THURSDAY, MARCH 8, 1883

THE ORIGIN OF CULTIVATED PLANTS

Origine des Plantes cultivées. Par Alph. de Candolle (Paris: Germer, Baillière et Cie., 1883.)

Les Plantes potagères, Description et Culture des principaux Légumes des Climats tempérés. Par Vilmorin-Andrieux et Cie. (Paris: Vilmorin-Andrieux et Cie., 1883.)

ALPHONSE DE CANDOLLE occupies a position in the botanical world which in its way is unique. He is in a manner the *doyen* amongst the heads of the botanical establishments of different countries which have for their especial object the study of the earth's vegetation in its taxonomic aspect. There is a special appropriateness in his being so; the Geneva botanical school, though in filiation related to the French, has always seemed to belong more to Europe than to Switzerland. The effect of this circumstance has doubtless operated indirectly on a mind naturally inclined to wide and general views. Accordingly as the invaluable "Prodromus"—the only modern work which has attempted to describe all known species of flowering plants—drew near the point at which it was decided to conclude it after occupying two generations of botanists, we find De Candolle himself more and more engaged with works dealing with general questions—works which both temperament and point of view peculiarly fitted him to undertake. Such were his "Histoire des Sciences et des Savants depuis deux Siècles," published in 1873, and his "Phytographie; ou, L'Art de décrire les Végétaux," published more recently (1880).

Long ago however, in 1855, he had published his classical "Géographie botanique raisonnée," and in this he had stated the theory, sufficiently novel then, though now a commonplace, that the present distribution of the earth's flora cannot be accounted for by any possibility as the result of the existing configuration of its surface, but is the gradual result of long antecedent geological changes. De Candolle's conclusions are now seen to form a particular case in the general theory of evolution. But we must not forget that they were the independent result of a long and laborious induction.

The study of geographical distribution requires the elimination from the facts of all disturbing elements. It is necessary to ascertain the precise nature of the flora of any given district undisturbed by artificial modifications. The slow action of natural forces is one thing: the changes brought about by man are another. De Candolle was therefore obliged to devote no small attention to the question of introduced and cultivated plants. They must clearly be eliminated from the enumeration of feral productions. But the question then arises, What is to be done with them, and to the flora of what country are they to be relegated? The result is not merely one of disembarrassment to the botanist; it has its interest no less for anthropology in the widest sense. Different races have taken advantage of plants susceptible of cultivation in the places where nature had originally planted them; and as these races have migrated they have taken their cultures with them. If the botanist then does his work properly in tracking them back to their original cradle, he is tracking back the migratory race as well, and doing the work of the anthropologist. Plants often take their old names with them, and these may and frequently have persisted when the race that brought them has passed away, been dispersed, or changed its language. All the various names, for example, given to hemp by the descendants of the Aryan race go back to the same root.

These considerations will be sufficient to establish the utility of the study which De Candolle has had in hand for some thirty years, and with regard to which he has now given us, in a singularly succinct form, probably as much as we are ever likely to know. Hitherto we have been badly off for a handy synopsis of the subject. It is true we have the chapter in De Candolle's work already referred to, and Mr. Darwin brought together a considerable body of information in his "Variation of Animals and Plants under Domestication." The former book has, however, long been out of print, and Mr. Darwin's purpose only led him to deal with those species which have largely varied under cultivation. For my own part I have generally used for reference the two admirable articles in the ninth volume of the *Journal* of the Horticultural Society—a body which unhappily, while taking the title of Royal seems to have lost its taste for such studies. These articles—in form a review of a little work by Targioni-Tozzetti, of which I have never seen but a single copy—are really an extremely useful examination of the whole subject; and as it is an open secret that they are from the pen of Mr. Bentham, the critical opinions they contain as to the origin of all our more important cultivated plants may be relied upon with considerable confidence.

"An English vegetable garden," says Mr. Tylor, "is a curious study for the botanist, who assigns to each plant its proper home; and to the philologist, who traces its name." But De Candolle, not confining himself to our temperate pot-herbs, has included in his studies the cultivated plants of all countries. Accurate knowledge in this matter is a thing of comparatively recent growth. Linnæus bestowed no pains upon it. Humboldt in 1807 dismissed it as an impenetrable secret. De Candolle has now discussed no less than 247 species. It is curious—perhaps significant—to note that 199 of these trace back to the Old World; only 45 are American, and 3 doubtful. Neither the tropical nor the southern regions of either hemisphere have any of these species in common. The northern have five which are so, but it goes with the rest of the facts that the domestication of these belongs to the Old World, and to this De Candolle has accordingly credited them. Some things no doubt have escaped him, although the list is remarkably complete. Perhaps the most curious omission is rhubarb, the use of which for the table seems pretty much confined to England and Holland.

It is rather to be regretted that De Candolle has abandoned the attempt to indicate the points on the earth's surface from which the maximum number of cultivated plants appear to have sprung. He contents himself with saying that the original distribution of the stocks of cultivated plants is most irregular. "It had no relation with the needs of man supplied nor with the area of origin." I have a decided suspicion that the facts might be made to yield a different result. There does not seem any *a priori* reason why plants susceptible of useful development under cultivation should be so arbitrarily distributed. The number of species domesticated in a given area would, other things being equal, seem to be related to the intelligence of the races working on them. North America has only given us the vegetable marrow and the Jerusalem artichoke; and neither deserve more than a *succès d'estime*. But our best domesticated plants have developed their merits *pari passu* with the races that educated them. If we stumbled *now* against the primitive stocks they might seem as little susceptible of development as the plants of the United States, whose capabilities we rank so low. But had the Old World races been but early enough on the New World soil to work out their progress to civilisation, possibly the balance in the proportion of domesticated plants would have been redressed. If the gardens of the United States are filled with Old World vegetables, the houses are inhabited by an Old World stock. The two things seem to me to go together; the indigenous races could neither develop their latent vegetables nor hold their own against an Old World human invasion.

The circumstances of domestication, however, impose certain conditions which the flora drawn upon must fulfil The early stages of civilisation were probably unsuited to any fixity of abode. Tylor, it is true, remarks that "even very rude people mostly plant a little." But they will plant only what will give a quick return, and the qualities of foresight as well as a permanent social structure must be developed before men would have the disposition to plant fruit trees, which perhaps only their descendants would gather from. The first domesticated plants must have been those that were in themselves succulent, or would in the course of a single season yield some desired product. We find then that out of the 44 species, the cultivation of which in the Old World goes back to the dawn of civilisation, half are annuals; and these are just what the great temperate flora of the northern hemisphere would supply. On the other hand, Patagonia and South Africa have not yielded a single domesticated plant. Australia only contributes the overrated *Eucalyptus globulus*, and New Zealand a wretched spinach (*Tetragonia*). But then, as De Candolle remarks, their floras are destitute of the types of *Gramineæ*, *Leguminosæ*, and *Cruciferæ*, which were available in the northern hemisphere, and predominate in the list of the 44 most anciently cultivated plants. As between the north and the south I think this argument is valid. But as between the east and the west in the north hemisphere, since the main features of the flora are radically the same, any similar explanation does not hold.

With regard to such of these primitive cultures as belong to the temperate regions of the Old World, it will be interesting to give De Candolle's conclusions. The turnip and rapeseed (not however sustainable as distinct species) originated in Northern Europe. The cabbage was derived from the western coasts of Europe, where its wild stock may still be found; it was first gathered and then cultivated by pre-Aryan races. Purslane is wild from the Western Himalayas to Greece. The onion was brought from Western Asia. As to textiles, the origin of flax is somewhat complicated. The inhabitants of the Swiss lake-dwellings of the Stone Age did not use our present annual flax but a subperennial sort indigenous to Southern Europe (*Linum angustifolium*). This was displaced by *Linum usitatissimum*, a native of countries south of the Caspian, which was introduced into Europe and India by Aryan races. The knowledge of hemp seems to have been brought into Europe by the Scythians about 1500 B.C.; there is no trace of it in the Swiss lake-dwellings. The vine is indigenous in Western Asia, whence its use was carried to various countries by both Aryan and Semitic races; but it did not reach China before 122 B.C.

The almond, although so characteristic of Mediterranean countries, seems to be a native of Western Asia, and perhaps Greece. As late as the time of Pliny the fruits were known to the Romans as *Nuces græcæ*. The wild stocks of our pears and apples seem to have been indigenous to Southern Europe and Western Asia before the Aryan invasion; their remains abound in the Swiss lake-dwellings. The quince is a native of North Persia, but seems to have been introduced into Eastern Europe in pre-Hellenic times. Remains of a form of the pomegranate have been found in strata of the Pleiocene age in Southern France by Saporta; but it died out and was reintroduced from countries adjoining Persia in prehistoric times into the Mediterranean region of which it is now so characteristic a feature. The primitive home of the olive was apparently the eastern shores of the Mediterranean, where the Greeks discovered its useful qualities the Romans learning them later. The fig has left its remains in quaternary rocks in France along with the teeth of *Elephas primigenius*, but its prehistoric home must be sought in the Southern Mediterranean shores and lands, where it survived after probably perishing in France. The common bean (*Faba vulgaris*) seems to have become extinct in a wild state; it may have originated south of the Caspian, and was introduced into Europe by the Aryans. The remains of lentils have been found in lake-dwellings of the Bronze Age, and it was probably indigenous in Western Asia, Greece, and Italy before its cultivation in these countries; subsequently it was introduced into Egypt. The chick-pea was carried from the south of the Caucasus by the Aryans to India and Europe. The carob is indigenous to the Eastern Mediterranean, whence the Greeks introduced it into Italy and the Arabs into Western Europe. De Candolle regards all the various kinds of wheat as derivatives of the small-grained kind found in the most ancient lake-dwellings of Western Switzerland. He inclines to the belief that the wild stock of this originated in Mesopotamia, where it may still exist. The origin of spelt is very doubtful, and it may possibly be an ancient cultivated derivative from the wheat stock. As to barley, the inhabitants of the Swiss lake-dwellings cultivated both the two-rowed and the six-rowed kinds. The former is found spontaneously in the area between the Red Sea and the Caspian; but nothing is known of the spontaneous occurrence of the latter or of the four-rowed kind. Either then both were derivatives in prehistoric times of the two-rowed variety, or they are the cultivated representatives of species which have since become extinct. As to rye, probability points to an origin in South-Eastern Europe. The lake-dwellers even of the age of Bronze did not know it, but Pliny mentions its cultivation near Turin. De Candolle supposes that the Aryan migrations westward met with it in Europe and carried it onward. Oats seem also to have originated in Eastern Europe; they are found not earlier than the Bronze Age in Switzerland. From Pliny's mention that the Germans used oatmeal, it is concluded that it was not cultivated by the Romans.

Space will not allow of my giving an idea of the method by which these results are arrived at. But they seem to me to take advantage of every line of evidence and to be as near the truth as we are at present likely to approach. De Candolle sums up with great pains the philological evidence which he has collected from the best quarters, and though, as he is prepared to admit, a professed philologist might handle the evidence in a different way, he claims that the inferences he draws are such as are fairly within the competence of instructed common sense. And controlled as they are by other lines of inquiry they do not seem to me to be pushed to a point where, except in the hands of an expert, they would be likely to prove treacherous. It is obvious that the philological evidence alone might make the most careful go astray. The two instances given by Tylor are, in a way, a case in point. "Sometimes," he remarks, "this (the name) tells its story fairly, as where damson and peach describe these fruits as brought from Damascus and Persia." This is true perhaps as far as it goes. The cultivated plums of Damascus had a reputation in the time of Pliny; but the wild stock does not extend to the Lebanon, and its home was probably far to the north in Anatolia and Northern Persia. As to the peach, De Candolle points out that its having no Sanscrit or Hebrew name is against an origin in Western Asia, and he gives a considerable body of evidence pointing to China as its true native country.

It is in fact the indirect evidence given by such names through their origin and history which is of use, not the actual information they imply. The Jerusalem artichoke is a well-known instance. As De Candolle says, it is not an artichoke, and being a North American plant can have nothing to do with the Holy Land. The plant is technically a sun-flower (*Helianthus*), though in our climate it rarely betrays its affinity by flowering. And the ordinary explanation is that Jerusalem is a corruption of *Girasole*. But this seems to be a wanton piece of euhemerism; there is no evidence that the Italians ever used such a name for it, and the real explanation seems to be that Jerusalem was applied in a vague way, like Indian or Welsh, simply to indicate a foreign origin. Thus an old-fashioned garden plant (*Phlomis fruticosa*) is called sage of Jerusalem with about as little reason. And in France the term Jerusalem artichoke is applied to a species of gourd.

The second work which I have cited at the head of this article deserves a more extended notice than it is possible to give it. It is safe to say that only in France could such a book be produced, either as regards the share of authors or publishers. It is a sort of complement to De Candolle's treatise, describing, from the cultural point of view (but with botanical references apparently carefully accurate), the various esculent vegetables which are known, with all their typical varieties, including even such sorts as are rarely seen in the gardens of cool countries. It is a book which any botanist will find a useful addition to his library, if only for the delicate illustrations, which contrast so strikingly with the coarse ostentation of the ordinary trade catalogue.

W. T. T. D.

OUR BOOK SHELF

Useful Rules and Tables relating to Mensuration, Engineering, Structures, and Materials. By William John Macquorn Rankine, C.E., F.R.S., &c. Sixth Edition, thoroughly Revised by W. J. Millar, C.E. With Appendix, Tables, Tests, and Formulæ for the use of Electrical Engineers, by Andrew Jamieson, C.E., F.R.S.E. (London: Charles Griffin and Co., 1883.)

We learn from the title-page of this edition of Rankine's well-known book of Rules and Tables that it has been thoroughly revised, but we are sorry to find so little evidence of this in the work itself. Many of the rules given in this book are only applicable in particular cases, and generally no explanation as to this is given. Take for example Rule XXV., p. 211, which gives the collapsing pressure of tubes as $\frac{9672000 \times \text{thickness}^2}{\text{length} \times \text{diameter}}$.

This rule is evidently based on Fairbairn's experiments, which were made on tubes with closed ends and of lengths in no case exceeding ten times the diameter. The rule as it stands is simply absurd, for it gives zero collapsing pressure for infinite length. The addendum to Part II. p. 367, referring to springs, may be taken as another example. Straight springs cannot be treated by the formulæ given for beams unless they are only slightly bent, and again, the ratio of the force to the elongation produced by it in a spiral spring is that given by the formula only when the spires have small inclination to a plane at right angles to the axis. This formula is not even accurate, as the r^3 in the denominator should be r^2. Some estimate of the care bestowed on the work by the editor may be gathered from the following slovenly sentences taken from p. 374:—"From experiments by Major Morant, R.E., India, it appears that only one-half the quantity of dynamite and one-third the number of bore-holes is required to remove the same quantity of rock as gunpowder." "The area of the fire-grate being about 14½ square feet."

The Appendix on Tables, Tests, and Formulæ, for the use of electrical engineers, is a real addition to the book. Beginning with a table of the "Formulæ of the Absolute Units," Mr. Jamieson goes on to the definition of the different practical units now in use; and then gives a large amount of useful information in the form of tables and rules for making electrical tests. Much of the information here given is published for the first time, and on this account will be the more valuable to engineers.

Cable work has received special attention, and although not fully treated, absorbs, we think, more than its due share of the sixty-four pages devoted to the appendix. The space taken up by some of the less useful tables might, it seems to us, have been saved, and a fuller treatment of the different methods of testing electromotive force, battery- and other resistances, &c., given. Mr. Jamieson gives only a few rules for such tests, and refers to other books for more, but we think that a book of rules should be full if it be anything. In order to measure the resistance of thick wire, Mr. Jamieson suggests that a piece of it may be drawn down to a fine gauge, and then tested in the Wheatstone bridge. This is neither convenient nor satisfactory, and should be replaced by one of the well-known methods of testing such wires. Again on page 361, Mr. Jamieson proposes to measure the work done in charging a secondary battery by joining up a suitable voltameter as a shunt to it. This method is worse than useless.

Although we should like to see an absence of such faults as the above, and considerably more space devoted to the subject of general laboratory and engineering work, Mr. Jamieson has made good use of the space at his disposal, and we have much pleasure in recommending his appendix as likely to prove exceedingly useful to electricians.

