view of that half of the globe to which the Pacific belongs, and will serve, I think, to convey a tolerably clear impression of the true proportions of this great ocean.

Near the shore of Peru I have marked the estimated region of central disturbance by a white circle.

The great waves which came surging onwards from the centre of disturbance must presently have lost their circular figure. On account of their enormous dimensions they "felt the bottom," so to speak, and were more or less retarded according as they traversed shallow or deep portions of the great ocean.

At Arica the first great shock of the earthquake was experienced at about five in the afternoon of August 13th. Twenty minutes later an enormous wave fifty feet in height swept in over the shores; and we may assume that about this time the waves which were about to traverse the Pacific started on their vast career.

Along the coast of Chili the wave travelled southwards, reaching Coquimbo three hours after the catastrophe at Arica. One hour later the wave had reached Valparaiso; and yet an hour later the inhabitants of Valdivia—marked (1) in the map—were terrified by an inrush of the sea which threatened to destroy their town.

Northwards from Arica the progress of the wave was not so carefully timed. On the 14th of August, but at what hour is not stated, the shores of Lower California, near San Pedro—marked (2) in the map—were swept by a wave no less than sixty-three feet in height.

At midnight of August 13-14, the sea-wave reached the Sandwich Isles (3), and from that time until the 16th of August the sea around those islands rose and fell in a surprising manner. It appeared as though the islands were first slowly raised as by some irresistible subterranean forces, and then suffered to subside until they seemed about to disappear for ever beneath the waves; nor was it easy to believe that in reality the sea alone was in motion.

Yokohama (4) was visited by the wave on August 14th, but unfortunately the exact hour is not known, otherwise there would have been the means of ascertaining how long a wave takes in traversing nearly a complete half of the earth's circumference.

The Marquesas Isles (5) were visited by waves of enormous dimensions before midnight of August 13th. Some of the islands of this group were indeed completely submerged by the crests of the principal waves.

At Opara (6), the coaling-station for steamships plying between Panama and New Zealand, nine waves came in one after the other, at intervals of twenty minutes, the highest sweeping over the coal depot.

At half-past two on the morning of August 14th, the watchman in Apiu, on the island of Opolu (7), aroused the frightened inhabitants from their sleep with the cry that the sea was coming in upon them; and during the whole of that day the sea rose and fell at intervals of only fifteen minutes. But the waves reached the Chatham Islands (8), though nearly as far from Arica, an hour and a half sooner. Three enormous waves rushed in upon these islands, one of which, the low-lying Tupunga, was completely submerged. Between two and three hours later the wave had reached the Fiji Islands (9).

The shores of New Zealand, and especially those bays of the southern island which face towards the east, were visited by enormous waves. Between three and four o'clock in the morning, the harbour of Lyttleton (10) was left completely dry by the retreat of the water, which did not return until more than an hour had elapsed. At five the water began again to retreat, reaching its lowest point an hour later. But at a quarter-past seven and at half-past nine, and again at eleven, a great sea-wave swept over the bounds of the harbour.

Lastly, the ocean-wave visited the Australian shores near Newcastle (11) at about half-past six in the morning of August 14th, the waves gaining in height at each return until about half-past eleven, from which hour they slowly subsided.

The chief interest of these results lies in the circumstance that they enable us to form an estimate of the depth of the Pacific Ocean. Airy, Whewell, and other eminent mathematicians have shown how the velocity of sea-waves varies with the depth of the part of the ocean they are traversing. Where the breadth of the waves is great, as in the tidal wave, a very simple law connects the variation of the velocity with that of the depth. If a wave travels twice as fast in one part of its course as in another, it may be assumed that the depth of the ocean is four times greater in the former than in the latter part of the ocean. A tripled velocity signifies that the depth is nine times greater, and so on. With waves of different breadth the law is slightly different. But the following table, extracted from a larger one in Airy's paper on sea-waves (*Encyclopædia Metropolitana*), shows how slightly the law is affected for waves beyond a certain breadth:—

Depth of the Water in feet.	*Breadth of the Wave in feet.*		
	100,000	1,000,000	10,000,000
	Velocity of Wave per Hour in Miles.		
100	38·66	38·66	38·66
1,000	122·18	122·27	122·27
10,000	364·92	386·40	386·66
100,000	487·79	1,151·11	1,222·70

Observe, however, how in this table the wave 100,000 feet in breadth remains relatively insensible of a change of depth from 10,000 feet to 100,000.

Now, Professor von Hochstetter has carefully estimated the velocity of the wave which passed from Arica to the points marked (1), (3), (6), (7), (8), (10), and (11) in the illustrative map, and his results may be briefly indicated as follows:—

Rate from Arica to station (1)	284	sea-miles per hour.
" " " (3)	417	" "
" " " (6)	362	" "
" " " (7)	358	" "
" " " (8)	360	" "
" " " (10)	316	" "
" " " (11)	319	" "

It is well to observe, first of all, how well the low rate of velocity to Valdivia accords with the theory of sea-waves, for this wave travelling along the sea-coast must have passed for the most part over shallows. The voyage to the Sandwich Isles appears to have been accomplished more rapidly than any of the others. Along the line, therefore, from Arica to (3), the Pacific has its greatest depth. Towards stations (6), (7), and (8), the sea-wave sped very swiftly, and here, therefore, the water is still deep, though not so deep as along the former route. But in voyaging onwards from the neighbourhood of the Chatham Isles (8) to New Zealand and Australia, the sea-wave lost a large portion of its velocity, insomuch that the average rate for this distance scarcely exceeds that with which the wave passed to Valdivia.

From these results it would be easy to calculate the mean depth of the ocean along the various tracks pursued by the wave-fronts. It will be found by those who care thus to apply Professor Airy's results, that the following estimates by Professor Hochstetter are approximately correct.

He makes the mean depth—

		Fathoms.
Between Arica and	Valdivia (1) . . .	1,190
,,	the Sandwich Isles (3)	2,565
,,	Opara (6) . . .	1,933
,, ,,	the Chatham Isles (8)	1,912
,, ,,	Lyttelton (10) . . .	1,473
,, ,,	Newcastle (Aust.) (11)	1,501

These results are the more valuable, because the Pacific Ocean has not been so carefully sounded as the Atlantic has. And though the progress of the tidal wave has long afforded similar evidence, yet a certain amount of doubt necessarily rests over conclusions drawn from the progress of a wave which is acted upon throughout its voyage across the Pacific by the attractions which gave it birth.

We may add, in conclusion, that on December 23, 1854, a wave traversed the Pacific from Japan to San Francisco and Diego, or from (4) to the neighbourhood of (2), whose progress, dealt with according to Professor Airy's numbers, showed the mean depth of the sea between Japan and San Francisco to be 2,149 fathoms, and between Japan and Diego 2,034 fathoms. These results agree fairly with those which have been deduced by Professor von Hochstetter.

R. A. PROCTOR

A NEW FORM FOR SCHOOLS

AT the first blush this may seem a trivial subject, but when we consider the immense floating multitude of children who frequent schools, spending at least some 6,000 hours on forms during the time that they are at school, and that their health may be injuriously affected by the use of unsuitable ones, the importance of the subject becomes evident.

Dr. E. H. Schildbach states, in the *Gartenlaube*, that amongst more than a thousand children whom he examined in several schools at Leipsic, he found only a few who did not show some lateral curvature or deviation of the spinal column, traceable to the use of improper forms.

The chief defect in the construction of these forms was the great space between the seat and the table. Seats without backs soon tire out even robust children; they cannot sit upright for several hours together, and after much shifting from side to side, they are constrained to obtain relief by sitting on the very edge of the bench, and resting their arms on the table before them. The position into which they are thus forced is anything but a salutary one. The back is curved, especially in its lower half; the thorax sinks between the shoulders, and chest and stomach suffer a not inconsiderable pressure. To write in this position, one shoulder is raised much higher than the other, and the whole body is twisted unnaturally. With young and growing people the assumption of constrained positions, even for a few hours day by day, soon becomes habitual, and in many cases may lead to real deformity.