LETTERS TO THE EDITOR

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

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

Mr. Stevenson's Observations on the Increase of the Velocity of the Wind with the Altitude

A HEAVY pressure of professional work has prevented me till now from noticing Mr. Archibald's remarks on my paper on simultaneous observations of the wind at different elevations.

I fear I have not been sufficiently explicit as to the object of my observations. All of them have reference strictly to the retarding influence of the friction caused by the earth's surface, and are not so much of a meteorologic as an engineering character. This I thought would have been understood from my statement that I believed they were approximately correct "*for practical purposes.*" The formulæ are intended to be applicable only to heights within the limits of my observations, and the idea of applying them to the higher regions of the atmosphere, such as from 3800 to 23,000 feet above the earth, never for one moment crossed my mind, and I think the following facts observed by Mr. Glaisher in his balloon ascents prove the futility of attempting to deduce from experiments made near the surface of the earth what the velocity of the wind may be at such great elevations.

"In almost all the ascents the balloon was under the influence of currents of air in different directions." "The direction of the wind on the earth was sometimes that of the whole mass of air up to 20,000 feet, whilst at other times the direction changed within 500 feet of the earth. Sometimes directly opposite currents were met with at different heights in the same ascent, and three or four streams of air were encountered moving in different directions."

"On January 12, 1862, the balloon left Woolwich at 2h. 8m. p.m., and descended at Lakenheath, seventy miles distant, at 4h. 19m. p.m. At Greenwich Observatory, by Robinson's anemometer, during this time the motion of air was six miles only."

On June 26, 1863, "at 9000 feet the sighing and moaning of the wind were heard, and Mr. Glaisher satisfied himself that this was due, not to the cordage of the balloon, but to opposing currents." On the descent, "a fall of rain was passed through, and then *below* it a snow-storm, the flakes being entirely composed of spiculæ of ice and innumerable snow crystals."

On July, 1862, the temperature of the air at starting was 59° Fahr., at 4000, 45°, at 10,000, 26°, at 13,000, 26°, at 15,500, 31°, at 19,500, 42°, at 26,000, 16°. On descending, it was found to be 37°·8 at 10,000, while on the ascent at the same height, it was only 26°.

Mr. Buchan states (article "Atmosphere," "Ency. Britt.," 9th edition): "observations of the winds cannot be conducted, and the results discussed, on the supposition that the general movement of the winds felt on the earth's surface is horizontal, it being evident that the circulation of the atmosphere is affected largely through systems of ascending and descending currents." The observations in the higher regions of the atmosphere quoted by Mr. Archibald confirms this irregularity of the atmospheric currents; as, for example, the velocity at an elevation of 1600 feet is greater than at an elevation of 7200 feet, showing that no satisfactory results can be deduced from them.

My observations on the 50-feet pole are only applicable to "small heights" above the ground, and they have proved the absolute necessity of all anemometers being placed at one uniform height above the ground, and are mainly useful in enabling us to reduce anemometric observations obtained by instruments at different heights to the same standard level—a matter which, as a meteorologist, I deem of great importance.

I believe that the formula for small heights will be useful, because I consider it applicable to such engineering works, for example, as the Tay and Forth Bridges.

As regards the other observations with pressure anemometers at comparatively great heights, the highest observed being 1600 feet at the Pentland Hills, the simple formulæ which I proposed were made only to cover the observations which I actually obtained, and they do agree nearly with these results. As to the assertion that I supposed that the force of the wind ought to vary as its velocity, the contrary is the fact, as Mr. Archibald might have seen by my statements that the only hypothesis on which I could account for the paradoxical result of the same formula being *practically* applicable both to force and velocity was the decreased density of the air as we ascend. I

Observations on Velocity at Arthur's Seat

Velocity recorded at high elevation.	Velocities computed for lower station: By Mr. Stevenson's 1st formula.	By Mr. Stevenson's 2nd formula.	By Mr. Archibald's formula.	Velocity recorded at low elevation.
775 feet above sea-level.	$v = V\sqrt{\frac{h}{H}}$	$v = \frac{Vh}{H}$	$v = V\sqrt[4]{\frac{h}{H}}$	550 feet above sea-level.
885	703	592	766	720
1,698	1,430	1,205	1,558	1,364
2,620	2,206	1,859	2,405	2,133
3,416	2,876	2,424	3,132	2,718
4,328	3,646	3,071	3,973	3,465
5,575	4,697	3,957	5,117	4,592
6,763	5,698	4,800	6,208	5,640
8,035	6,765	5,702	7,376	6,782
9,368	7,893	6,648	8,600	7,862
10,820	9,115	7,679	9,933	8,765
12,410	10,455	8,807	11,392	9,789
13,700	11,542	9,722	12,576	10,639
15,058	12,687	10,686	13,833	11,680
÷ 13	79,713	67,152	86,869	76,149
Mean results	6,132	5,165	6,682	5,857

Height of stations above sea-level in feet.	Observations: At higher station.	Observations: At lower station.	Calculations for lower station: By Mr. Stevenson's 1st formula. $f = F\sqrt{\frac{h}{H}}$	By Mr. Stevenson's 2nd formula. $f = \frac{Fh}{H}$	By Mr. Archibald's formula. $f = F\sqrt[4]{\frac{h}{H}}$
1617	5·656	—	—	—	—
1500	—	5·250	5·424	5·246	5·491
1500	8·542	—	—	—	—
915	—	5·000	6·671	5·208	7·516
438	5·077	—	—	—	—
371	—	4·259	4·675	4·301	4·873
371	4·577	—	—	—	—
276	—	4·181	3·945	3·405	4·247
Average for lower stations		4·672	5·179	4·540	5·532

am not prepared to admit that the velocity at 100 feet above the sea will, as Mr. Archibald supposes, be much greater than at sea-level, for my simultaneous observations of wind passing over the sea, over sand and over grass (*Min. Cir. Eng.*) render it doubtful. If for example a wind passes over the surface of the sea with a given velocity, which will depend to a certain extent on the comparatively small amount of friction due to passing over water, that velocity will be at once reduced when the current meets the shore and begins to pass over the more retarding surface of solid land. At a height of 100 feet above sea-level, it may not therefore have attained the initial velocity which it had at sea. But as to the whole subject, which is one of great difficulty, I will only repeat what I formerly said, that "additional observations are much wanted at high levels," and I might have added, at small elevations also.

I have tabulated as above the results given by my two formulæ and by that of Mr. Archibald, from which it appears that my first formula, viz. $v = V\sqrt{\frac{h}{H}}$, agrees more nearly with the recorded results of velocity at Arthur's Seat than any of the others, while my second formula, $f = \frac{Fh}{H}$, agrees best with my first observations of pressure.

Edinburgh, February 17 THOMAS STEVENSON

The Supposed Coral-eating Habits of Holothurians

IN glancing through my back numbers of NATURE my attention has been drawn to a letter on the above subject by Mr. H. B. Guppy, published in the issue dated November 2, 1882. Quoting the late Mr. Charles Darwin's famous work on "Coral Reefs," where it is stated at p. 14, on the authority of Dr. J. Allan, that Holothuriæ subsist on living corals, he recounts the results of his investigations made on the reefs of Santa Anna and Cristoral, with the object of putting such statement to the test. As the upshot of his experiences he writes that he has by no means satisfied himself that Holothuriæ do subsist on living coral. In no instance did he meet with a single individual browsing on the patches of living zoophytes, the two species observed being indeed found living only in the plots of detritus or dead coral matter that flanked the growing masses. Mr. Guppy gives an approximate estimate of the amount of coral sand daily voided by an individual Holothurian, but adduces no evidence as to the manner in which such hard matter is taken into its body. This phenomenon indeed he apparently did not witness; nor, so far as I am able to ascertain, has any other investigator brought forward any positive testimony in this direction.

Through my cultivation of Holothuriæ in company with various other Echinoderms a few years since in the tanks of the Manchester Aquarium, and also more recently in the Channel Islands, I find myself in a position to supply this hiatus in our knowledge of their life economy. The two species that were more particularly the subject of my observations included the large, dark purple *Cucumaris communis*, derived from the Cornish coast, attaining, in its fully extended condition, a length of from eight to twelve inches, and the white or dirty yellow variety of *Cucumaria pentactes*, that rarely exceeds half these dimensions. The oral tentacula in both of these species are largely developed, taking the form of ten extensively ramifying pedunculate plumose or dendriform tufts stationed at equal distances around the oral opening. It is with these organs that the food substances are seized and conveyed to the alimentary system, though in a manner totally distinct from what obtains in other tentaculiferous animals, such as a sea-anemone, tubiculous annelid, or cuttlefish. When on the full feed it was observed indeed that the tentacles of the Holothurian were in constant motion, each separate dendritic plume in turn, after a brief extension, being distally inverted and thrust bodily nearly to its base into the cavity of the pharynx, bearing along with it such fragments of sand and shelly matter as it had succeeded in laying hold of. No consecutive order was followed in the inversion of the separate tentacles, that which at the moment had secured the most appetising morsel gaining seemingly the earliest *entrée*. But little time was lost in this feeding process, for no sooner was one tentacle everted than another was thrust into the gullet, and so the meal continued, as not unfrequently observed, for several hours together. To furnish a fitting simile for this anomalous phenomenon of ingestion, one might imagine a child provided with ten arms, after the manner of ancient Buddha, grasping its food with every hand and thrusting it in a quick and continuous stream down its throat, the hands and arms with every successive mouthful, not stopping at the mouth, but disappearing up to or above the elbow within the visceral cavity. That the Holothuriæ are not devourers of living corals is shown not only in connection with the data just recorded, but from the fact also that several of these animals were kept in a tank containing sea-anemones and corals (*Balanophyllia verrucosa*) without their interfering with them in any way, or manifesting alimentative functions other than those just described. All that they require for their nutrition is evidently derived then from the coral or shell debris with which they are customarily associated. At first sight this material would appear to be in the last degree adapted for the sustenance of such highly-organised animals, but, as may be confirmed at any time by the investigation of like conditions in aquaria, it will be found that shell-sand, gravel, and all other debris forming the superficial layer at the bottom of the water, when exposed to the light, is more or less completely invested with a thin pellicle of Infusoria, Diatoms, and other microscopic animal and vegetable growths. It is upon these minute organisms that the Holothuriæ feed, swallowing both them and the shelly or other matter upon which they grow, much in the same way as we might subsist on cherries, swallowing stones and all—the nutritious matter in the case of the cherries being in much greater ratio—and the Echinodermata having the advantage over us that they have no vermiform appendage to their alimentary system to jeopardise their safe indulgence in such stone-swallowing propensities. Most probably, but this as a fact I did not at the time take steps to determine, the shell or coral debris, with its investing organisms conveyed to the mouth, is triturated by the characteristic teeth that arm the pharynx into one homogeneous mass, which, after the extraction of all nutritious substances, is discharged in the form of sandy pellets at the opposite extremity. At all events, the phenomenon of food ingestion as witnessed and here described amply accounts for the relatively prodigious quantities of shell- or coral-sand that the Holothuriæ have been observed to void by Mr. H. B. Guppy and other writers.

Data of interest concerning the feeding processes of various other Echinodermata were noted by me at the Manchester Aquarium. Two species of Echini—*E. miliaris* and *E. lividus*—throve well, and devoured large quantities of the seaweed, *Ulva latissima*, thus demonstrating their essentially herbivorous tastes, while the common Sand-star, *Ophiura texturata*, exhibited peculiarly interesting habits. These were kept in a shallow tank with a sandy bottom, and, except at feeding-time, were but rarely visible. No sooner, however, had a few small pieces of chopped fish been dropped into the water and settled to the bottom than their snake-like arms appeared above the sand in all directions, next their entire bodies, then a general scramble ensued for the provided food. This was conveyed to the creatures' mouths with the aid of the flexile arms, one of which was dexterously twisted round the selected fragment—as an elephant might use its proboscis—and the morsel then dragged beneath the body with its central oral aperture, or rather the body dragged on top of it. Phenomena of corresponding interest, did space permit, might be related of numerous other species, but the foregoing will suffice to illustrate the amount of knowledge that may be gained, and gained in no other way, concerning the habits and life-histories of marine organisms by their intelligent study in the tanks of an aquarium.

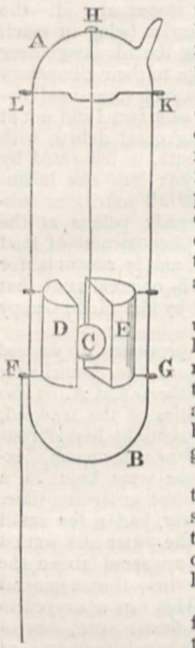
Apropos of this subject of aquaria, it will interest all biologists to know that the long-hoped for opportunity has at last arrived, or is about to arrive, of securing to the nation an aquarium suited in all ways, in both position and equipments, for the conduct of scientific pisciculture and biological research. Included in the buildings now in course of erection for the forthcoming International Fisheries Exhibition is a fine series of marine and freshwater tanks, having such substantial construction and perfect mechanical arrangements, that it is proposed to leave them standing after the close of the Exhibition, their final destiny having alone to be decided on. The close contiguity of these tanks in the Western Arcade of the Horticultural Gardens to the existing Museum of Economic Pisciculture immediately suggests the appropriateness with which they might be incorporated and more fully developed in conjunction with that Museum, or with the biological department of the Science Schools on the opposite side of the road. As an appanage of the last-named institution, it is indeed almost impossible to prognosticate the important *rôle* this aquarium might be adapted to fulfil. Leaving a sufficiency of tanks for public exhibition, the remainder might form an efficient depot or inland zoological station for both supplying the class-rooms and for placing at the disposal of original investigators facilities hitherto unprecedented in this country for making themselves acquainted with the structure, habits, and developmental histories of organisms pertaining to every branch of marine biology. It is at all events most earnestly to be desired that steps will be taken at the right time by the proper authorities to turn to good account so magnificent and rarely recurring an opportunity. W. SAVILLE KENT

Buckland Fish Museum, South Kensington, February 21

Influence of a Vacuum on Electricity

THE theory of Prof. Edlund that a perfect vacuum is a perfect conductor of electricity, but that a discharge across such a vacuum between two electrodes is prevented by an electromotive force at the surface of the electrode, involves our attributing to the vacuum the property of screening from electrical influence any body which it envelops. If the vacuum be a conductor, what we call induction cannot take place through it.

Not having been able to find any record of an experiment which conclusively proved that a vacuum so perfect as to offer considerable resistance to the passage of a current nevertheless permitted induction to take place through it, I have tested the matter by means of the apparatus shown in the figure.



A B is a glass tube about 15 cm. long; C is a light hollow platinum ball, 1 cm. in diameter, hung by a fine platinum wire from the top of the tube between D and E the two separated halves of a cylindrical platinum box, which are insulated from each other and held in position by platinum connections sealed into the sides of the tube, and projecting to the outside at F and G.

It is of importance to mention that the upper terminal H, from which the sphere hung, does not reach more than about 3 millimetres above the inner surface of the tube. The two halves of the cylindrical box are sufficiently near together to prevent the ball coming in contact with the sides of the glass.

This tube was exhausted until an induction current, would give a 12-millimetre spark in air, rather than pass between two terminals, K L, sealed in the upper part of the tube with their opposed ends about half a centimetre apart.

A wire about 30 cm. long was then hung from F, and an electrified body presented to the lower end. On the approach of this body to the wire the sphere was at once attracted towards D, and when a discharge was permitted between the electrified object and the wire, the sphere was violently attracted, and a minute spark was seen when the wire holding it touched the cap of the box D. The sphere was then repelled by the similarly charged box.

It thus appears that the phenomena of electric induction take place across a discharge-resisting vacuum, and that the sphere hung in it is not screened from electrical influence as it would be if surrounded by a conductor. A. M. WORTHINGTON

Clifton College, Bristol, February 22

The Meteoroid of November 17, 1882

THERE has already been much discussion on this subject, but I do not think that such exceptional phenomena lose any of their interest by having happened a few months ago; and so I write partly to correct a misapprehension on the part of Mr. Backhouse and Mr. Groneman as to the bearings of the positions of appearance and disappearance of the meteoroid as seen by myself. It seemed to me to appear in the S.E.E. and disappear S.W. by S., but these are not the directions of those points where the trajectory and the horizon would intersect. By mentally continuing the apparent path down to the east and west horizons, points would be reached, nearly, but I think not quite, 180° apart, the former about 20° N. of E. and the latter nearly opposite, so that I scarcely think that it was a great circle, but it is very uncertain. Mr. Saxby states that a similar cloud was observed to cross the zenith of Brussels by M. Montigny. Now there are two accounts—one by M. Zeeman of Zierickésee and the other from near Rye (Sussex)—which seem to consistently apply to one and the same thing, for the latter place is W. by 20° S. from Zierickse, and from both places the same elevation of about 50° was reached. These accounts, if combined with that from Brussels, indicate a height of about 70 miles; but then how does such a height agree with some of the English observations? On the supposition of the above height, the altitudes of culmination as seen from Woodbridge and Windsor would be about 29°, from Bristol 25°, and from York 10° only, which last angle is directly at variance with the actual one. For my part, I will give up the reconciling of such contradictory evidence to those who have an aptitude for conundrums. The evidence is in favour of this being an auroral manifestation, but the spectrum of the cloud does not prove this, for as yet it is not known whether the extremely rarefied upper atmosphere may not be excited to such incandescence as will yield the so-called "auroral" spectrum by other means than the electric discharge, as, for instance, by the passage of a cloud of meteorites. Mr. Petrie upholds the latter hypothesis, but I think that there is a simple but weighty objection to it; for it is difficult to see how a cloud of meteoric dust of such closeness and defined form as the appearance of this cloud would imply, could travel through space for any length of time without coalescing into one granular lump, owing to the mutual gravitation of its particles. Of course this objection will have the less weight the smaller we suppose the individual particles to be. This argument will scarcely apply to the well-known meteor streams, whose individual particles are really so very far apart. If this "flying arch" was subject to gravity, it certainly had more than sufficient velocity to prevent it being appropriated by our earth as a satellite, for the tangential speed necessary to a circular orbit of 4100 miles radius round our earth would only be about $4\frac{3}{4}$ miles per second, with a period of $1\frac{1}{2}$ hours. All interested in this phenomenon will no doubt pay more attention to the southern sky during future auroras, in hopes of noting something more of a similar nature, and they will also look forward to seeing a full account of Prof. Lemström's remarkable experiments on the nature of the aurora, which he has been conducting at Sodankylä with such unlooked-for results.

Heworth Green, York H. DENNIS TAYLOR

A Meteor

LAST evening at 9.35 p.m. a remarkably large and brilliant meteor was seen from here, appearing at a point about 10° east of η Canis Majoris, passing slowly over that star in a south-west direction, and vanishing a few degrees above the horizon; time about three seconds. Its light had a pale green tint, and in brightness and apparent diameter it far exceeded Sirius (which was particularly bright all the evening), so much so that my companions, though not looking in that direction, were instantly attracted by the light, and saw it in its splendour.

R. W. S. GRIFFITH

Eyeworth Lodge, Lyndhurst, Hants, March 3

Aurora

LAST night at about ten o'clock there were two beautiful white auroral streamers, like the tails of enormous comets, near the Pleiades. They were nearly vertical, and slowly moved, in a direction parallel to the horizon, towards Orion, after which they gradually vanished. There was little wind, and the night was bright starlight, after a cloudy day. There was an auroral glow like twilight over the northern horizon. The barometer rose during yesterday and last night, and stands high.

JOSEPH JOHN MURPHY

Old Forge, Dunmurry, Co. Antrim, February 28

Hovering of Birds

WITH regard to Mr. W. Clement Ley's remarks, I have already been permitted to explain in NATURE (vol. xxvii. p. 366) how I had accidentally misunderstood Mr. Airy's meaning. I do not believe that any bird having a greater specific gravity than the air can retain a perfectly fixed position in a calm without some wing-motion. Mr. Ley "believes that there is nothing in the etymology of the word 'hover' that implies movement." This has induced me to look up a somewhat voluminous and recent dictionary, in which I find "Hover, *v.i.* (W. hoviaw, to hang over, to fluctuate, to hover). To flap the wings, fluttering or flapping the wings with short irregular flights"; and more to the same effect, all indicating movement. J. RAE

AMATEURS AND ASTRONOMICAL OBSERVATION

THE labour done by astronomical amateurs has had no little influence upon the progress of the science. The work achieved by them has indeed often been of the utmost value, and a long list of names might be adduced of those who in past years attained a most honourable position either as discoverers, as systematic observers, or as both. Seeing therefore that amateurs, whose efforts are purely disinterested and the natural outcome of a love for the subject, have contributed so largely to place our knowledge of astronomy in its present high place, their efforts should be encouraged and utilised by their contemporaries, who hold official positions, and who may find it convenient to assist them by some of that practical advice and instruction which they are eminently qualified to afford.

It seems a thing to be deplored that in this country there are no establishments where astronomy is made a special subject for teaching, and where those who early evince a taste in this direction may be educated in conformity with inclination. We think that an institution giving special facilities to astronomical students, and affording instruction both in observation and computation, must prove a most efficient means of advancing the interests of the science. It cannot be denied that the work of many amateurs is rendered far less valuable than it would otherwise be by its approximate character, that is to say, by its lack of critical exactness—both as regards practice and theory. This cannot be avoided under present circumstances. A man on first becoming imbued with the desire to study astronomy as a hobby is generally in a measure isolated; he has to rely entirely upon his own exertions and what he can get out of the popular treatises upon the subject. It must, however, be conceded that he has many difficulties to encounter, both imaginary and real, before he proceeds very far; and these impediments are of such force as either to deter him altogether from advancing further, or check him so effectually that more than ordinary enthusiasm is required to surmount them. Now this could be obviated by a little timely assistance from some practical astronomer. Treatises, however exhaustive and felicitous in explanation, can never be as effective as personal instruction and example, and hence it seems a desideratum that some establishment should be arranged to afford assistance to such amateurs as are anxious to qualify themselves as practical astronomers. It is certain that could such instruction be imparted on reasonable terms, there are many amateurs who would gladly avail themselves of the opportunity. The main purpose might be to train observers to the use of equatoreals, transit instruments, micrometer work, photography, &c., and in the proper reduction of observations and computation of orbits.

The fault with amateurs seems to be that they are devoid of organisation, and generally of proper education to the work in hand. Labouring independently and intermittently they have, as a rule, no definite purpose in view other than the mere gratification of curiosity. It is obvious that some means should be adopted to attract them to suitable channels for systematic work, so that they may be enabled not only to find pleasure, as hitherto, in seeing objects of interest, but also more effectively to aid the progress of the science by making their observations of practical utility. For it cannot be doubted that the means of determining exact positions and the capacity to reduce them will naturally increase the ardour and interest of observers, and must introduce a new and powerful element to the further advancement of astronomy. The number of amateurs is steadily increasing year by year, and there are now in this country a very large assortment of efficient telescopes which are lying comparatively idle or so misdirected as to be of little service. Under these circumstances it seems desirable to make some attempt to organise the labours of amateurs in directions suitable to their means and inclinations, and to utilise such results for the benefit of astronomy.

It is generally the case that amateurs employ their instruments in spasmodic fashion, and do not tenaciously follow up important observations even when such are well within their grasp. For instance, an interesting marking on a planet may be once seen and recorded as a feature of peculiar interest, but it is then allowed to escape subsequent observation, and thus the value of the record is lost. It is not sufficient to see a thing; we must hold it as long as possible, watching its variations of motion and form, and thus possibly arriving at something definite as to its behaviour and physical character. We cannot, it is true, expect amateurs, who generally are much pressed with other engagements, to work for long periods and at inconvenient hours, because this directly means a sacrifice of other interests which it is imperative should not be neglected. But by the exercise of discretion, and by the utilisation of favourable opportunities, we think that observers, though their time may be much restricted and their instrumental means very limited, may yet contrive to do valuable work in one or other of the many attractive departments of astronomy.

The fact sometimes forces itself upon us that astronomical *work* is not nearly commensurate with the *means*. The large number of powerful instruments now in use might surely be expected to yield a most abundant harvest of results; but we cannot deny that this is far from being the case. It is sometimes the boast of the fortunate possessors of a 10-inch refractor or 12-inch reflector that their instruments are comparable, as regards performance and reach, with those employed by the first Herschel; and this being granted, how comes it that there is such a manifest lack of new discoveries and of that unwearying enthusiasm exhibited by the earlier observers? Possibly some of our best instruments are merely erected as playthings serving to gratify popular curiosity. The possessor of a "big" telescope is always courted to a certain degree by people who, though knowing little and caring nothing about the science, yet profess great interest in order to be permitted to view some of the most interesting wonders in the sky. These ordinary sightseers love novelties of any kind; moreover a view of such objects and an explanation by the "astronomer" himself is a thing to be desired, because one acquires self-importance and can dilate upon the subject to one's open-mouthed friends who have never been honoured with such marked distinction. It is needless to say that such exhibitions are mere waste of time; valuable opportunities—and they are few enough in this climate!—are lost never to return.

Many fine telescopes, though occasionally in use, are not directed to the attainment of any important ends. Year after year they are kept in splendid adjustment; a speck of dust on the lens is removed with scrupulous care; a spot of dirt on the circles is rubbed off with anxious energy, and the owner stands off a few paces to view his noble instrument with intense pleasure. How grand it looks! How massive! Surely this splendid machine is able to reveal the most crucial tests of observational astronomy? The knowledge that he has the means to see great things is in itself a sufficient satisfaction without any practical application. Besides, how can he think of departing from his invariable custom of going to bed at 10.30 p.m. and risk catching a slight cold into the bargain? His intention certainly had been to make a prolonged vigil to-night, but that was decided on in the sunny afternoon before the frosty air came on and before the fog began to rise up from the valley, and so he decides with some show of reluctance to leave it all to another night! Here is the hour, but not the man.

It is a fact to be regretted that many promising amateurs have had to relinquish, prematurely, all astronomical work on account of circumstances. A man on first experiencing the desire to do something to astronomy buys a few books, and then, when he finds it indispensable, a telescope, thus expending it may be the hard-earned savings of a few years. He becomes more interested with new facilities, and devotes much time to the subject. Ultimately the fact is realised that his business affairs are suffering from want of proper attention, and what is of even more importance his health is failing with over-application to work. There is no alternative but to relinquish his favourite hobby, and he parts with his books and instruments for what little they will fetch. How many are there who have had this experience? How many promising observers have left the science because it offers no pecuniary rewards or benefits such as other work commands? "Life is real, life is earnest"; the telescope must be neglected for the ploughshare, and the solitary though withal happy hours of vigil must be given over to Morpheus! Many have realised all this, and though their names will never be known as astronomers, they have deserved as much credit for their disinterested efforts as many others who have from more fortunate circumstances achieved eminence.

It must be admitted that observers of the present day have many advantages over their predecessors, owing to the greater perfection and size of instruments and the conspicuous advances in the serial literature of the science. The latter has developed wonderfully during the last few years with such publications as *The Observatory*, *Copernicus*, *L'Astronomie*, *Sirius*, *Ciel et Terre*, *The Sidereal Messenger*, &c. Formerly we had but the *Astronomische Nachrichten*, *Wochenschrift für Astronomie*, and *Astronomical Register*. This leads us to hope for a corresponding increase in the number of astronomical workers.

It cannot be questioned that the essential direction of labour on the part of amateurs should be more of a systematic or methodical character than hitherto. A certain department or definite work should be taken in hand and followed up persistently. Little good is likely to accrue from erratic work or from the hasty and necessarily incomplete examination of many different objects. Every observer has a leaning towards a speciality, and he should pursue this exclusively even to the absolute neglect of other departments. Astronomy offers such a large number and variety of objects that to attempt an investigation of more than a mere fragment will tax more than the energies of a lifetime. We would therefore recommend amateurs to apply themselves sedulously to such special branches as they may individually select, for the indiscriminate use of a telescope is to be deprecated on many grounds.

W. F. DENNING

ON THE NATURE OF INHIBITION, AND THE ACTION OF DRUGS UPON IT[1]

II.

M. VULPIAN has observed that the excitability of the lower parts of the spinal cord increases as the upper part is gradually shaved away, so that each layer of the cord appears to exercise an inhibitory action on the one below it. M. Brown-Séquard supposes that in each layer of the cerebro-spinal system there are both dynamogenic elements and inhibitory elements for the subjacent segments.

We are, in fact, almost obliged to assume that each nerve-cell has two others connected with it, one of which has the function of increasing, and the other that of restraining the function of the nerve-cell itself.

Applying this same hypothesis to Newton's rings, we would say that certain parts of the lens or of the glass plate possessed the property of interfering with the rays of light, or were inhibitory centres for them. Others again had the property of increasing the brightness, or were stimulating centres for them; and, moreover, that different parts of the lens or of the glass plate contained each its stimulating and inhibitory centres for different coloured rays.

The multiplication of centres in the lens and glass plate soon becomes more than the imagination can well take in; and we are at present almost precisely in the same condition regarding inhibitory and stimulating centres in the nervous system.

As soon as we get rid of the idea that the darkness caused by the interference of the rays of light at certain points is due to some peculiar property inherent in the glass, and attribute the interference simply to the relationship between the waves of light and the distance they have to travel, the whole thing becomes perfectly simple, and the same is, I think, the case in regard to inhibition in the nervous system.

Let us now take a few more examples of inhibition.

We find in experiments with the frog's foot exactly the same as on our own hand. Thus, when a little turpentine is placed upon the toes it excites a violent reflex, but if a little turpentine be injected under the skin of the same foot, the reflex is abolished.[1] We find also that irritation applied to a limited region of the skin usually causes marked reflex, but if the same stimulus be applied to the sensory nerve supplying that region, the reflex is very much less.[2] In the cases just mentioned the irritation is applied to sensory nerves of the same part of the body, and close together, and the explanation of its different results is the same as that already given for the different effects of tickling and pressure. Different sensory nerves on the same side of the body, but at some distance from each other, will also cause inhibition of motor reflexes; thus it has been shown by Schlosser[3] that simultaneous irritation of the skin over flexor and extensor surfaces will lessen reflex action.

Some years ago I observed that frogs suspended by the fore-arms with cords, or tied with their bodies against a board, reacted less perfectly to stimulation of the foot by acid than a frog suspended by a single point, as in Türck's method. Tarchanoff[4] has also observed that frogs held in the hand also respond less perfectly than when hung up; the gentle stimulation of the sensory nerves in the skin of the body appearing to exercise an inhibitory action over the reflex from the foot.

The injection of acids or irritating solutions into the mouth[5] or dorsal lymph sac[6] also exercises an inhibitory action on reflexes from the foot.

A similar effect is produced by irritating the sciatic nerve on one side by a Faradaic current, and applying a stimulus to the other foot. So long as the irritating current is passed through the sciatic nerve, no reflex movement can be elicited by stimulation of the other foot; but so soon as the Faradaic current stops, the reflex excitability again appears in the other foot.[7] As this phenomenon occurs when the influence of the brain and upper part of the spinal cord has been destroyed by a section through the cord itself, the inhibition which occurs must be due to an action which takes place in the lower portion of the spinal cord.

Stimulation of the nerves of special sense has also an inhibitory action on reflex movements. This we can readily see in ourselves, by observing our actions in the dark. If we touch something cold or wet, or if something suddenly comes against our face, we give an involuntary start, sometimes almost a convulsive one. If, however, we were able to see, we should not give a start in the least when we touched a piece of wet soap, or when the end of a curtain suddenly came against our cheek.

Without entering into the nervous mechanism through which sight effects this change in our actions, but only reducing it to its simplest form of expression, as we would

[1] Continued from p. 422.