Our illustration represents the model form recommended by Dr. Schildbach, invented by Mr. E. Kunze, of Chemnitz, in Saxony, and will scarcely require a detailed description. It will be seen that the table forms an inclined plane without the usual level projection at its upper part. It is divided by cross bars into separate desks, and the boards which form the desks are movable and can be drawn out. A metal button with a lateral motion holds each board in its place, and also fixes it when drawn out. At the top in front are places for inkstands and writing materials, covered by the board when pushed home. Each seat has its separate back, of a shape best calculated to give proper support with the least possible pressure, while it allows the pupil to leave his place by stepping back over the seat without disturbing his neighbour. Underneath the table is a shelf for books, slates, &c., and beneath this there is a foot-board, an important provision against cold. The inexpensive character of this form and simplicity of its construction will be apparent to everyone.

THE NOVEMBER SHOOTING-STARS

THE earth is rapidly nearing the band of cosmical bodies to which the November star-showers owe their occurrence. Whether we are to witness a display or not depends wholly on the nature of that portion of the band through which we are to pass this year. The portion which gave the great display of 1866 has now passed many millions of miles away on its course towards the orbit of the distant planet Uranus. Nearer to us, but still many millions of miles away, is the part which we traversed in 1867, when (in America) there was a short but brilliant display of meteors, which would have afforded a yet more striking exhibition but for the full moon which dimmed their splendour. In 1868 meteors were seen in every part of the earth, and even, in America, on two successive nights. It is clear, therefore, that the portion of the band then traversed was very much wider than the part through which the earth had passed in the two former years. But even the part traversed in 1868 is more than five hundred millions of miles away from us now; and it is difficult indeed to say what may be the character of the portion we are approaching. Most probably it is even wider than the part we passed through in 1868; in which case we are sure (if the weather be but fine) to see a display of the November shooting-stars, though the same process of wide-spreading would of course tend to make the display so much the less brilliant.

It must be remembered that it will be absolutely useless to look for the meteors much before midnight of November 12—13 and of November 13—14. England does not come round to the exposed hemisphere of the earth—that is, to the hemisphere which is bearing directly through the meteor-band—much before ten o'clock in the evening; and she does not turn her full face, so to speak, towards the meteors before midnight. From that time until ten in the morning the rain of meteors is directed upon England without intermission, though no sign of the falling stars can be noticed after sunrise.

Our neighbours across the Channel propose to send observers to the shores of the Mediterranean, there to watch the meteors under more favourable circumstances than in more northern latitudes. Although we already know the principal conditions under which the meteors move, yet all observations directed to the determination of the size, colour, and constitution of these interesting bodies, will be well worth the making. The comet-nucleus of the system has now travelled nearly a thousand millions of miles away since in 1866 he passed his perihelion; and it will be interesting to learn whether the character of his train of followers is at all dependent on their distance from him.

R. A. PROCTOR

[To this note we add the following extract of a letter from Mr. Hind, which appeared in the *Times* of Tuesday.—ED.]

"The elements of the orbit in which the November meteors revolve are as follow, according to the last calculations of the Italian astronomer Schiaparelli, founded upon the accurate data obtained during the grand display in 1866. Heliocentric longitude of perihelion or of the point nearest to the sun, 56° 26′; crosses the plane of the earth's path from north to south in 51° 28′; inclination of orbit to the plane of the earth's path, 17° 45′; eccentricity of orbit, 0·9046; distance from sun in perihelion, 0·9873 (the earth's mean distance being taken as unity); semi-axis major of the orbit, 10·340, similarly expressed; period of revolution, 35·25 years; motion retrograde or opposite to that of the earth. At its nearest approach to the sun the orbit is therefore situate close to the earth's, while in aphelion it is not far distant from that of Uranus. It is well known that these numbers are almost identical with those applying to the orbit of the first comet of 1866, and I have lately ascertained beyond reasonable doubt that the comet of 1366, which became visible three days after the memorable meteoric exhibition in October of that year, when 'there was a movement of the stars such as men never before saw or heard of,' and 'those who saw it were filled with such great fear and dismay that they were astounded, imagining they were struck dead, and that the end of the world had come,' as the exaggerated language of the time has it, also moved in a similar orbit. It was, doubtless, visible during the shower on the confines of Ursa Major and Leo Minor, but the Chinese did not perceive it till three nights later. It was not seen in Europe."

PENNY SCIENCE CLASSES

IN opening the session of the Birmingham and Midland Institute recently, the President, Mr. Charles Dickens, referred to the "penny system" of instruction as "one of the most remarkable schemes ever devised for the educational behoof of the artizan;" and as this system, so far as we know, is adopted only at the Birmingham institution, we have made inquiries respecting its working there. We learn that, soon after the opening of the Science Classes in 1854, the teacher, Mr. Williams, observing that after a few terms the attendance fell off, suggested the establishment of Penny Lectures, as introductory to systematic scientific instruction. This plan answering well, an arithmetic class was commenced by Mr. Rickard, to which students were admitted on payment of one penny at the door. Subsequently other classes were started on the penny system, and now among others even chemistry and physical geography are taught in penny lessons. The chemistry class was formerly conducted on the quarterly plan, the fee being 3*s*. per term of twelve lessons. Though the fee was low, the attendance seldom reached more than 40 or 50 per night; while since the introduction of the penny system it is about 100 during the winter months. The persons attending the class are of all grades of society; but since the change to the penny system the proportion of artizans has much increased. We are not surprised at this, in fact it is what we should expect. The wage-paid class receive their earnings weekly, they pay their rent weekly, their "settlings" are made weekly, and their books they take in in weekly numbers. It is not to be surprised at, then, that a science class in which the fee is paid weekly should be popular with artizans. Where the fee is so low as one penny we do not see how a class can pay; but such institutions as that of Birmingham are not intended, and never were intended, to pay in a commercial sense. The promoters and subscribers are only too pleased to find their efforts successful in inducing attendance at the classes. Viewed in this way we believe the penny system to be the best of any; and the Birmingham and Midland Institute deserves all honour for having introduced it.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his Correspondents.*]

Scientific Education at Cambridge

I NOTICE a paragraph at page 26 of NATURE, in which, while the facts are correct, a wrong inference is drawn from them. Two gentlemen at Cambridge have been appointed to lecture on subjects in natural science, and one of these has been appointed to lecture on electricity, magnetism, and botany. These facts are correct, and your informant congratulates the University on the increased desire for instruction in these subjects manifested among the members of the University, but says, "is the number of men in the University competent to teach them so small, that it has been found necessary to entrust electricity and botany to the same lecturer?" But the real state of the case is, that in the University there is not a want of those able to teach Natural Science, but a want of those desiring to learn it. In fact, there are so few who want to learn these matters of science, that we cannot afford to pay, and have no need to appoint, more than one man to do the work. The lectures which we have in these subjects are insufficiently attended. The University is not behind the age in the power of teaching these matters, but before the age. If there had been many people coming here desiring to be taught certain subjects, and we had been unable to supply that teaching, we should in that have been behind the age. But we are offering teaching which those to whom we offer it have not yet learned, or do not yet care, to appreciate. I am not saying that we have the power of showing all the wonders that the astronomers of the present day can watch with their spectroscopes. We are not well supplied with apparatus; but our want of it does not arise so much from the inefficiency of our teachers as from the apathy of those who are taught. We have quantities of excellent apparatus exhibited and lectured about daily by several of our professors well able to deal with these matters, and yet these lectures are taken advantage of by only a very few. If these lecture-rooms were once crowded, the University would only be too happy, and would immediately have at its command abundant means to increase the staff of competent teachers. We have in fine more than a sufficient number of people who can teach, and, what is more, are willing to teach, natural science, if only there are those who care to be taught.

But it would seem as if the classes, from whom the University is recruited, were behind the age in their desire to be taught these matters; for if we turn away from the University we find a very different state of things. There can be no doubt that throughout England there is a great demand for scientific education. This demand exists more or less among all classes, and it exists among the working-men of this country to an extent which could hardly be believed by those who have not had some experience in the matter. Among these there is a great desire for scientific instruction, and there is no one to supply it.

The case of the University is exactly reversed. There are 1,500 undergraduates at Cambridge, and there are more men able to teach them science than there is any need for. But look to the non-university classes of England; there are a thousand times that number eager to learn, and not all the men who come forward to teach them unite the qualifications of willingness and of competency. That there is a great demand for scientific education, and that not of a desultory kind, among vast numbers of the various uneducated classes of England, is a most certain fact. If anyone doubts this, let him go to some of our great workshops, and let him give a series of careful lectures on some scientific subject, and I will venture to say he will be simply astonished at the numbers who will come. I have seen crowding to a weekly lecture on Astronomy, or on Light, hundreds of workmen who had all been working for at least ten hours that day, and who are so greedy for instruction that on a summer evening, instead of playing at some game during their only hours of leisure, they will spend one part of it in reading, and the other part in listening to a lecturer, the intricacies of whose demonstrations require the most unhalting attention. Suppose I were to start a lecture on some scientific subject at Cambridge, probably none, or at most a score, would come. I am not setting this down to their blame, for the truth is that they have not the same need, for they have many men able to teach them anything they could possibly want to learn. I am not here stating the reasons why there should be so small a demand for scientific teaching at the University; the reasons are various and complicated, although we have not to go far to seek them; but the fact is certain. Now all this ought not to be so. There is a supply without a demand, and a demand without a supply; and the matter calls for the gravest consideration of those scientific men who care that the benefits which are to be got from the true study of science should be diffused among the people of this country. Of all things in the world, this is a demand which, wherever it exists, it is right to foster and encourage, and it can only be successfully fostered and encouraged by men whose intimate acquaintance with the subjects with which they deal renders them competent for a task at once of such magnitude and of such importance. It is not any want of teachers at the University, but the almost absolute want of teaching and teachers for those classes that presses upon us.

JAMES STUART

Trinity College, Cambridge, Nov. 8

Fertilisation of Winter-flowering Plants

MR. DARWIN has done me the honour of calling my attention to one or two points in my paper, published in your last number, "On the Fertilisation of Winter-flowering Plants." He thinks there must be some error in my including *Vinca major* among the plants of which the pollen is discharged in the bud, as he "knows from experiment that some species of *Vinca* absolutely require insect aid for fertilisation." On referring to my notes, I find them perfectly clear with respect to the time at which the pollen is discharged. My observation, however, so far agrees with Mr. Darwin's, that I find no record of any fruit being produced in January; it was, in fact, the absence of capsules on the *Vinca* which induced me to qualify the sentence on this subject, and to say "in *nearly all* these cases, abundance of fully formed seed-bearing capsules were observed." It is worthy of remark, that the *Vinca* is the only species in my list of apparently bud-fertilised plants not indigenous to this country. The second point relates to the white dead-nettle, with respect to which Mr. Darwin says, "I covered up *Lamium al um* early in June, and the plants produced no seed, although s irrounding plants produced plenty." This again would agree with my conjecture that it is only the flowers produced in winter that are self-fertilised. I may, however, be permitted to suggest that the test of covering up a plant with a bell-glass is not conclusive on the point of cross-fertilisation, as it is quite probable that with plants that are ordinarily self-fertilised, the mere fact of a complete stoppage of a free circulation of air may prevent the impregnation taking place. Has the experiment ever been tried with grasses, which, according to the French observer, M. Bidard are necessarily self-fertilised?

ALFRED W. BENNETT

3, Park Village East, Nov. 8, 1869

A Meteor

THIS evening, at 6.50, Greenwich time, I was called to my door by the letter-carrier, who pointed out a serpentine band in the sky, having a brightness rather above that of the Milky Way. It was about 3° in greatest breadth, and 20° in length. Its longest axis was in the line from the north-west point of the horizon to the pole star, from which, where nearest, it was about 20° distant. Its other extremity was very near the Milky Way, and surpassed every other part in brightness. Its pole-ward termination was faint, filmy, and bifurcated.

The postman said, "About five minutes ago," *i.e.* 6.45 p.m., "whilst waiting at another house, I suddenly became aware of a great light, but on looking up, instead of a shooting star, as I expected, I saw a fixed crooked line, as broad as my finger, and quite as bright as that star" (pointing to Jupiter). It gradually became broader and fainter, but not longer; and I came on here as fast as I could to let you know about it."

I observed it at intervals of five minutes; and observed that it gradually grew fainter and straighter, and moved slowly towards the north-east, its axis remaining apparently parallel to itself throughout. I saw it distinctly at 7.35, but was not satisfied that I did so at 7.40. It must have remained visible from 50 to 55 minutes.

W. PENGELLY

Lamorna, Torquay, Nov. 6, 1869

[It is to be hoped that advantage was taken of this almost unprecedented opportunity to bring the spectroscope to bear upon a meteor cloud. From other accounts the meteor itself appears to have been exceptionally brilliant, and to have burst with noise, as of a rocket (Falmouth); to have changed its colour from yellowish red and lurid red to brilliant green at the moment of explosion, and then from violet to orange (Birmingham.) Another account (Wimborne) states, that at the moment of explosion the colour was dazzling purple and blueish, fading into white at its upper extremity. The cloud was observed to assume a serpentine form both at Bristol and Stokesay. Mr. Pengelly's 50 or 55 minutes' duration was most nearly equalled at the latter place, where it was observed for half an hour. There are ample elements for the determination of the meteor's path.—ED.]

Tempel's Comet

I ENCLOSE an orbit for the comet discovered by Tempel on October 11, of which no elements have yet been published in the *Astronomische Nachrichten.* Indeed, but for an observation kindly sent me by Dr. Winnecke, and not yet printed, it would not have been practicable to work out an orbit.

Elements of the Orbit of Tempel's Comet, 1869, *Oct.* 11.

Elements calculated from an observation at Bonn, Oct. 12, one by Dr. Winnecke, at Carlsruhe, Oct. 17, and a third at Leipzig, Oct. 23:—

Perihelion Passage, 1869, Oct.	8·4421	Greenwich M. T.
Longitude of Perihelion .	124°·41′ 1″	From appt. Equinox.
,, Ascending Node	311°·24′ 4″	
Inclination to Ecliptic .	68°·48′ 8″	
Log. perihelion distance .	0° 08995	

Heliocentric Motion Retrograde.

The above orbit does not resemble that of any comet previously computed.

J. R. HIND

Observatory, Twickenham, Nov. 8.

NOTES

THE argument that British manufacturing and commercial superiority cannot be maintained unless the means of a sound scientific education be placed within the reach of all classes all over the kingdom, seems likely to be put to the proof. Oxford and Cambridge local examinations, the examinations by the Society of Arts and the South Kensington Museum, we are told, only serve to show how backward we are in real knowledge, and that we want more schools, more places of instruction. Well, by act of parliament, a number of our Public Schools are to be ruled by new "Governing Bodies," the members of which are to be appointed by different authorities; but we confine ourselves here to the fact that among those authorities are "the President and Council of the Royal Society." These gentlemen, the very head and front of British science, are to nominate a member of the "Governing Body" of each of seven schools, namely, Westminster, Eton, Winchester, Harrow, Charterhouse, Rugby, and Shrewsbury. Here is, indeed, an innovation! The President and Council of the Royal Society will of course nominate men of science. Consequently, science will be taught in all those schools, side by side with the classics. Can the two run together? If science goes up, will Greek and Latin and scholarship go down? We hope not; but these are questions for the future to answer. Meanwhile, we have much pleasure in stating that the two nominations already made by the Council of the Royal Society are such as will command universal approval. Prof. G. G. Stokes, Secretary of the Royal Society and President of the British Association, has been nominated for Eton School, and Mr. W. Spottiswoode, F.R.S., for Westminster School. The interests of science could not be in better hands than these, and we can only hope that the five nominations yet to be made will be equally acceptable. There is movement too in other quarters. The University of Durham is stirring, and desires to establish a school of Physical Science, and to change its humdrum terms of twenty-four weeks in the year, for terms of eight months. All hail to the innovation! Theology at Durham will now have Science for a companion. And the great county of York does not mean to be left behind, for a preliminary meeting of the general council of the Yorkshire Board of Education has been held at Leeds, to talk about the establishment of a Science college. Should this come to pass, the youth of the North of England will have a fair opportunity for scientific education, for Lancashire is already provided with a college at Manchester.