[1] Richet, Muscles et Nerfs, Paris, 1882, p. 710.
[2] Marshall Hall, Memoirs on the Nervous System, London, 1837, p. 48.
[3] Arch. of Physiol. 1880, p. 303, quoted by Richet, *op. cit.* 709.
[4] Quoted by Richet, *op. cit.* p. 709.
[5] Setschenow, Physiologische Studien über die Hemmungsmechanismen für die Reflexthätigkeit des Rückenmarks im Gehirn des Frosches, Berlin, 1863, p. 33.
[6] Brunton and Pardington, St. Bartholomew's Hospital Reports, 1876 p. 155.
[7] Nothnagel, Centralblatt d. med. Wiss. 1869. p. 211.

in talking of animals, we say that the stimulus to the sensory nerves of the hand or cheek, by contact with the wet soap or with the curtain, caused in us a reflex spasm, which was inhibited by the stimulus applied to our optic nerves. A similar occurrence is observed in frogs, and the reflex actions produced by stimuli applied to the feet are much stronger when the inhibitory effect of the optic nerves upon them is removed by covering up or destroying the eyes, or by removal of the optic lobes.[1]

Regarding the optic lobes, we will have a good deal more to say presently, for they have been considered to be special inhibitory centres, and are often known by the name of Setschenow's centres.

If we try to explain all those instances of inhibition by the assumption of special inhibitory centres for each action, we must suppose, in connexion with every sensory nerve, that centres exist which lessen or abolish the ordinary reflexes produced by stronger or weaker stimulation applied to the nerve. Besides this, we must suppose other centres which inhibit motor actions in other parts of the body: as for example, when irritation of the extensor lessens reflex excited by irritation of the flexor surfaces, or *vice versâ*, or when the irritation of one sciatic stops reflex action from mechanical irritation of the other foot. A special inhibitory centre must be placed also in the optic lobes in connection with the optic nerves. This complication reminds us of the multitude of inhibitory centres which one must imagine in glass, in order to explain the occurrence of Newton's rings by them, but it seems to me that all these cases are readily explained on the hypothesis that the motor and sensory cells concerned in them are so placed with relation to each other that the stimuli passing from them produce interference *under normal or nearly normal conditions of the organism*.

A spot of light may be caused to disappear by throwing another ray upon it, so as to interfere with it, but it may be also made to disappear from the place where it was, by simply reflecting it somewhere else.

A similar occurrence to this takes place in the body, and although two stimuli may interfere with and destroy each other, we not unfrequently find that the apparent abolition of the effect of a stimulus is simply due to its diversion into some other than the usual channel. In very many cases, where we have inhibition we have also diversion; and it is not at all improbable that when the stimulus is very strong complete inhibition may be impossible by interference alone, and can only be effected by diversion of part of the stimulus. We have already said that two waves of sound will neutralise each other and produce silence, but this only occurs when the waves are not too powerful. When they reach a certain intensity they produce secondary waves which give resultant tones, and several facts seem to point to an analogous condition in animal organisms.

We have hitherto considered cases in which the inhibition was probably brought about by interference of two stimuli, so that the one counteracts the other in much the same way as two rays of light interfered with one another in Newton's rings. In one case which we have mentioned, the movement of the hand when it is tickled is entirely arrested by a strong effort of the will, and the hand is allowed to remain perfectly passive and limp. Here we suppose the impulse sent down from the motor centres in the brain to interfere with that which has originated in the cord by irritation of the sensory nerves, and to counteract it so that no muscle whatever is put in action. But very frequently we find that a result apparently similar is produced by a different mechanism, viz. by diversion of the stimulus into other channels. In the former case the arm is felt to be quite limp, but in the latter though it is quite quiet, it is perfectly rigid—all the muscles being intensely on the stretch. Here the stimulus which would usually have excited convulsive movements of the arm, and probably of the body, resulting in a convulsive start, have been diverted from the body into other muscles of the same limb.

A similar power of diverting a stimulus is seen in the instinctive muscular efforts which any one makes when in pain. One of the most common of these is clenching the teeth, and it used to be a common practice in the army and navy for men to put a bullet between the teeth when they were being flogged, and at the end of the punishment this was usually completely flattened. A patient seated in a dentist's chair usually grasps convulsively the arms of the chair, or anything which may be put into his hand; and there can be little doubt that pain is better borne, and appears to be less felt, when the sensory stimulus occasioning it can thus be diverted into motor channels. In children the motor channels into which diversion usually takes place are those connected with the respiratory system, and the sensory stimulus works itself off in loud yells. At a later age the stimulus is often diverted into those motor channels through which reaction occurs between the individual and his surroundings. Thus most people probably remember how a kick in the shins at football often served simply to accelerate their speed; and during the heat of battle the pain of a wound is often but little felt, the stimulus having been diverted into motor channels.

Many more instances might be given of the effects of diversion of stimuli, but having discussed this subject at length in a former paper,[1] I shall not pursue it further here.

Sensory stimuli are also capable of inhibition by interference. Hippocrates[2] noticed, and it is a matter of general observation, that pain in one part of the body may be lessened or removed by the occurrence of pain in another. In many instances, the removal of the pain to one part may be indirect, through the action exerted on the vessels by the pain in the other part. But in some instances it may be, and probably is, due to the direct interference of sensory impressions.

This question of the removal of pain by the interference of waves in the sensory nerves or nerve-centres has been very fully and clearly discussed by Dr. Mortimer Granville.[3] Starting from the hypothesis of interference, he has also devised a plan of treatment which appears to give satisfactory results. By means of a small hammer moved by clockwork or electricity, he percusses over the painful nerve in order to induce in it vibrations of a different rhythm to those which are already present and which give rise to the pain. Thus he percusses rapidly over a nerve when the pain is dull or grinding, and percusses slowly when the pain is acute, in order to produce interference if possible. In many instances the treatment is successful, and its success affords additional support to the hypothesis on which it is based.

We have hitherto spoken of reflex inhibition in the cerebro-spinal axis alone, but we find also reflex inhibition of motor actions produced by irritation of sympathetic nerves; and, *vice versâ*, we find inhibition of the movements of internal viscera produced by irritation of cerebro-spinal nerves. Thus strong irritation of the sensory nerves of the liver, intestine, uterus, kidney, or bladder, occasionally abolishes the power of walking or standing. Irritation of a sensory nerve will frequently arrest the movements of the heart.

The phenomena which occur in swallowing afford an excellent example, not only of inhibition occurring in parts innervated by the sympathetic system, but also of

[1] Langendorff, Arch. f. Anat. u. Physiol. 1877; Von Boetticher, Ueber Reflexhemmung, Inaug. Diss., Jena, 1878, p. 12.

[1] Brunton, "Inhibition, Peripheral and Central," West Riding Asylum Reports, 1874.

[2] Hippocrates, Aphorisms, sec. i. 46; Sydenham Soc. Ed. vol. ii. p. 713.

[3] Mortimer Granville, Nerve Vibration and Excitation. (London: Churchill, 1883.)

partial diversion of stimuli. Kronecker has found that when we swallow, the food or water is sent down at once into the stomach by the contraction of the muscles of the pharynx, and that afterwards a peristaltic contraction of the œsophagus occurs. When several attempts to swallow are made one after the other, however, the œsophagus remains quiet until they are ended, and then it occurs at the same interval of time after the last, that it would have done after a single act of swallowing.

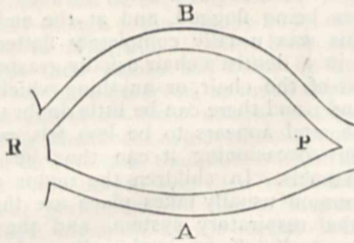


FIG. 2.—Diagram to illustrate Sir J. Herschel's observations on interference. Adapted from his article on "Absorption of Light," Phil. Mag. 1883, p. 405.

If we now refer again to our diagram (Fig. 2, which for convenience we repeat here) we will see that it answers just as well for the contractions of the œsophagus as for the tides at Batsha by simply giving a different meaning to the letters. Let R now instead of representing a reservoir or the open sea represent the ganglia of the pharynx, A and B the nerve fibres which conduct nervous impulses from these ganglia to P, and let P be the ganglia of the œsophagus which stimulate its muscular fibres to peristaltic action. A single wave passing from R causes two waves at P, one succeeding the other, but a number of waves from R under the conditions supposed also cause only two waves: one at the beginning and one at the end, for during all the intermediate period they neutralise each other.

It might perhaps seem that the two stimuli should cause two contractions of the muscular fibres of the œsophagus. But it frequently happens that a single stimulus is unable to produce muscular contraction. It only increases the excitability of the contractile tissue to a second stimulus, and when this is applied contraction ensues. The effect of the first wave then would be to increase excitability, that of the second wave to cause contraction. This is well shown in the accompanying tracing from the contrac-

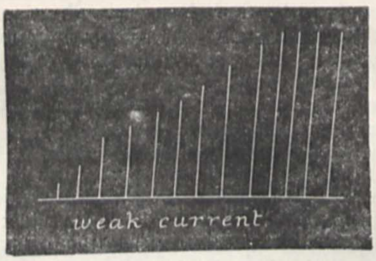


FIG. 6.—Showing the increasing contractions of the tissue of medusa when stimulated by repeated weak induction shocks of the same intensity.

tile tissue of medusæ, which I owe to the kindness of my friend, Mr. Romanes. He has found that when very slight stimuli, such as from weak Faradaic shocks, are applied, the first has no apparent action, but the effect of each successive stimulus is added to that of the preceding ones, until contraction is produced. Two shocks were applied before the first small contraction shown in the tracing occurred, and the shocks are all of the same strength, although the last ones produce the maximal contraction of which the tissue is capable, and the first had apparently no effect at all. This relation of the contractile tissue to stimuli is usually expressed by saying that the tissue has the power of summation.

At the same time that a stimulus is sent down from the pharynx to the œsophageal ganglia, which has an inhibitory action, there appears to be another sent to the medulla oblongata, which acts on the roots of the vagus nerve. This latter stimulus has a very curious effect, viz. inhibition of inhibition. The vagus usually exercises an inhibitory action on the heart, rendering its beats less rapid than they would otherwise be, but during swallowing this inhibitory action is removed and the heart pulsates at nearly double its normal rate.[1] Here we seem to have a stimulus one part of which passes along one path, while another part is diverted and passes along another. Each part interferes with the nervous actions which would occur in its absence, but one part interferes so as to prevent, and the other so as to increase muscular activity in the œsophagus and heart respectively.

The same diversion of a stimulus which we find in the case of the œsophagus seems to occur frequently throughout the body. Thus we find it almost invariably in relation to the vascular changes which occur on stimulation of a sensory nerve. When a sensory nerve going to any part of the body is irritated, the vessels of the district which it supplies usually dilate, while those of the other parts of the body contract.[2] The stimulus in this case passes to the vasomotor centre, and thence is reflected as an inhibitory stimulus in one direction and as a motor stimulus in another.

Some results of the greatest interest have recently been obtained by Dastre and Morat, in some experiments which they have made on the subject of vascular dilatation or inhibition.

In many cases the stimulation and inhibition of vascular nerves take place in the medulla oblongata, or in the spinal cord, and the inhibitory and motor centres are close to each other; but in other cases, such as those experimented on by Dastre and Morat,[3] we find the inhibitory and motor centres separated from one another, some of the motor centres being in the cord and some of the inhibitory in a ganglion situated nearer the periphery.

It was previously known that in some cases, as in the dilatation of the vessels of the submaxillary gland on irritation of the chorda tympani, small ganglionic structures were situated at the terminal branches of the nerve, and it was supposed that these ganglia, by their interposition between the nerve and the structure on which it was to act, converted its motor power into an inhibitory one. The experiments of Dastre and Morat are much more definite on this point. Excitation of the cervical sympathetic nerve has the effect of causing the vessels of the ear to contract very greatly in the rabbit, but irritation of the same nerve causes in the dog enormous dilatation of the vessels of the mouth. Moreover, in the rabbit this constricting action on the vessels of the ear is exerted only when the nerve is irritated between the first cervical ganglion and the ear. When the nerve is irritated beyond the cervical ganglion, instead of causing constriction, it produces dilatation.

In order to explain this action, the authors suppose that the fibres of the sympathetic, in passing through the ganglion, end in the ganglionic cells, and thus suspend the tonic action which they exert on the constricting fibres which issue from the ganglion and pass to the ear. It seems to me, however, that a more satisfactory explanation of this fact also is afforded by the hypothesis of interference.

In the cerebro-spinal system, cells being ranged above, below, and around one another with free communication between them, we have ample provision for the passage of two stimuli along paths of such different length, as to enable them to interfere with and inhibit each other.

[1] In my own case the proportion is 120 to 76.
[2] Ludwig and Loven, Ludwig's Arbeiten, 1866, p. 17.
[3] Archives de Physiologie, 1882, tom. x. p. 326.

But in peripheral nervous mechanisms, such as those in the heart of the frog, where we have no such provision, and the cells are not only few in number,

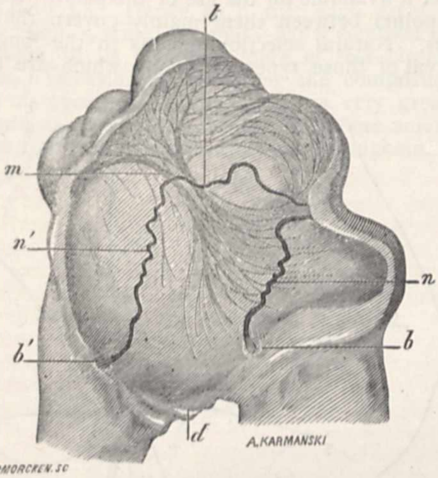


FIG. 7.—View of the auricular septum in the frog (seen from the left side). *n* is the posterior, and *n'* the anterior cardiac nerve. *t* is a horizontal portion of the latter nerve; *b* is the posterior, and *b'* the anterior auriculo-ventricular ganglion; *m* is a projecting muscular fold. This figure is taken by the kind permission of my friend, M Ranvier, from his Leçons d'Anatomie Générale, Année 1877-8.—Appareils nerveux terminaux, t. 6, p. 79. (Paris: J. B. Baillière et Fils, Rue Hautefeuille 19.)

but not arranged in strata, we find a special form of ganglion cell which seems constructed for this very purpose. This is the spiral cell described by Beale,

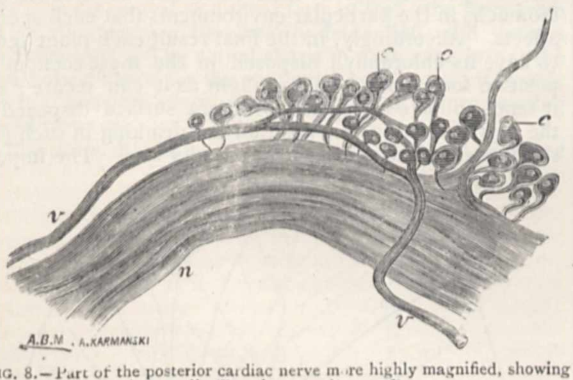


FIG. 8.—Part of the posterior cardiac nerve more highly magnified, showing the ganglia (Ranvier, *op. cit.* p. 106).

in which we find one nerve-fibre twisted round and round in a way which reminds us of a resistance coil in a galvanic circuit. The object of this peculiar arrangement has, so far as I know, not been discovered; but it seems to afford the exact mechanism which is wanted, in order to alter the distance two stimuli have to travel, and thus allow them to interfere with and inhibit each other. The occurrence of these ganglia in the heart and other viscera seems to afford in itself some support to the

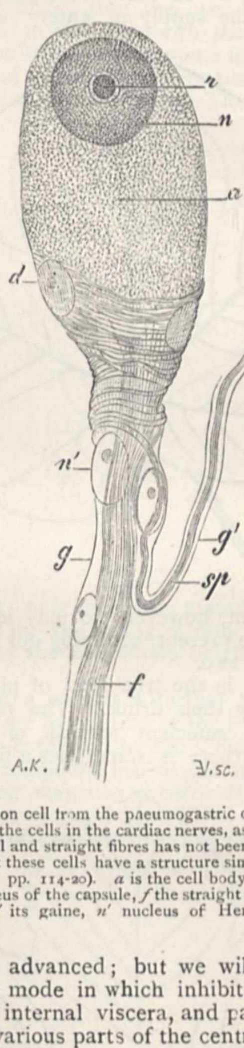


FIG. 9.—Spiral ganglion cell from the paeumogastric of the frog. This figure is not taken from the cells in the cardiac nerves, as in them the connection between the spiral and straight fibres has not been clearly made out, but it is probable that these cells have a structure similar to the one figured (Ranvier, *op. cit.* pp. 114-20). *a* is the cell body, *n* the nucleus, *r* the nucleolus, *d* nucleus of the capsule, *f* the straight fibre, *g* Henle's sheath, *sf* spiral fibre, *g'* its gaine, *n'* nucleus of Henle's sheath (Ranvier, *op. cit.* p. 114).

hypothesis here advanced; but we will defer the consideration of the mode in which inhibition occurs in the heart and other internal viscera, and pass on at present to the effect of various parts of the central cerebro-spinal system upon each other.