WE learn from the *Astronomical Register* that an Observatory of the first order has been recently inaugurated at Florence with much solemnity, and in the presence of a large number of scientific men of all countries: among them being many astronomers who had come to Florence to discuss the measurement of the great European arc. From the municipality of Florence, the provincial council, the Government, and the King himself, have come the necessary funds : Professor Donati stating that in Italy, at all events, the maxim is well understood that "as private means are insufficient for continuous scientific researches, and as it is clear, that every advance of science, whatever it may be, becomes sooner or later of the greatest public benefit to all classes; it is therefore natural and just that the public coffers, and those of the wealthy, should unite to enrich the patrimony of science, which is the patrimony of all." What a happy day it will be for England when her administrators and statesmen, and Cabinet Ministers, come up to the Italian standard, when the governing classes are sufficiently educated, and single-minded, and far-sighted, to help in the erection of scientific workshops. A crying want at the present moment is a Physical Observatory. He would be a brave man who would suggest that the municipality of London and the Government should supply us with one!

HERE is a welcome piece of news from the *London Gazette*:— "The Queen has been graciously pleased to give orders for the appointment of Joseph Dalton Hooker, Esq., M.D., Director of the Royal Botanical Gardens at Kew, to be an Ordinary Member of the Civil Division of the Third Class, or Companions of the Most Honourable Order of the Bath."

THE Geographical Society commenced work on Monday evening, the *pièce de resistance* being a long communication from Dr. Livingstone, full of interest and important details, to which we may return; the main drift of it is already known to our readers.

MELBOURNE no longer enjoys a monopoly of Australian science. A "Royal Society of New South Wales," to which we heartily wish success, has been established in Sydney, and the first volume of its "Transactions" is now before us. This publication—an octavo of about ninety pages—may be accepted as an earnest of good work yet to come; for, besides the inaugural address by the President (Rev. W. B. Clarke) it contains mathematical, geological, astronomical, and statistical papers. Chief Justice Cockle, F.R.S. (who, by the way, is President of a Philosophical Society in Queensland), contributes a paper on Non-linear Coresolvents; Mr. Gerard Krefft one on the Bones found in a Cave at Glenorchy, Tasmania; Mr. Smalley, the Government astronomer, one on the Mutual Influence of Clock Pendulums; and Prof. Pell one on the Rates of Mortality and Expectation of Life in New South Wales, as compared with England and other countries. In all, there are seven papers in the volume, and we congratulate our cousins at the antipodes on their meritorious contributions to the cause of science.

ON Saturday last the Cambridge Philosophical Society celebrated their jubilee by a dinner, Professor Cayley occupying the chair. It was pleasant to hear the venerable Professor Sedgwick give an account of the formation of the Society, and bless God that he had lived to see it so far on its way.

FROM Saint John's College, Cambridge, we learn that besides seven minor scholarships or exhibitions, there will be offered for competition an exhibition of 50*l*. per annum for proficiency in Natural Science, the exhibition to be tenable for three years in case the exhibitioner have passed within two years the previous examination as required for candidates for honours; otherwise the exhibition to cease at the end of two years. The candidates for the Natural Science exhibition will have a special examination on Friday and Saturday the 29th and 30th of April, 1870, in chemistry, including practical work in the laboratory, physics (electricity, heat, light), and physiology. They will also have the opportunity of being examined in one or more of the following subjects, geology, anatomy, botany, provided that they give notice of the subjects in which they wish to be examined four weeks prior to the examination. No candidate will be examined in more than three of these six subjects, whereof one at least must be chosen from the former group. It is the wish of the master and seniors that excellence in some single department should be specially regarded by the candidates. They may also, if they think fit, offer themselves for examination in any of the classical or mathematical subjects. The exhibitions are not limited in respect to the age of candidates.

WE are promised a new illustrated weekly—the *Graphic*—shortly, and we observe with pleasure that Science is to find a place in it.

THE attention of the Ethnological Society during their last session was directed (in a series of able papers recorded in their journal) to the Megalithic remains—cromlechs, dolmens, stone circles, &c., such as are found in our own island, as well as in all parts of Southern Europe, in India, Arabia, and in Africa along the shores of the Mediterranean. The desirability of collecting evidence of at least relation of race in their builders, which the identity of form and size of these stone wonders suggest, whether found in Kaseem, in Arabia, or in Avebury in Somersetshire—induced the assistant-secretary of the Society to send a competent photographer to take views of the stone circles of Wiltshire. In these views, 12 inches by 10, by a simple method of scale measurement, the exact dimensions are recorded, and the compass bearings noted; enabling the closet student to make careful comparisons. Will not our learned societies, and munificent individuals interested in prehistoric studies, come forward to provide funds to secure a systematic delineation of at least the European Megalithic structures?

WELL-CONSTRUCTED maps are among the most needful appliances of scientific education: we are glad to notice a Physical Map of India, compiled by the Librarian R.G.S. of a size sufficient to render it easy of use, yet showing distinctly the comparative mountain elevations, the great alluvial plains, river systems, &c. This map, which has been adopted by one of our greatest educational establishments, is, we understand, the first of a series.

AT the last meeting of the German Chemical Society in Berlin, the President, Prof. Hofmann, opened the proceedings by referring to the great loss the Society had sustained through the death of their honorary member, Thomas Graham; and remarked: "Graham's was one of those singular minds which create and open new roads of science. Our young society deems itself fortunate to see his name inscribed amongst its members. Let us honour his memory by rising from our seats." On the 9th of October, a German chemist of high standing followed Graham into the grave. Otto Luiné Erdmann was born in Dresden, in

1804. He began his career as a pharmaceutical chemist, but soon embraced pure science with such success that a chair of Chemistry was given to him in the University of Leipzig, in 1830. This chair he occupied until his death; attending to his professional duties with great zeal, although a number of practical occupations (that of director of the Leipzig and Dresden Railway Company, the Leipzig Gas Company, &c.) divided his attention. We owe to him a great number of mineral analyses, a celebrated investigation of indigo, from which he was the first to obtain isatine (in 1840), and several other derivatives, also the analyses of several colouring matters, as jaune indien, euxanthic acid, oxypicric acid, of stearic and of mellitic acid. Together with Marchand he determined a great number of atomic weights with considerable accuracy. With the same chemist, and, after his death, with Professor Werther in Königsburg, he edited the Journal "für practische Chemie"—a journal which will most likely cease to appear, both editors, as well as the publisher, having died during the last few months.

THE Königsburg chair has been offered to Prof. Baryen in Berlin, who declined it, and it still remains open.

PROFESSOR STRECKER of Tubingen has accepted the chair of Chemistry in Wurzburg, in place of the late Professor Schirer, who was known chiefly as a physiological chemist.

IN the Annual Report of the Gardens of the Royal Botanic Society, Regent's Park, recently issued, it is stated that during last season free orders of admission to the gardens for the purpose of study have been granted to 200 students and artists, and 10,653 specimens of plants have been given to professors and lecturers at the principal hospitals and schools of art and medicine. The collection of living economic plants now contains specimens of all the spices and condiments in domestic use, most of the tropical esculent fruits, and many of those from which furniture and other woods are obtained, the principal gums and medicinal products, and the poison-trees of Brazil and Madagascar. The lecturers at the schools of medicine attached to the various metropolitan hospitals are greatly indebted to the liberality of the Botanic Gardens in furnishing them with a copious supply of fresh specimens, so difficult to obtain in London, and without which the lectures would lose so much of their instruction. We may suggest, however, whether some improvements might not be introduced into the so-called "herbaceous" department of the Gardens. A needless amount of space appears to be occupied by the arrangement of British plants in two different classifications, the Natural and the Linnæan, the latter being now entirely abandoned by all teachers of botany. Sufficient care also is not taken that the labels should correspond to the plants really growing beside them. It is confusing to the student to find immediately in front of a label a plant growing in full luxuriance belonging to an entirely different family, which has accidentally strayed there, and has not been weeded out. At Kew this department is kept in much better order. The Royal Botanic Society are now soliciting contributions in aid of the extension of their magnificent winter-garden.

SCIENTIFIC readers who want a treat should read M. Leverrier's masterly argument against M. Chasles in his assertion, based on the forged papers, that Pascal had anticipated Newton's discoveries. How any one could pretend to be unconvinced after such an overwhelmingly true and logical exposition of facts surpasses comprehension. Under the title "Examen de la discussion soulevée au sein de l'Académie des Sciences au sujet de la découverte de l'attraction universelle" M. Leverrier has republished from the *Comptes Rendus* the whole of his argument in ninety-two quarto pages. We recommend all who can to read it.

THERE was an omission—which we are very glad to supply—in our last week's Note on the results of the dredging expedition of the *Porcupine*. A large, if not the greatest share of the labour, both as regards time and work, fell upon Mr. Gwyn Jeffreys, and this fact will make all look forward to the publication of the results with a greater interest.

THE many friends of Professor Morris, who have long admired the zeal displayed by him, not only in giving to the world the sound knowledge which he possesses of geology and palæontology, but in presenting it to his pupils in such a form as to enable them profitably to apply it in after life, now propose to give their recognition and appreciation a substantial form, by presenting him with a suitable testimonial. To carry out this object, a committee has been formed, and Mr. Milnes, F.G.S., of the Coal Exchange, London, has accepted the office of treasurer to the committee, of which Sir Roderick Murchison is president.

THE fruit of the Mango has recently been sold in Covent Garden market, obtained from Madeira. It had previously fruited at Chatsworth, and in the garden of Lord Powis; but, we believe, has not before been offered for sale in this country.

AMONG the books which have reached us this week are two to which we wish especially in the interim to call attention in this column. One of them is the new edition of Sir John Lubbock's "Prehistoric Times," considerably enlarged; and the other is "The World of the Sea," translated from the French of the regretted Moquin Tandon, illustrations which it does one good to see, forming one of the many points of the latter.

THE editors of the new "Journal of Ethnology," published in Berlin, circulate with their first number a hand-bill, in which, after calling attention to the extreme importance of photography for ethnographical purposes, they request photographers of all nations to send to the publishers of the Journal their addresses, and a statement of the ethnographical types to be found in their neighbourhoods. It may fairly be questioned, whether scientific knowledge is likely to be much advanced by the indiscriminate collection of photographs of individuals, selected by persons totally unacquainted with ethnography. The editors seem, moreover, to be somewhat premature in issuing such a notice as this, as they appear to have taken no steps to arrange for the photographs being published; neither do they undertake to deposit them in any public library or museum. They merely say that men of business will no doubt be found, who will assist in a matter which assures them, as well as the photographers, the renumeration to which they are entitled. We venture to express a hope, that if any general response is made to this notice, the photographers will be at least cautioned to use great care in ascertaining the tribe and parentage of the subjects they select; also that, in all cases, one photograph may be taken in exact profile and another in exact full face.

ASTRONOMY

Winnecke's Comet

THE following ephemeris of Winnecke's comet has been calculated by M. Oppolzer.

	R.A. h m s	N. Decl. ° ′
Nov. 11	1 25 40	11 30·0
13	1 24 25	11 12·8
15	1 23 20	10 55·1
17	1 22 24	10 36·9
19	1 21 37	10 18·4
21	1 20 59	9 59·5
23	1 20 29	9 40·4
25	1 20 7	9 21·0
27	1 19 53	9 1·4
29	1 19 47	8 41·5

CHEMISTRY

New Test for Alcohol

LIEBEN has discovered a new and very delicate test for the presence of alcohol, depending upon its conversion into iodoform. The liquid under examination is heated in a test-tube, into which are then introduced a few grains of iodine, and a few drops of potash-solution; whereupon, if alcohol is present, a yellow crystalline precipitate of iodoform is produced immediately or after some time, according to the degree of dilution of the liquid. This test is said to be capable of detecting 1 part of alcohol in 12,000 parts of water. For greater certainty, it is best to examine the precipitate with the microscope, iodoform exhibiting the appearance of hexagonal plates or six-rayed stars.

The test just described is capable of an important physiological application. It is generally supposed that alcohol introduced into the animal organism in the form of wine or other spirituous liquors becomes completely oxidised, and does not pass into the urine as alcohol, but in the form of some product of transformation. Lieben, however, by applying the new test to the urine of a man who had drunk a bottle of wine half an hour before, was able to detect the presence of alcohol in it. A second portion of urine voided by the same individual, an hour later, and a third, after another half-hour, still exhibited the peculiar reaction under consideration. The urine was of course distilled before applying the test, and it had been previously ascertained that none of the other volatile matters contained in it would produce a similar reaction.—[Ann. di Chim. app. alla Med., Sept. 1869, p. 136.]

Preparation of Silver Nitrate

P. SCIVOLETTO proposes the following modification of the process of preparing silver nitrate for use in medicine, photography, &c. This salt is usually prepared from old silver containing copper, by dissolving the alloy in nitric acid, evaporating to dryness, and calcining the residue as long as nitrous fumes continue to escape. The product is a mixture of silver nitrate and cupric oxide, from which the former may be dissolved out by water. The inconveniences of this process are the time it takes, and the difficulty of ascertaining when the cupric nitrate is completely decomposed. To obviate these inconveniences, the author, after evaporating the solution of the mixed nitrates to dryness, redissolves them in water, and precipitates the silver from the neutral solution by means of a clean spiral of copper foil. The precipitated silver is then redissolved in nitric acid, and the resulting nitrate is either crystallised, fused, or left in solution, according to the use to which it is to be applied.—[Ann. di Chim. app. alla Med., August 1869, p. 70.]

A. SAYTZEFF has discovered a new method of converting fatty acids into the corresponding alcohols, namely, by the action of dry sodium amalgam on a mixture of a fatty acid with the corresponding chloride; e.g. acetic acid and acetyl chloride yield ethyl alcohol. In this manner he has prepared ethyl, propyl, and butyl alcohol.—[Zeitschr. f. Chem. (2), v. 551.]

GRUNE has found that the photographic image, as ordinarily produced, is on the surface, and not in the substance of the collodion film. By transferring the film to wood, and then dissolving out the collodion by means of ether, a purely metallic image is left, admirably suited for the purposes of the engraver.

PHYSICS

Thalen's New Map of the Spectra of the Metals

M. ROBERT THALÉN has contributed to the Royal Society of Upsala an important memoir on the determination of the wave-lengths of the metallic lines of the spectrum. Dissatisfied with the pure results of refraction, as not being sufficiently refined to meet the requirements even of ordinary analytical accuracy, the author resolved to construct a new chart, based on the principle of wave-lengths. For the systematic examination of spectra, an electric source of light should always be employed, and entire groups of characteristic lines ought to be observed in all cases. The ordinary spectroscope, with a fine micrometer scale, gives readings which vary sensibly with the temperature and material of the refractive medium; and two such instruments cannot be compared with each other unless by specific tables, or graphically. Accordingly, the highest accuracy can only be attained by direct comparison with the dark lines of the solar spectrum, which themselves furnish an excellent micrometric scale. M. Thalén has therefore founded his experiments on the laborious achievement of Ångström, with whose "normal solar spectrum" he was early associated.

The actual course of operations was as follows. Each bright metallic ray, whose spectrum it was desired to study, was laid down on the plates given by Kirchhoff and Hoffmann (A to G) or by Ångström and Thalén (G to H); these rays were next referred to Ångström's plates of the normal spectrum of the sun, unless a direct comparison with the solar lines could be made; and, lastly, the rays were drawn in the order of their wave-lengths as thus obtained, and sometimes with the assistance of a graphic method, on a map which accompanies the memoir.

The instruments employed in this research consisted of a large Ruhmkorff induction coil, aided by a sufficiently powerful condenser; and a voltaic battery of fifty pairs furnished the light for certain determinations. The spectroscope consisted of two tolerably large telescopes (one being used as a collimator) and a carbon disulphide prism of 60°. In favourable cases, two such prisms or six flint-glass prisms of 60° were employed; but when the intensity was very feeble, only one (of the latter kind) could be used.