T. LAUDER BRUNTON

(*To be continued.*)

THE SHAPES OF LEAVES

I.—*General Principles*

THE leaf is the essential and really active part of the ordinary vegetal organism: it is at once the mouth, the stomach, the heart, the lungs, and the whole vital mechanism of the entire plant. Indeed, from the strictest biological point of view every leaf must be regarded as to some extent an individual organism by itself, and the tree or the herb must be looked upon as an aggregate or colony of such separate units bound together much in the same way as a group of coral polypes or the separate parts of a sponge in the animal world. It is curious, therefore, that so little attention, comparatively speaking, should have been given to the shapes of the foliage in various plants. "The causes which have led to the different forms of leaves," says Sir John Lubbock, "have been, so far as I know, explained in very few cases." Yet the origin of so many beautiful and varied natural shapes is surely worth a little consideration from the evolutionary botanist at the present day, the more so as the main principles which must guide him in his search after their causes are simple and patent to every inquirer.

The great function of a leaf is the absorption of carbonic acid from the air, and its deoxidation under the influence of sunlight. From the free carbon thus obtained, together with the hydrogen liberated from the water in the sap, the plant manufactures the hydro-carbons which form the mass of its various tissues. Vegetal life in the true or green plant consists merely in such deoxidation of carbonic acid and water, and rearrangement of their atoms in new forms, implying the reception of external energy; and this external energy is supplied by sunlight. We have thus two main conditions affecting the shape and size of leaves: first, the nature and amount of the supply of carbonic acid; and second, the nature and amount of the supply of sunshine. But as leaves also aid and supplement the roots as absorbers of water, or even under certain circumstances perform that function almost entirely alone, a third and subordinate element also comes into play in many cases, namely, the nature and amount of the supply of watery vapour in the air.

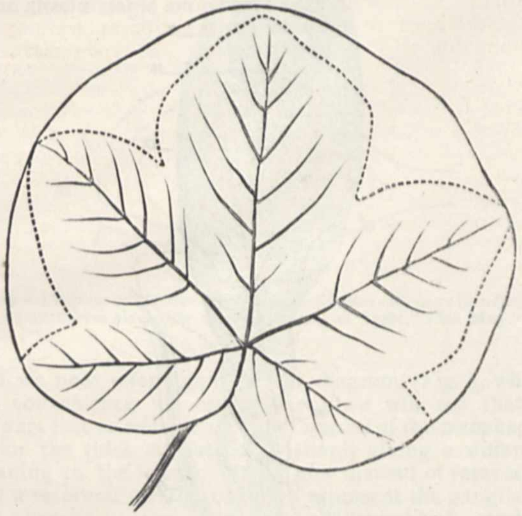


FIG. 1.

This last element, however, we may leave out of consideration for the present, confining our attention at the outset to the first two.

Carbonic acid is the true food of plants: water, one may say, is only their drink. The roots can almost always obtain a sufficient amount of moisture; and though no doubt there is sometimes a fierce struggle for

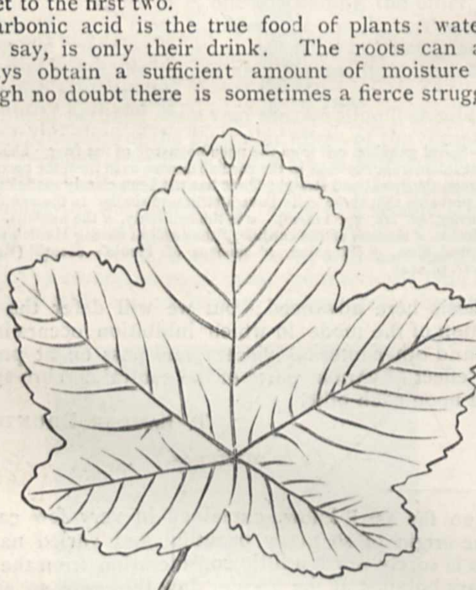


FIG. 2.

this material between young plants, yet its effects are not usually so obvious or so lasting on the shape of the parts concerned. But for the carbon of which their tissues must be built up there exists a competition between plants as great and as evident as the competition between carnivores for the prey they pursue, or between herbivores for the grasses and fruits on which they subsist. The plant endeavours to get for itself as much as it can of this fundamental food stuff; and all its neighbours endeavour to frustrate and to forestall it in the struggle for aërial nutriment. Again, the carbon is of no use without a supply of sunlight in the right place to deoxidise it and render it available for the use of the plant. Hence these two points between them mainly govern the shapes of leaves. Natural selection insures in the long run the survival of those types of foliage which are best fitted

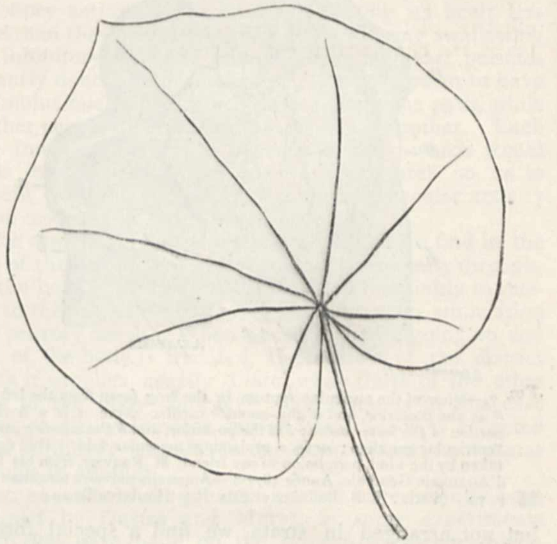


FIG. 3

for the performance of their functions as mouths and stomachs in the particular environments that each species affects. Accordingly, in the final result each plant tends to have its chlorophyll disposed in the most economical position for catching such sunlight as it can secure; and it tends to have its whole absorbent surface disposed in the most advantageous position for drinking in such particles of carbonic acid as may pass its way. The import-

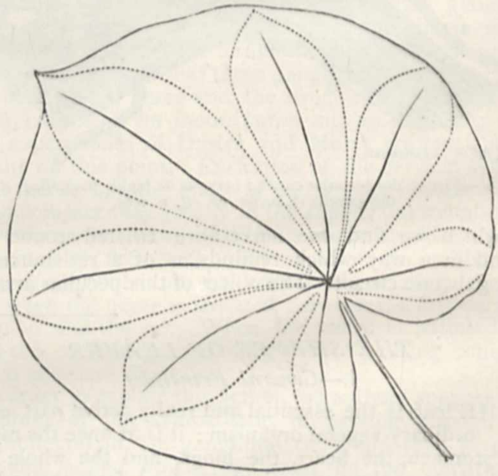


FIG. 4.

ance of the first element has always been fully recognised by botanists; but the importance of the second appears hitherto to have been too frequently overlooked.

At the same time, the shape of the leaf in each species is not entirely determined by abstract considerations of fitness to the function to be performed: as elsewhere in the organic world, evolution is largely bound by hereditary forms and ancestral tendencies. Each plant inherits a certain general type of foliage from its ancestors; and it modifies that type so far as possible to suit the exigencies of its altered conditions. It cannot remake the leaf *de novo* at each change of habit or habitat : it can only remodel it in accordance with certain relatively fixed ancestral patterns. Hence, as a rule, each great group of plants—family, tribe, or genus—has a common type of leaf to which all its members more or less closely approximate. Occasionally, as among the composites, the diversity of types in a single family is very great ; at other times, as among the peas and still more among the pinks, the type is fairly well preserved throughout. But,

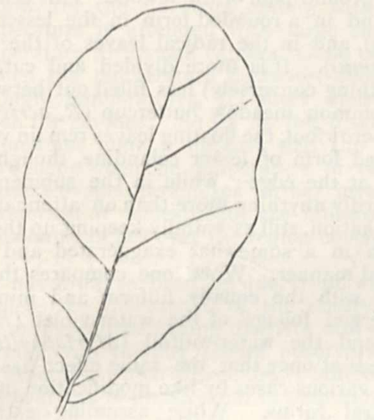


FIG. 5.

in spite of all apparent exceptions, and of numerous very divergent cases, there is a general tendency in most allied plants to conform more or less markedly to a certain general central and ideal form of leaf—the form from which all alike are hereditarily descended with various modifications. The actual shape in each case is not the ideally-best shape for the particular conditions ; it is only the best possible adaptive modification of a pre-existing hereditary type.

The point that is most common to leaves of different

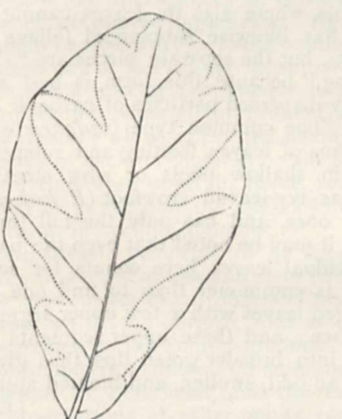


FIG. 6.

sorts in the same group is their vascular framework or ground-plan ; in other words, their venation. This is the typical thing which tends most of all to reproduce itself, under all varieties of external configuration. The plant seems to build up first, as it were, its ancestral skeleton, and then, if it can afford material, to flesh it out with the intervening cellular tissue (not, of course, literally, for all the leaf buds out at once from a single knob). A glance at the accompanying diagrams will show how easily, by failure of growth in the intervals between the principal ribs, a simple primitive rounded leaf may be converted during the course of evolution into a lobed or compound one. In Fig. 1 we have such an ovate leaf, with digitate venation : the dotted line marks the chief intervals between the ribs, mainly filled by cellular tissue. In Fig. 2 we have the leaf of a sycamore, with the same venation, but with the intervals between the ribs unfilled. Here it will be noticed that the apex of the five main lobes corresponds in each case with the termination of a main rib ; and the largest lobe answers to the midrib. Similarly, the apex of each minor serration answers to the termination of a secondary riblet. The type remains the

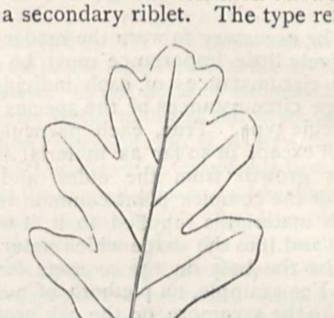


FIG. 7.

same throughout; only in Fig. 1, material has been supplied to fill it all in, and in Fig. 2, only enough has been supplied to cover the immediate neighbourhood of the main veins.

In Figs. 3 and 4 we get a further modification of a similar type. Here the cutting of the lobes goes so deep as to divide the entire blade into separate leaflets ; and the result is the compound leaf of the horse-chestnut.

The same thing may also occur with pinnately-veined leaves. In Fig. 5 we get a typical leaf of this character, where the supply of carbonic acid and sunshine under the

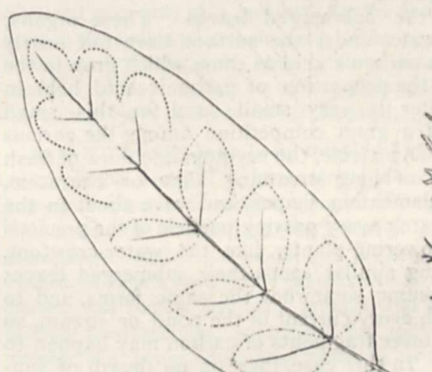


FIG. 8.

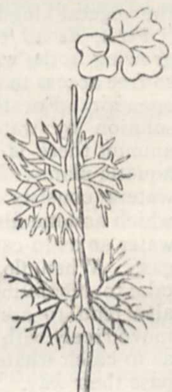


FIG. 9.

average circumstances of the plant is sufficient to allow of its having assumed a full and rounded specific form. Fig. 6 shows the less fully-veined tracts in such a type of foliage ; and in Fig. 7, where the ordinary conditions do not favour full development, we get the familiar irregularly-lobed blade of the English oak. The diagrammatic representation in Fig. 8 suggests the steps by which a regularly pinnately-veined leaf, such as that of the common olive, may pass into a pinnatified and pinnatisect form by non-development of the mainly cellular tracts. We may thus get either a lobed leaf like the hawthorn, as adumbrated at the summit of the diagram, or a compound leaf with pinnate leaflets like the commonest papilionaceous type, as shown in the lower portion. These examples will at once make clear the principle that with very slight changes in the real structural composition of a leaf we may have very great differences in the resulting outline. How the various underlying types of venation themselves are acquired or modified we must consider at a later stage; for the present we must take them for granted as relatively fixed generic or tribal characteristics.

It may be necessary to warn the reader in passing that comparatively little importance must be attached to the particular circumstances of each individual leaf. It is the average circumstances of the species which give rise to the specific type. True, each particular blade cannot grow at all except in so far as material is supplied to it during its growth from the older and more settled members of the complex plant-commonwealth; but even when such material is supplied to it, it will only grow to the extent and into the shape which natural selection has shown to be the best on the average for all its predecessors. For example, no plethora of available material would make the sycamore or the oak produce leaves like those represented in Figs. 1 and 5; it would only make them produce a greater number of normal leaves like those represented in Figs. 2 and 7, since these embody the final result of all the past experience of the race—the residuum of countless generations of unsparing selection.

A single illustration of the way in which these general principles work can best be found, as a first example, in the foliage of the water-crowfoot (*Ranunculus aquatilis*, Fig. 9). This well-known plant, growing as it does in streams or pools, has two forms of leaf on the self-same branch, strikingly different from one another. The lower or submerged leaves, which wave freely to and fro in the water, are minutely subdivided into long, almost hair-like, filaments; the upper or floating leaves, which loll upon the surface of the stream, are full and rounded, though more or less indented at the edge into from three to six obovate lobes. Familiar as is this curious little English plant, the causes which give it its two types of leaves admirably illustrate the laws which we must employ as the general key to all the shapes of foliage throughout the vegetal kingdom.

First, as to the submerged leaves. These organs, growing in the water under the surface, have not nearly so free access to carbonic acid as those which grow in the open air. For the proportion of carbonic acid held in solution by water is very small; and for this small amount there is a great competition among the various aquatic plants. As a rule, the cryptogamic flora of fresh waters consists of long streaming algæ or characeæ, which assume filamentous shapes, and wave about in the water so as to catch every passing particle of the precious gas. When flowering-plants, like the water-crowfoot, take to inhabiting similar spots, their submerged leaves also tend to assume somewhat the same forms, and to move freely with every current in the pond or stream, so as to catch whatever fragments of carbon may happen to pass their way. In this case, there is no dearth of sunshine, no interference of other plants with the incidence of the light; the waving thread-like form depends solely upon the comparative want of carbon in the surrounding medium. The leaves have acquired the shape which enables them best to lay hold on whatever carbon there may be in their neighbourhood; any other arrangement would involve a waste of chlorophyll—a misplacing of it in an unadvantageous position. Full round leaves would be useless under water, because there would not be work enough for them to do there.

On the other hand, when the leaves reach the surface, they have room to spread out unmolested into an area singularly free from competing foliage. Here, then, they plim out at once into a larger rounded type, as they can obtain abundant carbonic acid from the air around, and can catch the unimpeded sunlight on the surface of their pond. The two cases, as Lamarck long since remarked, are somewhat analogous to those of gills and lungs; for though in the one case it is oxygen that is required, and in the other case carbonic acid, yet inasmuch as both are gases dissolved in water, the parallelism on the whole is very close.