The registration in the solar spectrum of the lines of incandescent bodies may be effected by different methods. When the voltaic arc is operated with, or even the induction spark (provided, in this case, that the electrode is made of the metal submitted to experiment), it is convenient to bring the rays from the two sources of light into the slit of the collimator in such a manner that the solar and metallic spectrum are one above the other. If the lines of the latter have sufficient intensity, the reference is effected without difficulty. On the other hand, when the intensity of the electric spectrum is feeble—which is generally the case when the spark is taken between electrodes moistened with saline solutions—it is better that the two pencils should enter the slit in the same direction, so as to be mutually superposed. As the bright lines are now scarcely visible on the illuminated background of the solar spectrum, the latter must be temporarily excluded by a screen; the vertical wire in the eye-piece of the telescope is made to coincide exactly with a bright metallic line; and then, on re-introducing sunlight, its position among the dark lines is seen with precision. It is not unworthy of notice that the exactness of this observation is impaired by a somewhat singular circumstance. If the wire and the Fraunhöfer lines are seen simultaneously in the focus of the eye-piece, the wire being placed among the weaker and narrower lines, it commonly happens that these entirely disappear, or can only be made out with difficulty. The great difference between the intensities of the two objects, and the diffraction fringes produced by the two sides of the wire, are, no doubt, the causes of this curious phenomenon.

M. Thalén gives a table in which the normal spectrum of the sun is recorded in wave-lengths, and compared with the refraction spectrum of Kirchhoff. By its aid, the metallic lines on the chart accompanying the author's paper may be identified with those of the refraction spectra alluded to, and an approximate value can be obtained of the wave-length corresponding to any line. The chart itself gives, in millimetres, the wave-lengths of metallic lines within about 0·0000001 of their true value. It was drawn by hand on paper upon which the scale had already been printed without the usual damping process; in this manner all shrinking was avoided. It is rendered still more valuable by a long appendix of tables, in which all its numerical elements are appropriately distributed among the respective metals. Only the most intense lines, such as are obtained by the induction apparatus, have as a rule, been submitted to measurement.

The following are the names of the metals whose lines coincide with those of the solar spectrum: sodium, calcium, magnesium, iron, manganese, chromium, nickel, cobalt, and *titanium*. The chart contains lines belonging to forty-five metals. Iridium, rhodium, ruthemium, tantalum, and niobium were examined, but without any definite result. The spectrum of air is given at the bottom of the chart, for the sake of reference, and some integers, roughly representing the intensity of the lines.

Some of the lines which show very strongly with metallic electrodes become very weak, when a saline solution is taken, and the more so as this is diluted. Two large and well-marked groups belonging to zinc and cadmium appear only when the metal itself forms the electrode, not the slightest trace of them appearing with a saline solution.

In a concluding note, M. Thalén points out the probable existence of titanium in the sun. Titanic oxide only gave feeble lines, of which a few characteristic individuals were mapped with difficulty. These were afterwards found in the spectrum of calcic chloride, with which some gas-carbon electrodes had been impregnated; but with electrodes of a different material the lines did not reappear. Perfectly pure titanic chloride, however, readily furnished them; and titanium was also obtained, by a chemical process, from the ash of the coal which had yielded the gas-carbon. A direct comparison of the numerous and delicate titanium lines with those of Fraunhöfer, under high dispersive power, left no doubt whatever that titanium must now be added to the list of solar metals.

PHYSIOLOGY

Gases of the Secretions

PFLUGER has investigated the gases of urine, milk, bile, and saliva. The quantity of nitrogen gas is very much alike in all, being in urine ·9, in milk ·75, in bile ·5, in saliva ·75 per cent. in volumes. The quantity of oxygen, on the contrary, varies much more, being in urine ·075, in milk ·095, in bile ·1, in saliva ·5 per cent. Pflüger attributes the larger quantity of oxygen in saliva to the fact that in the much less rapid secretions of bile, &c., the epithelium of the secreting passages consumes, during secretion, a large portion of the oxygen contained in the secreted fluid. In the more swiftly secreted saliva, the oxygen escapes in a large measure this consumption. The quantity of carbonic acid varies according to the reaction of the secretion. In alkaline, bile, and saliva, it reaches 56·1, and 64·7 per cent.; in neutral or acid urine, milk, and bile, it sinks as low as 13·7, 7·6, 5 per cent. respectively.—[Archiv. für Physiol. ii. 156.]

According to Bogoljubow, the carbonic acid of the bile depends largely on the quality and quantity of food taken. It seems to diminish during the stay of the bile in the gall bladder.—[Centralblatt f. Med. Wissen. 1869, No. 42.]

Changes in Milk

KEMMERICH brings forward observations to show that in standing milk, especially at blood-heat, an increase of the *casein* takes place at the expense of the *albumen*. He also confirms the statements of previous observers, that in milk (and cheese) the quantity of fat increases on keeping. He attributes, however, this "ripening of the cheese," to the action of fungi.—[Archiv. für Physiol. ii. 401.]

Effect of Alcohol on Animal Heat

CUNY BOUVIER affirms as the result of experiments on rabbits (apparently carefully conducted with due sense of sources of error) that alcohol lowers the temperature of the body, in small doses to a slight in large doses to a very marked degree.—[Archiv. für Physiol. ii. 370.]

Metamorphosis of Muscle

O. NASSE, extending the previous observations of MacDonnell and others, affirms that *glycogen* is a normal constituent of muscle, the quantity existing in frog's and rabbit's muscle amounting to 3—5 per cent. of the wet mass. He also states that in living quiescent muscle sugar is totally absent, or present in inappreciable quantity only. The conversion of glycogen accompanies rigor mortis, whether natural or artificial, and is also brought about by muscular contraction. Nasse further shows that muscular contraction and rigor mortis are accompanied by a consumption of the total carbo-hydrates of the muscle. The amount of sugar (or glycogen) lost under these circumstances is insufficient, however, to account for the acid (paralactic) produced at the same time; indeed the two processes run by no means parallel, and apparently are not connected.—[Archiv. für Physiol. ii. 97.]

Vertebrate Epidermis

F. E. SCHULTZE describes various modifications of the uppermost layers of the epidermis in vertebrata, distinguishing between *cuticular thickenings* of living cells and *cornification* of dead ones. In particular he describes curious laminated cuticular thickenings of the epidermic cells of various species of *hippocampus*. These cells he proposes to call *flame*-cells, from their curious resemblance to the flame of a candle.—[Max Schultze's Archiv. v. 295.]

Development of Grey Matter of Brain]

ACCORDING to Arndt, the grey matter of the convolutions of the rabbit at birth consists of nuclei imbedded in a protoplasmic matrix, studded with granules, and very faintly fibrillated. After birth the matrix becomes increasingly fibrillated, the granules partly coalesce and partly become dispersed. The nuclei become separated through a greater development of the matrix, and a nucleolus appears in them by coalescence of previously existing nucleolini. Part of this differentiated matrix is directly gathered round various nuclei to form the ganglionic cells and their branches, other parts become arranged in strands to form the axis cylinders of nerves, while the rest remains as the permanent granular faintly fibrillated matrix of the adult brain. Arndt tries to accommodate the "Cell theory" to these new facts.—[Max Schultze's Archiv. v. 317.]

Regeneration of Spinal Cord

MASIUS and VAN LAIR assert that if strong frogs be operated on in early or mid winter, complete reparation of structure with restoration of powers takes place, even when sections of the whole spinal cord 1–2 mm. in length have been removed. Degeneration occurs first at either cut surface: the central end swells by deposition of new tissue into a hollow cup-shaped bulb; the peripheral contracts into a cone fitting into the former; and so union takes place.—[Centralblatt, Med. Wissen. 1869, No. 39.]

SOCIETIES AND ACADEMIES

Syro-Egyptian Society, Nov. 2.—Mr. W. H. Black, F.S.A. in the chair. The latest communication from Dr. Livingstone, that he has found what he believed "to be the true sources of the Nile, between 10° and 12° south (latitude) or nearly the position assigned to them by Ptolemy," was received with much satisfaction; and the passages in the Greek text of Ptolemy's geography, relative to "the mountain of the moon," from which the lakes "of the Nile receive the snows," *twice placed by him in 12½ south latitude*, were read; and the old traditional maps, showing a mountain range of about 10° of longitude in extent, with streams running northward into two lakes (as published in the Amsterdam edition of 1605), were compared therewith. A resolution was then passed, sympathising with Dr. Livingstone in his laborious researches, and congratulating the present age on this confirmation of ancient scientific literature by means of modern exploration.

Mr. Black described the results of his own recent application of the symbolic and mathematic teaching of the great pyramid to the geometric geography of Africa; stating the full conformity of that monument to the geodetic laws and uses of other uninscribed megalithic monuments in Asia and Europe, which have been erroneously assigned to religious and superstitious purposes. He promised to illustrate the subject further, and to demonstrate by diagrams the results then verbally described, at a future meeting of the society.

Anthropological Society, Nov. 2.—Dr. Beigel, V.P., in the chair; the following new members were announced:—*Fellows.*—Captain G. J. D. Heath; Dr. Samuel E. Maunsell, R.A.; Messrs. Thomas Milne, M.D.; E. W. Martin; Robert Watt; Horace Swete, M.D.; Lieut. Wm. Francklyne; and Wm. Pepper. *Hon. Fellow.*—M. Le Baron d'Omalius d'Halloy. *Corresponding Member.*—Professor Dr. August Hirsch.

Mr. Pike read a paper on the Methods of Anthropological Research. He considered it useless to speak of methods of research without some previous definition of the objects of research. The real difficulty in anthropology was to know what to observe, and how to verify. He believed that the science could advance only by a double method of observation—the observation of mankind individually and in masses, and that the conclusions suggested by the observation of masses, races, or nations must be verified by the observation of individuals, and *vice versâ*. For this reason he thought it was a mistake to speak of ethnology as a science, as it consisted only of a series of disjointed observations without conclusions, and without the means of verifying conclusions if made. Mr. Pike then reviewed at considerable length the ramifications of Anthropology into anatomy, physiology, psychology, and the various subdivisions of those studies, suggesting that all kinds of unsuspected correlations were yet to be discovered by a rigorous application of a scientific method. The relations of mind to body, of faculty to faculty, of one part of the body to another, were still removed but little from the realms of mystery from which only anthropology could thoroughly drag them away. Mr. Pike concluded by describing anthropology in one of its aspects as the only kind of philanthropy which could be of service to mankind—philanthropy founded upon science.

BIRMINGHAM

Natural History and Microscopical Society, October 26.—Mr. G. Heaton exhibited a collection of sea urchins, of the species *Echinus Sphæra*, recently taken on the North-West coast of Ireland, and exceeding in dimensions the largest recorded by Professor Forbes. Mr. W. R. Hughes, in reference to these magnificent specimens, gave a general account of the structure and functions of the Echinodermata. He contrasted the mode in which calcareous matter is deposited in the Mollusca and other classes, with that which is characteristic of the Echini. Thus, in the Mollusca it is secreted in various directions by the "mantle" of the animal; in Crustacea it is deposited externally to the epidermis, and is cast off when the animal becomes too large for its covering, and replaced by a new shell reproduced in like manner; while in the tubicular Annelids a similar process prevails. In Anthozoa and Madreporidæ it is secreted at the base of the animal from its gelatinous investment; and again in Spongiadæ innumerable calcareous spiculæ are deposited throughout the mass. In Echinodermata, on the contrary, a method totally different from all the preceding is observed, the calcareous matter really forming a box, as distinguished from a shell, in which the viscera float in a surrounding medium of sea-water, and inasmuch as this box can never be cast off or replaced during the growth of the animal, from its original size of a pea, up to its full dimensions of 13 in. or 14 in. in circumference, a very special and wonderful provision is made for the gradual enlargement of the dwelling. This is effected by the secretion of the calcareous salts, not only on the interior but at the margins of the 600 pieces or plates of which the case is composed; so that by the slow extension of every one of these at its edges, the whole undergoes a corresponding gradual expansion in every direction, commensurate with the development of its tenant. Mr. Hughes referred to the fact that the magical number 5 prevails in a peculiar manner throughout the class, instancing the 5 rayed star-fish, the 5 teeth, 5 jaws, &c., of the Echini. The subject was further illustrated by various recent and fossil Echinoderms, contributed by Mr. R. M. Lloyd; spines of *Sidaris* from the South Sea Islands, the star-fishes *Cribella rosea* and *Uraster rubens*, by Mr. G. S. Tye, &c.

EDINBURGH

Geological Society, November 4.—The president, Mr. Geikie, delivered the opening address. After congratulating the society on its recent progress, he passed on to bring before its notice three special branches of inquiry, wherein much useful work remained to be accomplished. The first of these related to the study of organic remains, which, in the opinion of the speaker, was too much dissociated from that of the strata among which they are preserved. He thought that the palæontology of each geological formation should be as far as possible the natural history of a certain period of the past life of the globe. We should try to discover from the fossil remains more of the general character of the contemporaneous fauna and flora; the nature of the sea-bottom or land-surface on which they flourished; their various modes of growth; their distribution in space as well as in time; the light which they cast upon changes in the organic world, and the influence of these changes upon them; the causes of their decay as individuals and as species, and the circumstances under which they had been finally entombed. Mr. Geikie illustrated this subject from the rocks of the central valley of Scotland. He then passed on to the seeond topic, which related to the mineral structure of rocks or petrography. That branch of the science had fallen into strange neglect in this country. After indicating what had been done and what was now doing in Germany in that department, he pointed out the special way in which it lay open to observers in Scotland, and pressed upon the society the desirability of cultivating it. The third branch of his address bore on the balance of the various forces which have been instrumental in modifying the surface of the earth. Observers in Britain, he said, enjoyed special advantages when they set themselves to investigate this question. The completeness of their geological series, the diversities of configuration in their country, the extent of their coast line, the multiplicity and variety of their brooks and rivers, all conspired to aid them. On the other hand, they were apt from this very completeness of their opportunities to take a local and limited view of the phenomena. This he thought had really happened in the case of their estimate of the potency of the sea as a geological agent. Their position as islanders had led them to take an exaggerated view of the results attributable to the waves in the general economy of nature, and to undervalue the power of rains, springs, frosts, and rivers, which in this country do not produce the changes which they effect elsewhere. He pointed out how vast was the extent of coast-line where the sea did not reach the solid framework of the land, but was barred back by long lines of alluvial deposit—the waste of the land brought down by the streams. The sea in these instances, although perpetually wasting the sand-bars, did not perceptibly encroach on the land, for the bars were constantly being renewed from behind. The land, though not diminishing in breadth, was inch by inch sinking in height, the power of the sea being no more than equal to sweeping away the detritus brought down to the coast by the drainage from the interior. Although seemingly paradoxical, he yet believed that in the general balance of forces the influence of the ocean is more conservative than destructive, there being a greater area of rock under the sea, preserved there from that universal corrosion and removal which befall every part of the earth's crust that rises above the waves. The concluding portion of the address dealt with the relation at present subsisting between science and religion.

BERLIN

Chemical Society, October 25.—Prof. Fritzsche communicated a paper on the action of cold on tin. Tin was exposed to 40° C., the temperature produced by Carré's refrigerator. It was found changed in colour and structure, the latter becoming granular, and the colour turning from white to grey. By heating it to less than 100°, the white colour could be restored. By prolonging the action of the cold, the tin became so brittle, that it could easily be powdered, and a kind of blister appeared on the surface of the metal. This explains similar changes observed by the same chemist in block-tin and organ pipes exposed to the cold of a Russian winter. Emmerling reported on liquefied oxychloride of carbon. It constitutes a colourless liquid, and boils at 8° above zero. The oxychloride of carbon prepared in the usual way contained an excess of chlorine, which was absorbed by passing it over antimony, before the gas was condensed through cold. Der Müller communicated some observations on the preparation of Chloral. Prof. Kekulé sent in a report on Chemistry at the German Association of Innsbruck. This report being not as yet complete, we shall return to the subject.—A. O.