It is to be noted, however, that in both cases the central ranunculaceous type of leaf is faithfully preserved in the ground-plan or framework. This central type of leaf is found in a rounded form in the lesser celandine (*R. ficaria*), and in the radical leaves of the goldilocks (*R. auricomus*). It is more divided and cut, or (to put the same thing conversely) less filled out between the ribs in the common meadow buttercup (*R. acris*). But in the water-crowfoot, the floating leaves remain very close to the rounded form of lesser celandine, though a little more lobed at the edge; while in the submerged leaves, we get hardly anything more than an attenuated skeleton of the venation, still essentially keeping up the typical form, though in a somewhat exaggerated and minutely subdivided manner. When one compares these submerged leaves with the equally filiform and minutely dissected submerged foliage of the water-violet (*Hottonia palustris*) and the water-milfoil (*Myriophyllum spicatum*), one sees at once that the same effect has been obtained in the various cases by like modification of wholly unlike ancestral forms. While assuming extremely similar outer appearances, all these plants retain essentially diverse underlying ground-plans.

Furthermore, there are various minor forms or varieties of the water-crowfoot in which minor peculiarities of like import may be observed. The form known as *R. fluitans* lives chiefly in rapidly-running streams, where none of its leaves can reach the surface; hence all its foliage is submerged, and deeply cut into very long, thin, parallel segments, which wave up and down in the rapids, and are admirably adapted to catch the floating particles of carbonic acid carried down by the water in its course. The variety known as *R. circinatus* grows mainly in deep still pools, where also its leaves cannot reach the top; and it has likewise submerged foliage with finely-cut segments, but the separate pieces are "shorter and more spreading," because this form is best adapted to catch the stray dispersed particles of carbonic acid in the quiet waters. The common type (*vulgaris* of Bentham) has both forms of leaves, floating and submerged, and grows mostly in shallow pools or slow streams. The type known as ivy-leaved crowfoot (*R. hederaceus*) creeps on mud or ooze, and has only the full three-lobed leaves. Finally, it may be noted that even the particular position of individual leaves here counts for something; since nothing is commoner than to find one of the finely-cut submerged leaves with a few upper segments floating on the surface; and these upper segments begin to fill out at once into broader green tips, thus giving the end of the leaf an odd, swollen, and bloated appearance.

GRANT ALLEN

(*To be continued.*)

HERRING AND SALMON FISHERIES

AT a meeting of the Executive Committee of the Edinburgh International Fisheries Exhibition of 1882, which proved so successful, held on Wednesday, February 28, it was resolved, on the motion of Mr. John Murray, seconded by Sheriff Irvine, that the funds at the disposal of the Executive Committee be granted to the Council of the Scottish Meteorological Society to carry out the proposed investigations with reference to the herring, salmon, and other fisheries which are described in the Circular submitted by the Council with their letter of application to the Committee of May 23, with power to arrange for a zoological station, and with a recommendation that an application be made to Government for assistance. The sum granted is upwards of 1500*l*.

The results already obtained by the Scottish Meteorological Society in connection with the herring fishery show a close relation between the fluctuations of the catches and changes of temperature, wind, sunshine, cloud, thunder, and other weather phenomena. Thus the observations show, for the six years ending with 1878, that a low temperature is attended with large catches, and a high temperature with small catches. Good catches are also had when the temperature fluctuates about the average, and high temperatures, if short continued, scarcely diminish the catches. So far as the discussion of the observations has gone, it appears that the maximum catches are made when the temperature of the sea is about 55°·5, but this point requires further investigation. Thunderstorms, if widespread, are followed for some days with small catches over the region covered by them.

The Council has hitherto been unable, from want of funds, to complete the discussion of the observations already made; to inspect the fishing districts and confer with the fishermen, and thereby secure observations of the fulness and exactness which are required; and to carry on certain investigations in physics and in natural history which are essential to this inquiry. Of the physical investigations may be mentioned the heating power of the sun's rays at different depths of the sea, which appears to have important bearings, directly and indirectly, on the depth at which the herrings are caught. The inquiries in natural history are mainly those which concern the food of the herring and also the food of the animals on which the herrings prey, together with the influence of weather and season on the distribution of these animals in the sea. In carrying out the latter inquiries, the fishermen would be invited to assist, by entering, in schedules prepared for the purpose, observations as to the colour and appearances of the sea-water, due to the presence of minute organisms. As regards the discussion, it will be necessary to make weather maps of Scotland for each day of the fishing seasons—say upwards of 500—in which special prominence is given to charting the temperature, wind, cloud, thunder, and the other elements of weather which affect the fishings,—together with the catch of each day entered on the positions of the maps where they were severally made round the coast. From these maps some of the causes which tend to localise the shoals will become apparent.

The desiderata at present requiring to be supplied in carrying on the investigation of sea and river fishing are these:—1. Fuller and more exact observations of the temperature of the sea at the surface, and at different depths, by the fishermen at the fishing grounds. 2. The resumption of continuous maximum and minimum temperature observations at Peterhead, and the establishment of similar observations at other points round the coast. 3. The observation of maximum and minimum temperatures in other of the more important salmon rivers. 4. Daily temperature of the sea, by boat at some distance from land, at about six selected places. 5. The discussion of past observations, particularly of the herring fishings as described above. 6. Assistance of specialists in carrying on investigations into the food of the herrings, and into the heating power of the sun's rays at different depths.

We are glad to think that with the surplus funds of the Edinburgh Fisheries Exhibition, so wisely disposed of, the Scottish Meteorological Society will be able to prosecute their researches on these points with some hope of a satisfactory result.

NOTES

THE mathematical papers and memoirs of the late Prof. Henry Smith are, we believe, to be collected, and published in two volumes quarto by the Press of his own University. Miss Smith will contribute a biographical introduction; and the general editorship of the work, which will include a considerable quantity of hitherto unpublished material, will be intrusted to Mr. J. W. L. Glaisher.

IN NATURE for February 1 we gave a brief account of the remarkable results obtained by Prof. Lemström with his network of wires arranged up the face of the mountain at his station at Sodankylä, in North Finland. By this means he succeeded in procuring an appearance exactly similar to that of the aurora borealis. In connection with these experiments Mr. G. A. Rowell, assistant in the Natural History Department at Oxford, has issued a circular calling attention to the suggestion made by him forty years ago in reference to similar experiments. "My views on the cause of auroræ," Mr. Rowell states, "are that they result from electricity carried over with vapour by the superior trade-winds, from tropical to polar regions, and its occasional accumulation in the latter to such a degree as to flash back to lower latitudes, through the atmosphere at a reduced density, but still within the regions at which vapour is flotable although in a frozen condition. The directive properties of the magnetic needle I attribute to the return current of electricity from polar to tropical regions. The following is the concluding paragraph of the report on my paper on this subject:—'The author supports his opinion by general reference to the observations on the aurora, &c., in the appendix to Capt. Franklin's "Journey to the Polar Seas,' and concludes with proposing the experiments of raising electrical conductors to the height of the clouds in the *frigid regions during the frosts in winter*, which in his opinion would cause the aurora to be exhibited and lead to important discoveries in the science of magnetism.'"—(*Report* of the British Association, 1840, *Transactions* of the Sections, p. 49.)

DURING the past winter, the weather in Shetland and the north has been more stormy than for a number of years. In evidence of the severity of the weather, the inhabitants of the Island of Foula, which lies about eighteen miles to the west of Shetland were only able last week for the first time this year to cross to the mainland in their boats. The large supplies of food laid in, as is usually done, were in many cases exhausted, and several families were only saved from starvation by help received from neighbours who were better supplied.

ARRANGEMENTS have been completed for an exhibition, on an important scale, of hygienic dress, sanitary appliances, and household decoration, under Royal and distinguished patronage, and under the direction of the National Health Society, at Humphreys' Hall, Knightsbridge. The exhibition will be opened on June 2 next. The exhibits will be divided into seven classes, and besides hygienic, rational, and artistic dress, will include food-products, appliances for the sick-room, home nursing and home education, industrial dwelling and cottage hygiene, the sanitation of the house and hygienic decoration, heating, lighting, and cooking apparatus, fuel, &c. The Superintendent is Mr. E. J. Powell, 44, Berners Street, W.

THE National Smoke Abatement Institution is making arrangements for opening a permanent exhibition in a central part of London in an extensive range of buildings, for the display of apparatus, fuels, and systems of heating, combining economy with the prevention of smoke, and the best methods of ventilating and lighting. The exhibition will be free to the public, and will include examples of all the most recent inventions and improved apparatus. A lecture hall for the reading of papers, and instruction classes will be provided; also testing rooms under the supervision of experts, for the purpose of continuing the series of tests and trials commenced in connection with the South Kensington and Manchester Smoke Abatement Exhibitions of 1882. Particulars may be obtained at the offices of the National Smoke Abatement Institution, 44, Berners Street, Oxford Street, London, W.

THE Executive Committee of the International Fisheries Exhibition have come to a decision to light their galleries by electricity, and they have already made arrangements for the illumination of fully two-thirds of the area. Messrs. Davey Paxman and Co. have undertaken to supply the necessary motive power, which has been estimated at little less than 700 horse-power.

THE International Medical Congress, which, in accordance with the resolutions of the Italian Congress of last year, is to be held this year in Holland, will take place at Amsterdam, during the Colonial Exhibition, from September 6 to 8 next.

WE have on good authority the following instance of the liberality of Dr. Oscar Dickson, who has contributed so largely to the various expeditions of Baron Nordenskjöld:—An energetic Swedish botanist, Sven Berggren, was some years ago engaged in studying the flora of New Zealand, of which he gave some account in the Swedish *Aftonblad*. In one of his letters he stated, however, that his studies would have to be discontinued from want of funds. The next day a sum of 1000*l*. was received anonymously by the *Aftonblad*, with instructions to forward it to Herr Berggren. It was only many years after that it leaked out that the generous donor was Dr. Oscar Dickson.

PART IV. of Mr. Distant's "Rhopalocera Malayana" appeared this week. A complete synoptical key is given to the genera, and the geographical distribution of the genera and species is fully described. An attempt is made to allude to all biological facts which can illustrate or explain the many complexities in the distribution and economy of Malayan butterflies, and to draw attention to the different theories which have been promulgated to account for the same. The work may thus prove useful as an introduction to the study of Rhopalocera. Already it has assumed much larger proportions than estimated owing to the number of additional species recently received or found in other collections. Woodcuts have also been given, and the plates are equal to anything yet produced by chromolithography. Mr. Distant's work deserves every encouragement.

AN International Congress for the Protection of Animals is to be held at Vienna in September next. A great number of local societies, such as those of Berlin, Cologne, Munich, Dresden, Hanover, &c., besides several Spanish, Italian, and Russian, have expressed their intention of being represented at the Congress. Anti-vivisectionist societies will not be invited, as the promoters of the Congress, eminent men of science, do not consider them as societies for the protection of animals, and hold them to be generally incompetent regarding questions relating to such protection.

THE Dutch press considers the demand made by Baron Nordenskjöld perfectly legitimate and just.

THE death is announced of Dr. Bertillon, the well-known French anthropologist and statistician.

AT its January meeting, the Russian Chemical and Physical Society awarded its Sokoloff premium to Prof. Menshutkin, for his researches into the influence of isomerism of alcohols and acids on the formation of compound ethers.

IT is interesting to examine the items in the budget of Norway for the ensuing year, which has just been issued, relating to the "extraordinary" grants made in that country for the benefit of science. The following are some of the donations for this year:—To the academies of science in Christiania and Throndhjem, 600*l*.; the museums of Bergen, Stavanger, and Tromsö, 900*l*.; travels of scientific students abroad, 350*l*.; the European geodetic commission, 400*l*.; international observations of the physical condition of the polar regions, 700*l*.; *Archiv* of mathematics and natural sciences, 70*l*.; other scientific journals, 130*l*.; a new natural history journal, 70*l*.; "further," towards the publication of the works of the distinguished Norwegian mathematician, Abel, 100*l*.; a work by Herr Norman on the Arctic flora of Norway, 350*l*.; Herr Tromholt for the study of the aurora borealis, 60*l*.; the *Acta mathematica*, 60*l*.; scientific study of the Norwegian sea fisheries, 300*l*.; for the artificial hatching of salmon ova, 90*l*.; geological researches of Southern Norway, 600*l*.; the society for promoting the Norwegian fisheries in Bergen, 1600*l*.; publication of the reports of the North Atlantic expedition, 100*l*. These amounts, as well as the 3000*l*. granted towards the expenses of the Fishery Exhibition in London, are all in addition to the ordinary subsidies of the year.

THE Swedish Government has granted a sum of 60*l*., for this year, to an entomologist, whose duty it will be to advise farmers as to the best means of destroying injurious insects.

WE are informed by the secretary of the Society of Telegraph Engineers and of Electricians that the Crown Prince of Austria has consented to become patron of the Vienna Electrical Exhibition, and that the Emperor has signified his intention of devoting some highly decorated rooms for the purpose of testing the effects of incandescent lighting in connection with various styles of decoration. The time fixed for the receipt of applications for space has been extended from the 1st to the 20th inst., by which latter date they should be in the hands of the Secretary of the Society, 4, The Sanctuary, Westminster. We are also authorised to state that the Committee at Vienna are making arrangements for a reduction in the rates of transit on all goods forwarded to Vienna for exhibition.

IT is a common belief among persons who keep poultry that the shocks and tremors to which eggs are subject during transport on road or railway affect the germ contained in the egg. M. Dareste, who has been studying this matter (*Comptes Rendus*), found, a few years ago, that in eggs submitted to incubation directly after a railway journey, the embryo very generally died; but a few days' rest before incubation obviated this. He has lately inquired into the effect of shocks on the fecundated egg-germ, with the aid of a *tapoteuse*, or machine used by chocolate-makers to force the paste into the mills; it gives 120 blows a minute. Monstrosities were always the result of the tremors so caused. This teratogenic cause is the more remarkable that it acts before the evolution of the embryo; whereas the other causes M. Dareste has indicated, as elevation or lowering of temperature, diminution of porosity of the eggshell, the vertical position of the egg, and unequal heating, only modify the embryo during its evolution. The modification impressed on the germ by those shocks did not disappear after rest, as in the case mentioned above; but it is not known why. A few eggs escape the action.

THE radiometer is an instrament which may render good service in the hands of the teacher. Prof. Rovelli has been showing this (*Riv. Sci. Ind.*), and among other experiments he suggests are these:—Placing the instrument at the focus of a parabolic mirror, while a mass of snow is put at the focus of a like mirror facing the first a little way off; placing it, with sulphuric ether, under the bell-jar of an air-pump, and exhausting, afterwards letting in the air (the motion is opposite after the air is admitted); exposing the radiometer at the focus of a parabolic mirror turned towards the weak light reflected from snow, on a cloudy day, then turning the mirror away from the snow. Prof.

Rovelli finds that 8° of dark heat neutralise the effect of the weak light emitted by a common candle at the distance of 45 centimetres from the radiometer. The instrument may serve advantageously to demonstrate the relation between the absorptive and the emissive power of bodies, and to determine their respective values.

M. FERRY, the new Premier in the French Cabinet, as well as Minister for Public Instruction, will deliver the usual address to the Congrès des Sociétés Savantes at the end of this month.

M. HOUZEAU, the director of the Brussels Observatory, has returned from San José, but has obtained leave from his Government, and will spend the remaining part of the winter at Cannes. The King of Belgium is anxious to have the Observatory transferred to Laeken, to an eligible site placed in the vicinity of his castle, but nothing is decided in that respect. A temporary shed has been erected for the new meridian circle by Repsold, but the readings are taken with the old one.

M. SHULACHENKO, who managed the Russian military telegraph during the Kulja expedition, communicates to the Russian Physical Society the following results of his experiments with Siemens' telephones:—At a distance of 93 miles, music, singing, and speaking were heard quite distinctly; at 130 miles, conversation was difficult,—it was necessary to shout loudly, and those who received messages had to display a great sensibility of ear; but it was possible to have conversation even at a distance of 212 miles. When six pairs of telephones were put side by side, having each its wire, and the wires not being connected with one another, the conversation on one of them was heard on all the others. When the connecting wire of one pair of telephones was broken, the conversation on this pair was heard on the next pair of telephones the wire of which was in good state.

A COMMEMORATIVE stone has been placed on the house No. 17 in Via Dei Prefetti, Rome, to Morse, the telegraphist. The inscription was as follows, translated into English:—"Samuel Finkez Breese Morse inhabited this house from 20th February, 1830, to January, 1831, inventor of the writing electromagnetic telegraph. He was born at Charlestown 27th April, 1791; died at New York 2d April, 1872."