PARIS

Academy of Sciences, November 2.—MM. Sainte-Claire Deville and Dieudonné communicated a paper on the industrial employment of the mineral oils for heating engines, especially locomotive engines, in which they describe certain experiments made by the company of the Chemins de Fer de l'Est, tending to show that petroleum and coal oils may be advantageously employed to heat the boilers of locomotives. M. P. Thenard read a note in reply to that communicated to the Academy at its last meeting, by M. Pasteur, on the employment of heat for the preservation of wines. M. de Verneuil made some remarks on the conclusion of M. de Tchikatcheff's work on Asia Minor, giving a general account of the contents of the volume, which treats of the physical geography and natural history of that region. A memoir was presented by M. Hébert, entitled "Researches on the Chalk of the North of Europe." He distinguishes in the chalk of the Paris basin some distinct stages, the distribution of which, especially in the north of Europe, he indicates. A paper, by MM. Fougué and Gorceix, containing a chemical investigation of several of the gases with combustible elements of Central Italy, was presented by M. C. Sainte-Claire Deville. The authors have analysed 28 gases, collected in Italy—4 from the Tuscan *lagoni*, 24 from various stations in the Apennines, between Modena and Imola. Their analyses of the former confirm the results of MM. C. Sainte-Claire Deville and Leblanc: they contain free hydrogen. None of the gases contain acetylene, hydrocarbons of the series $C^{2n}H^{2n}$, or oxide of carbon. The gas from Sassuno contains hydride of æthyle, and those from Porretta carbonic acid in considerable quantity, and traces of sulphuretted hydrogen. These gases are characterised by the predominance of marsh gas in their composition, and they are very frequently impregnated with vapours of liquid hydrocarbons of the series $C^{2n}H^{2n+2}$. M. Faivre communicated an account of experiments upon the effects of wounds of the bark by annular incisions under various physiological conditions. In a note upon a measure of length unalterable by changes of temperature, M. H. Soleil proposes to make standard rules of beryl. He remarks that beryl, when heated, dilates in a direction perpendicular to the axis, and contracts in the direction of the axis; there will consequently be an intermediate direction in which no dilatation takes place, and in this he proposes to cut his standard rules. Some observations on the constitution and movement of glaciers, by MM. C. Grad and A. Dupré, were presented by M. Leverrier. The authors investigated the structure of the ice of the great Aletsch and other glaciers at different points of their course, and found that in all cases the size of the grains or constituent elements of the ice gradually increased from above downwards. They also noted the movements of the Aletsch glacier at those points of its course, and the amount of surface loss which it underwent by the action of the sun in the latter part of August, when their observations were made. A note by M. J. B. Baille on the heat reflected by the moon, was presented; the author confirms the results obtained by MM. Piazzi Smyth, Marié Dacy, and Lord Rosse. A notice of a new synthesis of guanidine, by M. G. Bouchardat, was presented. The author, in repeating M. Natauson's experiment for the production of urea by the action of gaseous ammonia upon oxychloro-carbonic gas, found that other amides of carbonic acid were produced, especially guanidine, the sulphate of which he obtained crystallised. Melanuric and cyanuric acids are also produced. M. C. Dareste communicated a note on arrest of development regarded as the proximate cause of most simple monstrosities; M. Bonchut read a note on hydrate of chloral, with especial reference to its physiological action, which led to some remarks by MM. Bussy and Dumas. An extract from a report by M. Gauldrée Boilleau on the recent earthquakes, and a fresh outbreak of yellow fever at Peru, was read, a note on the etiology of goître, by M. D. Brunet; a note on the phosphorescence of the sea, by M. Duchemin; and a note on the causes of the mortality of new-born infants and on the means of restraining it.

PRAGUE

Royal Society of Bohemia—Natural Science Section, October 6.—M. E. Weyr read a memoir on the conic sections inscribed or circumscribed upon a triangle, having a double contact with a fixed conic section.

October 27.—Dr. E. Schöbe read a paper on the discovery of the terminations of the nerves in the wings of the Chiroptera. The well-known power possessed by bats of finding their way through numerous small obstacles, even when blinded and deafened, has led several anatomists to seek for the nervous apparatus by which this great sensibility is attained. Cuvier described a complete nervous network in the wings; but what he took for nerves, turn out to be elastic trabiculæ. Leydig and Krause have also published upon this subject. The author describes the wings in several genera of bats as composed of a duplication of the general integument, in which the two layers of cutis become amalgamated. The epidermis consists of a single layer of lineagonal cells, and the *rete Malpighianum* of two layers of cells, the upper ones large, polymorphic, and filled with colouring matter. The cutis contains very complete systems of elastic trabiculæ and striated muscles, and a vascular system, which were described in detail by the author, as also the hair-follicles, each surrounded by 7 or 8 sebaceous glands, and a hydrotic gland. Each wing has from 8,000 to 10,000 hairs, with their glandular systems. The nervous system is very highly developed and delicate. The principal branches follow the direction of the great vessels; the last ramifications, composed of from 8 to 12 fibrillæ, issue from the neurilemma, and form bundles, each consisting of 4 fibrillæ. Each bundle runs to a hair-follicle; two of its fibrillæ surround this in a loop, and terminate in a stratiform, *terminal papilla*, formed by the twisting of the fibrillæ into a ball; the other two interlace with the free fibrillæ of adjacent follicles, and form an extremely delicate terminal nervous network. The terminal papillæ are compared by the author to those in the human skin; he has sought and found papillæ also in the mouse, shrew, and mole. Dr. A. Fritsch announced the discovery of a new reptile, or batrachian, in the coal of Nyran, in the south-west of the carboniferous basin of Pilsen. The head is triangular, less elongated than that of *Archegosaurus*; the orbits are large; the lower jaw furnished with denticles; the vertebræ numerous, very close and equal, and the anterior limbs slender, and but little developed. The animal was probably about a foot in length. It is compared by the author with the well-known *Proteus anguinus* (= *Hypochthon Laurentii*).

SCHAFARIK

DIARY

THURSDAY, NOVEMBER 11.

LONDON INSTITUTION, at 7.30.—On Architecture, or the Fine Art of Building: Prof. Robert Kerr.

ZOOLOGICAL SOCIETY, at 8.—On the Anatomy of the Aard-Wolf (*Protel. cristatus*: Prof. Flower, F.R.S.

LONDON MATHEMATICAL SOCIETY, at 8.—General Meeting at Burlington House.

FRIDAY, NOVEMBER 12.

ASTRONOMICAL SOCIETY, at 8.

MONDAY, NOVEMBER 15.

LONDON INSTITUTION, at 4.—Elementary Physics: Prof. Guthrie.

TUESDAY, NOVEMBER 16.

STATISTICAL SOCIETY, at 8.—Inaugural Address by the President: W. Newmarsh, F.R.S. Report on the International Statistical Congress of 1869: Mr. Samuel Brown.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Discussion on Mr. Gandard's Paper on the Strength and Resistance of Materials; and, time permitting, Public Works in the Province of Canterbury, New Zealand: Mr. Edward Dobson, Assoc. Inst. C.E.

WEDNESDAY, NOVEMBER 17.

METEOROLOGICAL SOCIETY, at 7.—Lunar Influence upon Rainfall: Mr. J. C. Bloxam, M.R.C.S. On the Summer of 1868: Dr. G. H. Fielding.

THURSDAY, NOVEMBER 18.

ROYAL SOCIETY, at 8.30.

LINNEAN SOCIETY, at 8.—Review of the genus *Hydrolea*, with descriptions of three new species: Mr. A. W. Bennett, F.L.S.

CHEMICAL SOCIETY, at 8.

LONDON INSTITUTION, at 7.30.—Architecture: Prof. R. Kerr.

BOOKS RECEIVED

ENGLISH.—Cassell's Technical Manuals: Projection, Linear Drawing, Building, Construction (Cassell).—Our Houses (Cassell).—First Book of Indian Botany: Prof. Oliver (Macmillan).—Via Medica: B. Langley (Hardwicke).—Wonders of Italian Art: Louis Viardot (Sampson Low).—What is Matter? Inner Templar (Wyman and Sons).—Essays on Physiological Subjects: G. W. Child (Longmans).—Phenomena and Laws of Heat: A. Cazin, translated by E. Rich (Low).—Thunder and Lightning: W. De Fouvielle, translated by T. L. Phipson (Low).—Wonders of Optics: F. Marion, translated by C. W. Quin.—Tommy Try and what he did in Science (Chapman and Hall).

AMERICAN.—Origin of Genera: E. A. Cope (Trübner).—Annual Report of the Trustees of the Museum of Comparative Zoology at Harvard College.

FOREIGN.—Vierteljahrsschrift der Astronomischen Gesellschaft.—Les Pierres, Esquisses Minèralogique: L. Simonin (Hachette).—Bibliothèque des Merveilles: 4 vols. (Hachette).—Dictionnaire Général des Sciences: Privat-Deschanel et Ad. Focillon.—Untersuchungen über einige merkwürdige Thiergruppen des Arthropoden-und Wurm-Typus: Dr. R. Greeff.—Handbuch der Edelsteinkunde: Dr. A. Schrauf (Through Williams and Norgate).

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