THE last number of the *Izvestia* of the Russian Geographical Society gives interesting particulars of the naphtha-wells in the province of Ferghana, in Turkistan. There are no less than 200 wells which are situated at the foot of both mountain ridges that inclose the valley of Ferghana. One range of wells, twenty-seven miles long, is situated on both banks of the Naryn, twenty miles north of Namangan. The other, about sixty-five miles long, is situated in the latitude of Makhram, in the districts of Marghilan and Kokan. There is a third intermediate group some thirty miles east of Andijan. The wells are situated in the limestones and slates of the "Ferghana level" of the chalk formation. The specific weight of the Ferghana naphtha is 0·950 at 17° Cels., 0·9517 at 28°, and 0·945 at 43°; it belongs therefore to the heavy mineral oils. The heavier parts remaining after the evaporation of naphtha in open air are known under the name of *khilk*, and when mixed with sand give an excellent waterproof cement, sometimes used by natives for irrigation canals. There are also mines of mountain-wax on the Kok-tube Mountain, in the district of Namangan, and a very good mine of sulphur at Karim-duvany.

M. DOMOJIROFF continues to publish in the *Izvestia* of the Russian Geographical Society his anemometric observations on board the clipper *Djighit*. In June, 1881, during the cruise from the Zond Strait to the Seychelles Islands, he met mostly with south-east winds, the velocity of which varied from 3 to 7·5 metres per second, with one exception, on June 9, when it reached 15 metres. On the cruise from the Seychelles to Aden, from June 25 to 30, the wind was mostly south-west, and varied from 5 to 12·7, reaching 14·3 metres per second on June 29. The observations are carried on in the same way as was described in a preceding number of NATURE.

THE young West Siberian branch of the Russian Geographical Society proposes to publish in its next volume of *Memoirs* a botanical description of the district of Tara, which has the interest of having an intermediate flora between the forest region and the Steppes, the Irtish being a boundary-line between the two. The same Society continues the excavation of several koorgans in the district of Yalutorovsk.

FROM various parts of the Greek Archipelago and from the Pelikon district continued volcanic phenomena are reported. The neighbourhood of Volo in Thessaly is particularly affected. Also the island of Chios seems again to be a centre of disturbance. The volcano at Santorin is very active.

ON February 16, at 8.10 a.m., a slight earthquake was noted at Bologna and the whole Southern Romagna. Mount Vesuvius increased its activity on that occasion.

A DISCOVERY, which is expected to throw some light on prehistoric times in what is now Germany, has been made near Andernach on the Rhine. Remains of prehistoric animals have been found in a pumice-stone pit, and Prof. Schaaffhausen of Bonn has investigated the spot closely. A lava-stream underlying the pumice-stone was laid bare, showing a width of only two metres. The crevices between the blocks of lava were filled with pumice-stone to a depth of one-half to one metre; below this, however, there was pure loam and clay, and in this were found numerous animal bones, apparently broken by man, as well as many stone implements. It is supposed that there was a settlement there, of which the food-remains fell into the lava-crevices *before* the whole was covered with pumice-stone.

THE additions to the Zoological Society's Gardens during the past week include a Macaque Monkey (*Macacus cynomolgus*) from India, presented by Miss Annie M. Davis; an Ocelot (*Felis pardalis*) from South America, presented by Mrs. A. Harley; a Grey Ichneumon (*Herpestes griseus*) from India, presented by Miss G. Gordon Clark; a Black Rat (*Mus rattus*), British, presented by Mr. H. B. Stott; a Tawny Eagle (*Aquila nævioides*) from South Africa, presented by Mr. Roland Trimen, F.Z.S.; a Slender-billed Cockatoo (*Licmetis tenuirostris*) from South Australia, presented by Mr. A. Anderson; a Common Magpie (*Pica rustica*), British, presented by Mr. Charles Davis; a Ring-necked Parrakeet (*Palæornis torquatus*) from India, presented by Miss Bibby; a Common Curlew (*Numenius arquata*), a Golden Plover (*Charadrius pluvialis*), British, purchased.

OUR ASTRONOMICAL COLUMN

THE COMET 1883 *a*.—In a circular issued from the Imperial Academy of Sciences, Vienna, are the following elements of a comet discovered at Rochester, N.Y., on the 23rd ult., founded by Dr. Hepperger upon observations on February 24, 25, and 26.

Perihelion passage, February 20·20206 M.T. at Berlin.

	°	′	″	
Longitude of perihelion	33	23	51	M.Eq. 1882·0.
,, ascending node	280	4	20	
Inclination	77	32	48	
Logarithm of perihelion distance ...	9·879124			

Motion—direct.

Prof. Millosevich kindly communicates observations made at the Collegio Romano in Rome:—

	Rome M.T. h. m. s.	R.A. h. m. s.	Decl. ° ′ ″
Feb. 28 ...	7 43 12 ...	23 43 19·58 ...	+31 37 54·5
March 1 ...	7 53 14 ...	23 53 1·27 ...	+31 49 7·0

From Prof. A. Riccò, who writes from Palermo on February 28, we learn that he has found the spectrum to be formed of the three bands of hydrocarbons, with an extremely faint continuous spectrum of the nucleus; the sodium line (D) was not present.

The comet is receding from the earth as well as from the sun. The elements have but little similarity to those of any comet previously calculated.

THE GREAT COMET OF 1882.—Prof. Julius Schmidt has published some particulars of his observations of this remarkable body since the commencement of the present year. On Jan. 3 the tail was traced through upwards of 11° with the naked eye; on the 10th it was visible for 8°, on the 28th it had diminished to 5½°, but was readily seen without the telescope; on the 30th its length was 3°. On February 5 a tail 2° in length was perceptible to the naked eye; Prof. Schmidt obtained his last distinct glimpse of the comet without the telescope on February 7.

Dr. B. A. Gould, director of the Observatory at Cordoba, who is now in London *en route* for the United States, informs the writer, that on February 11, three days out from Rio Janeiro, he was satisfied of the visibility of the tail of the comet to the naked eye; its distance from the earth at this time was 2·48, and its distance from the sun 3·05.

THE VARIABLE STAR U CEPHEI.—Mr. G. Knott secured a good observation of the minimum of this variable, at Cuckfield, on the night of March 2. An uninterruptedly clear sky enabled him to keep a watch on the star from 7h. 24m. to 14h. 30m. G.M.T. At about 8h. 15m. it began to fade from 7·2m., and at 14h. 30m. it had risen again to 8·1m. The observed time of minimum was 12h. 36m., or seven minutes earlier than the time assigned in the ephemeris in NATURE, and the magnitude at minimum was 9·45. The star remained at minimum for nearly 2½ hours. The low magnitude attained, Mr. Knott considers, is confirmatory of a suggestion he made from his earlier observations, that at alternate minima the star touches a lower magnitude than at those which intervene.

NEW NEBULÆ.—M. Stephan, director of the Observatory at Marseilles, publishes a catalogue of fifty nebulæ observed there, forty-five of which he believes to be new. A group of four pretty bright nebulæ he gives as identical with *h*, Nos. 2352, 2356, 2358, and 2359, but their relative positions resulting from his observations are not in accordance with Sir John Herschel's Catalogue. The Marseilles places and descriptions are—

	R.A. 1880·0. h.	m.	s.		N.P.D. °	′	″	
No. 42 ...	11	9	8·45	...	71	14	8·7	Assez belle, assez petite, ronde, condensation centrale.
,, 43 ...	11	10	28·49	...	71	19	39·1	Assez belle, assez petite, ronde, condensation centrale.
,, 44 ...	11	10	36·52	...	71	17	35·0	Belle, ronde, assez étendue, condensation graduelle centrale très forte.
,, 45 ...	11	10	40·73	...	71	11	46·7	Assez belle, ronde, condensation graduelle centrale assez forte.

The catalogue is published in the *Comptes Rendus de l'Académie des Sciences* of February 26.

GEOGRAPHICAL NOTES

WE are now enabled, on the authority of Dr. Oscar Dickson, to give the following particulars of the programme of Nordenskjöld's proposed expedition:—The expedition will leave Sweden early in May next, in all probability in the Government steamer *Sophia*, and if the state of the ice is favourable to a landing on the east coast this will be effected; but as this is not expected to be the case until later in the season, Baron Nordenskjöld will proceed to the west coast, not for geographical discovery, but to study the appearance and extent of the inland ice on this side before attempting to penetrate from the eastern side. There are also known to exist on the west coast some very large blocks of ironstone, perhaps of meteoric origin, which a party of the expedition will be despatched to examine. When these researches are finished, and the state of the ice more favourable, the vessel will make her way from Cape Farewell along the eastern shore in the open channel, which is generally found between the coast and the drift-ice. With regard to the "break" or oasis, believed by Baron Nordenskjöld to exist in the interior of Greenland, to which we have previously referred, the explorer has been led to this conviction during his wanderings on the inland ice on a former occasion. He maintains that not only the constant advance of the ice-mass, but the fact that the country does not rise continually in the interior, show that the whole land is not covered with perpetual snow and ice; and this theory, he states, has been further corroborated by the studies made by him and others of the temperature and moisture of the air on the inland ice. The expedition, which will be accompanied by a complete scientific staff, will also aim at studying the conditions of the drift-ice between Iceland and Cape Farewell, the fossil remains in Greenland, as well as the appearance and quantity of the cosmic dust there. One object will also be, if possible, to discover traces of the former Norse settlements. It is expected that the party will return in September next. We understand that the reason why Baron Nordenskjöld has not issued any official programme concerning his expedition is that, being occupied with preparations for his journey and public duties, he would not be able to enter into any critical controversies as to his plans and theory.

IT appears from a letter of Dr. L. E. Regel to the Secretary of the Russian Geographical Society, that this Central-Asian traveller successfully pursued his explorations during last summer. He left Samar-land at the end of June last, and to reach Hissar he chose the shortest route, *viâ* Penja-kent. This route, by which the expedition visited the Fan River and Lake Iskander-kul, and crossed the Mur Pass, was very difficult; but the botanical collections and the geographical results were all the richer. In the centre of this region is situated a great mountain range, whose summits—the peaks of Kuli-kalan and the Chandar and Bodhan Mountains—are seen from Samarkand. To the south of this range runs the Saridagh valley, beyond which rises the Hissar range proper; to the north it has the Kul-i-kalan plateau and the valleys of a tributary of the Voron and the Pasrut River. The plateau of Kul-i-kalan has a circumference of about thirteen miles, and is dotted with five lakes 10,000 feet above the sea-level. The mountains around it have no real glaciers, but there are old moraines which can be traced also along the tributary of the Voron, which is fed by one of these lakes. We have here a separate Alpine landscape, the mountains of which are mostly fossiliferous limestones (sandstones with casts of thick fossil trees are found in the Pasrut valley), and with a vegetation not only richer than that of any other part of the basin of the Zarafshan, but also more varied as to its distribution. The forest vegetation is richest in the zone between 4000 and 8000 feet above the sea-level: M. Regel found there apple, cherry, and nut trees, together with the *Archa*. The upper zone, where the *Archa* also predominates, contains birches, willows, and an arborescent *Ephedra*; it reaches 10,500 to 11,000 feet, and the vegetation altogether goes higher up than the limit of perpetual snow. The Mur Pass—about 14,000 feet high—is very steep; the expedition had to cross snow-fields for nearly four miles, and found on the southern slope immense accumulations of snow, which probably is due to the foggy climate of Hissar,, although the amount of rain is small in this region. The vegetation of the southern slope is very rich and much like that of Karateghin. The range is composed of syenite; the next range, of the same height, between Khoja-Hassan and Hakimi, consists of granite, syenite-gneiss, and fossiliferous slates. Between Hakimi and Karatagh there is a series of lower parallel ridges, consisting of fossiliferous sandstones. The same sandstones are met with also between the two main ranges; they contain fossils at Khoja-Hassan. Changing his former plan, M. Regel proceeded further directly to Kala-i-Khumb, while his topographer was despatched to Kulab, *viâ* Hissar, the two to meet in the Darvaz. The remainder of M. Regel's letter gives several interesting topographical details, and information about different routes, as well as an enumeration of the chief questions that must be resolved as to the topography of this region.

WE announced last week that a Danish expedition would explore the east coast of Greenland during the summer. The funds required for this expedition were voted by the last Danish Parliament, and it will consist of two lieuteuants in the navy, G. Holm, and T. Garde, with two scientific men, but the remaining members will be natives of Greenland. The expedition will only employ boats for their purpose.

THE Ural Mountains are again becoming the field of exploration for Russian geologists and geographers. We learn from the *Izvestia* of the Russian Geographical Society that M. Nasiloff is spending a third year in the exploration of the Northern Ural. After having explored the river Lala under 59° N. lat., where he discovered layers of spherosiderites which were not yet known on the eastern slope of the Ural Mountains, he explored the banks of the Sosva—their geological structure, and the koorgans that are met with in its basin, as well as the fauna and flora of the region. In 1882 he visited the banks of the Lozva and Sosva, and the old mines of this locality, and made large geological, botanical, and ethnographical collections. He followed the Lozva to its junction with the Tavda, and went up the Sosva. The collections brought home by M. Nasiloff are now in the Mining Institute, in the St. Petersburg University, and in the Geographical Society. Another member of the Geographical Society, M. Malakhoff, continued his zoological and ethnographical researches on the Middle Ural. He explored the lake-dwellings discovered in the neighbourhood of Ekaterinburg, and, together with a member of the Mineralogical Society, explored the 3000 feet high mountain, Kachkanar, making there interesting collections of plants and insects. Later on in the summer he visited the districts of Irbit, Ekaterinburg, and Trvitsk, and discovered close by Irbit very interesting accumulations of bones, lake-dwellings on Lake Ayat, containing large implements of slate, and finally stone and bone implements in a cavern close by the Mias ironworks. At Lake Bagaryak he discovered interesting forms for casting animal and human figures during the prehistoric epoch.

HARTLEBEN of Vienna has published a unique little work by Dr. Jos. Chavanne, on "Afrika's Ströme und Flüsse," in which the author briefly surveys the hydrography of Africa as far as recent discoveries have furnished them. The book is accompanied by a well-drawn hydrographical map.

IN the March number of Hartleben's *Deutsche Rundschau* for geography and statistics, Dr. Chavanne has a sketch of the progress of discovery in Africa during 1882. There are interesting biographies, with portraits, of General Strelbitski and the late Prof. Henry Draper.

THE following papers will be read at the third German "Geographentag," which will be held at Frankfort-on-the-Maine on the 29th-31st inst:—On the importance of Polar research to geographical science, by Prof. Ratzel (Munich); on the commercial conditions of South Africa, by Dr. Buchner (Munich); on the significance of the International Colonial Exhibition at Amsterdam with regard to geographical science, by Prof. Kan (Amsterdam); on the reciprocal relations of climate and the shape of the earth's surface, by Dr. Penck (Munich); on the means of determining the geographical position at the time of great discoveries, by Dr. Brensing (Bremen); on the latest efforts made to determine more accurately the shape of the earth, by Dr. Günther (Ausbach); memoir of Emil von Sydow, by Dr. Cramer (Gebweiler); on topography as an introduction to geography, by Dr. Finger (Frankfort); on the pedagogic requirements and principles in drawing wall-maps for the use of schools, by Herr Coordes (Cassel); on the method of representing various objects on maps, by Prof. Jaroslaw Zdenck (Prague); on the Prussian teaching order and examination with reference to geographical instruction, by Dr. Kropatschek (Brandenburg); on the geographical handbooks of M. Neander, by Dr. Votsch (Gera). Three other highly interesting papers are also promised, viz. notes from his botanical journeys in Tropical America extending over five years, by F. R. Lehmann; on the Balkan Mountains, by Prof. Toula (Vienna); and a report on his great journey across Africa, by Lieut. Wissmann.

NEWS from Zanzibar, dated November 8, 1882, brings the sad announcement of the death of Dr. Kayser, who had been sent by the German African Society to their station on the shores of Lake Tanganyika, together with Drs. Boehm and Reichard, and who had left his station and was on his way to the Gold Coast.

THE CONSERVATION OF EPPING FOREST FROM THE NATURALISTS' STANDPOINT[1]

THE great expanse of primitive woodland in the immediate neighbourhood of East London declared "open" to the public on May 5, 1882, by Her Majesty the Queen, should be regarded as one of the numerous bequests to posterity marking the enlightenment of our times. The feelings leading to the agitation for the preservation of open spaces in and around the metropolis are sure indications on the part of the public of a recognition of the necessity for protecting and conserving our common lands for outdoor recreation—a recognition which must be considered as marking a decided advancement in the ideas of the British holiday-maker. If we compare a map of the environs of London of, say, twenty years ago, with the actual state of the country at the present time, it will be seen that large tracts of open land have disappeared; shady coppices and furze-clad heaths have been inclosed and built upon, and the country-loving Londoner has had to go further and further afield for his rambles. If it is obviously true that increased pressure of population demands more dwelling accommodation, it is equally true that a denser population requires more open spaces. The indifference of the public in former times to their own rights and to the wants of their successors is naturally making itself more and more seriously felt with a rapidly augmenting population and a corresponding spread of buildings. The formation of such public bodies as the Commons Preservation Society and the Epping Forest Fund was a healthy sign that people were beginning to be alive to the gravity of the situation, and we may now fairly say that rural London is on the defensive. The remarks which I am about to offer on the present occasion are based on an unpublished article written many months ago, when that wooded area in which our interest as a society centres was threatened by tramway invasion. The withdrawal of the Great Eastern Railway Company's bill for extending their line from Chingford to High Beech in 1881, and the apparent collapse of the tramway scheme had led to the hope that the "people's forest" would remain unmolested, and that the Epping Forest Act of 1878 would be carried out in spirit and in letter. But unfortunately new grounds of alarm have recently arisen, and our honorary secretaries, to whom I showed the original manuscript, did me the honour of thinking that the views which I had expressed would still be found to be in accordance with those of our own and kindred societies.

Like other open tracts in the metropolitan district, the great Waltham Forest, which comprised the forests of Epping and Hainault, was rapidly undergoing absorption. From the report of the Select Committee of the House of Commons presented in 1863, it appears that of the 9000 acres which constituted the Forest in 1793, only 6000 acres then remained uninclosed. In 1871, when the Corporation of London took up the Forest question, this area had been reduced to 3500 acres. I do not here propose to trouble you again with the now familiar history of the rescue of this picturesque remnant of primeval Britain (see Mr. J. T. Bedford's "Story of the Preservation of Epping Forest," *City Press* Office, 1882). The work—commenced more than a decade ago by the Corporation of London—received its crowning reward at the late Royal visitation. We shall the more appreciate the results of the action taken by the Corporation when we bear in mind that the total area dedicated to the public last May is very nearly equal to the expanse of 6000 acres reported upon by the Select Committee of 1863. But whilst expressing the gratitude of metropolitan field naturalists generally for the restoration of one of their largest and most accessible hunting grounds, it certainly does seem to me that the shout of triumph raised by the Conservators has been allowed to drown the smaller voices of those who had previously demonstrated to certain rapacious lords of manors by somewhat forcible means that a "neighbour's landmark" was not a movable thing. It must not be forgotten that prior to the year 1871, besides many vigorous individual protests, both the Commons Preservation Society and the Epping Forest Fund had declared war against illicit inclosure. The restoration of the Forest to the people has cost a sum of money considerably exceeding a quarter of a million pounds sterling, and it will be generally admitted that this amount has been well if not wisely spent in the public cause. There are no doubt many who have suffered by their own cupidity, or by that of former manor lords, who still feel aggrieved at the action of the Corporation, and it must indeed be conceded that many whose estates have suffered curtailment have been the unconscious receivers of illegally acquired property and are thus deserving of commiseration. The principles involved in the conflict between public rights on the one hand and manorial actions on the other are of the very deepest importance to the community at large, and it is therefore no matter of surprise that the "Forest Question" should have acquired

[1] Being a paper read before the Essex Field Club, at the meeting held on February 24, by Raphael Meldola, vice-president of the Club.

a quasi-political aspect during the last few years in this neighbourhood.

As far as I have been able to learn, the motives leading to the preservation of our Forest at the great cost specified appear to have been purely philanthropic. The main object was to secure this splendid area for the "recreation and enjoyment" of Londoners generally, and more especially for the East-End inhabitants, whose chances of holiday-making are only too often limited to an occasional day in the country. In one sense the latter class may now, thanks to the movement first set in action by Mr. J. T. Bedford, claim to have a decided advantage over their wealthier West-End brethren, for the total area of the West-End parks (including Regent's) amounts only to about 1150 acres as compared with the 5000 to 6000 acres of open country so easily accessible to East Londoners. In the face of such an obviously enormous gain to the country rambling holiday folk, it may perhaps seem ill-advised to attempt to criticise the action of the Conservators in their dealings with the Forest. It is with great reluctance on my part that I forsake the peaceful paths of scientific study to take up a question which generally appears to lead to nothing more than a manifestation of angry controversy, and I only do so now on behalf of that numerous and ever increasing scientific class of holiday-makers whose claims thus far appear to have been altogether put out of court.

Long before the question of encroachment or of preservation had been brought into its present prominence, botanists, entomologists, microscopists, and students of nature generally were in the habit of frequenting our Forest and of rambling in quest of the objects of their study through this woodland expanse so conveniently situated with respect to the great scientific centre of this country. There are records which prove that Epping Forest has been for more than a century the hunting ground of many who have gathered materials from its glades for the great storehouse of human knowledge, and who have taken a true and purely intellectual delight in studying its animal and vegetable productions. The London naturalists of the present time should surely have something to say in connection with the fate of this favourite haunt, made classic ground to them by the memories of such men as Richard Warner, the author of the "Plantæ Woodfordienses" (1771), Edward Forster, the Essex botanist, who wrote between the years 1784 and 1849, and Henry Doubleday, of Epping, our own grocer-naturalist, who died in 1877. It is time for the natural history public, by no means such an insignificant body as is generally supposed, to raise their voice on behalf of these "happy hunting grounds." The position to be taken up is not necessarily one of antagonism towards the Conservators, but it is certainly desirable that some understanding should be come to respecting the claims of those who, in pursuit of knowledge, have long been contented to bear with the pitying smile of the ignorant for "trifling away their time upon weeds, insects, and toadstools." The numerous scientific societies and field clubs of the metropolitan districts have already declared their views on former occasions, and it is chiefly with the object of attempting to define the respective attitudes of the parties concerned that I have entered the arena on the present occasion.

There are at the present time more than twenty Natural History Clubs in the environs of London, and of these many have long been in the habit of making collecting excursions to our Forest. Our own Society and our Walthamstow colleagues have their head-quarters in the Forest district. Some of the East-End clubs are entirely composed of working men, and have done excellent work in fostering a healthy taste for the study of outdoor natural history among this class of the community, a matter of considerable importance to us when we so often hear that the Forest has been acquired as a recreation-ground chiefly for the working men of East London. In addition to these numerous local clubs, there are the great London Societies, which, like the Linnean, Zoological, Entomological, Royal Microscopical, and Quekett Club, are all interested in promoting the study of biology in its various branches. Now, in face of the rapid destruction of all the truly wild tracts of country in the vicinity of London, it must assuredly be of the greatest importance to the natural history public as a body to watch with a most jealous eye the dealings by those in authority with this the largest, wildest, and most accessible of all the open spaces in the metropolitan district. To naturalists generally such a tract of primitive country as that which has come under the management of the Corporation is something more than a mere picnic-ing ground—to all students of nature it is a *biological preserve*. Nay, I will even go so far as to declare that forest management is essentially a scientific subject in itself—a natural history question in the broadest sense. Now with the exception of our esteemed members, the Verderers, by whom we were invited to a conference some months ago, it appears to me that the Conservators as a body—and a confessedly unscientific body—are not aware that scientific counsel is necessary to enable them to faithfully carry out the Act of Parliament, *i.e.* to keep the area committed to their charge in its "natural aspect" as a forest. I will therefore take the present opportunity of pointing out that scientific criticisms would have been disarmed and the fears of natural history students allayed if the Epping Forest Committee had only recognised the claims of science by consulting, let us say, the Directorate of Kew Gardens, or by appealing to the Councils of some of the London Societies.

If we consider the actual work done during the period that the Forest has been under the jurisdiction of the Corporation, we may fairly say that the energies of this body have hitherto been developed in the direction of landscape gardening; *i.e.* of *artificialising* certain portions of the Forest. The great hotel at Chingford has been made the centre of convergence of a number of roads, some of which have been newly cut even at the risk of being superfluous. The aquatically-disposed holiday-maker may hire boats in which he can paddle about on an "ornamental water," or can embark on a floating machine turned by hand-paddles, and possibly constructed with a view to delude the occupants into the belief that they are on board a steamer. The exhausted East Londoner whose vitality appears to require that recuperation which seems to be derivable from swinging, steam-roundabouts, and throwing sticks at cocoa-nuts, has been amply provided for, and his wants have in every way been attended to. In 1881 the Forest was threatened by a railway; in 1882 by a tramway, and again this year another railway bill is about to be introduced into Parliament. To all these schemes the Committee, no doubt with the best motives, gave and still give their support, and one has to seriously ask what is the meaning of the word "conservator," and how far this attitude is compatible with the instruction that "the Conservators shall at all times as far as possible preserve the natural aspect of the Forest," and "shall by all lawful means prevent, resist, and abate all future inclosures, encroachments, and buildings, and all attempts to inclose, encroach, or build on any part thereof, or to appropriate or use the same, or the soil, timber, or roads thereof, or any part thereof, for any purpose inconsistent with the objects of" the Act of 1878. It must not be supposed that there is any desire on the part of naturalists to exclude the general public. I wish only to emphasise the fact that up to the present time it would appear that the Forest has fallen into the hands of those who are disposed to regard it exclusively from the point of view of excursionists and "cheap trips," and in accordance with the principle that supply and demand act and react, it may be expected that this class—which has thus far alone been catered for—will more and more frequent the Forest district. Increased accommodation for excursionists means, if we may judge from the line of action pursued by the Conservators, an extension of facilities for swinging and donkey-riding. The "improvements" that have hitherto been made have not been of such a nature as to preserve the woodland in its native beauty, but have been limited to the conversion of a portion of the Forest land into a resort for pleasure-seekers of the class indicated. To the naturalist—and I am sure I may say to the intelligent public generally—such a tract of primitive country is beautiful only so long as Nature is given full sway, and the adjustments which for long ages have been going on slowly and silently under the operation of natural laws remain unchecked and uninterfered with by man. No unscientific body of Conservators can possibly realise to the fullest extent the seriousness of the charge committed to their care.

With respect to the management of the Forest, the views of naturalists are now so well known that no excuse can be made for ignoring them. Our wants are of the simplest and most economical nature—our case is perfectly met by the trite aphorism, "let well alone." The whole Forest area at present existing may be considered to consist of primitive woodland and of tracts formerly under cultivation. The former can best be dealt with by leaving the "management" to Nature; whilst the latter should be naturalised as soon as possible. And here we cannot close our eyes to the fact that while a large amount of money has been expended in altering portions of the Forest proper, no attempt has yet been made to plant or to restore to a natural condition those unsightly tracts which were formerly inclosed, and of which many remain as barren wastes to the present time. The cause of the naturalist is thus imperilled both by the active and by the passive position of the Committee—he is like the pitcher in the Italian proverb, which says that "whether the pitcher hits the stone or the stone hits the pitcher, it is always the worse for the pitcher."

It is now quite unnecessary to make detailed statements of the views of individual naturalists with reference to the present subject. It will be remembered that at a meeting of this Society held last year, Sir Thomas Fowell Buxton brought forward a proposal—and a very excellent one it was—that all landowners round the Forest district should agree to stop generally the destruction of all birds and animals on their estates, so that a great experiment might be carried out for some years, leading to a true "balance of nature" in the whole area comprised between the valleys of the Lea and Roding. At the discussion arising from that suggestion the preservation of the fauna and flora as a whole was advocated, and many naturalists whose opinions will carry great weight expressed their views on the question of forest management. The complete report of this meeting has not yet appeared, but I will refer you to it prospectively, and in an appendix to the part of our *Transactions* now going through the press will appear papers, drawn up at the request of the Council, by Dr. M. C. Cooke, Mr. J. E. Harting, and Prof. Boulger. The evils of deep drainage, from the naturalist's point of view, which form the text of Dr. Cooke's protest, have already been pointed out by many, and I will just call your attention to some remarks on this subject by our eminent honorary member, Mr. A. R. Wallace, in an able article published in the *Fortnightly Review* for November, 1878, wherein he says:—"It must be remembered, too, that a proportion of bog, and swamp, and damp hollows are essential parts of the 'natural aspect' of every great forest tract. It is in and around such places that many trees and shrubs grow most luxuriantly; it is such spots that will be haunted by interesting birds and rare insects; and there alone many of the gems of our native flora may still be found. Every naturalist searches for such spots as his best hunting grounds. Every lover of nature finds them interesting and enjoyable." After enumerating some of the rarer marsh plants of our Forest, Mr. Wallace continues:—"These and many other choice plants would be exterminated if by too severe drainage all such wet places were made dry. The marsh birds and rare insects which haunted them would disappear, and thus a chief source of recreation and enjoyment to that numerous and yearly increasing class who delight in wild flowers, birds, and insects, would be seriously interfered with."

It is somewhat exceptional for a society founded for the study and promotion of natural science to find itself engaged in active polemics, but in taking up the position into which we have been forced, we are simply carrying out that line of action which at our foundation I ventured to lay down as our true function with respect to the Forest. (Inaugural Address, *Transactions*, vol. i. pp. 19, 20.) It is extremely unfortunate that the claims of science should appear to be opposed to the wants of the general public—I say should *appear* to be opposed, because I am convinced that there is no real antagonism. The grievance of naturalists is not only that their claims have been ignored, but the action of the Conservators has hitherto been entirely on the destructive side, and a feeling of alarm has arisen lest the whole of the Forest should piecemeal be desecrated in the name of a fictitious philanthropy. The public wants—as interpreted by the Board of Conservators—are made to take the form of clearing of underwood, drainage, roadmaking, the intersection of the Forest by railways and tramways, and ample public-house accommodation. If these are really the fundamental requirements of holiday-seekers, then there must for ever be a strong antagonism between this class of the public and those whose cause I have taken it upon myself to advocate. At this juncture, however, we may fairly ask whether this kind of artificialised recreation-ground, *à la* Cremorne, is actually demanded by the frequenters of the Forest. I believe myself that it is not. The notion of keeping a holiday in what is only too often a bestial manner is not a fair estimate of the British excursionist. If he gives way to the temptations which have been so lavishly scattered in his path, it is, as Shakespeare puts into the mouth of King John, because "the sight of means to do ill deeds makes ill deeds done." The East Londoner who wishes to spend a day in a "people's park" is provided for elsewhere, but if we consent to the denaturalising of our Forest, the more intelligent class of excursionists—and their name is legion—will be either driven from its precincts or will suffer that degeneration which the line of action at present pursued is exclusively calculated to bring about.

In the course of these remarks I may have somewhat exaggerated the supposed antagonism between the two classes most interested in the conservation of Epping Forest, but I have done so with the object of defining as sharply as possible the position of the hitherto unconsidered naturalist. The conditions requisite for transforming the Forest into a "people's park" are fatal to its preservation as a natural history resort. Any piece of waste land can be made into a park, but a tract of wild forest once destroyed can never be restored. I would once more urge, and most emphatically, that there is not the slightest desire on the part of naturalists to exclude the "toiling million," or to prevent their full enjoyment of the Forest. I wish only to point out that my present contention is that in the long run the wants, both of the naturalist and of the ordinary excursionist, will be found to be absolutely coincident. If the neighbourhood of a railway terminus with its concomitant evils leads to the destruction of the "natural aspect" of any portion of the Forest, that portion is ruined, not only for the naturalist, but likewise for the general public who come to enjoy a day in the country far from "the busy hum of men." By judicious management the requirements of both classes can be met, and it rests entirely with the Conservators to determine whether the attitude of the respective parties is to be pacific or the reverse. It must be remembered that long before the Forest was rescued by the Corporation this district was a favourite resort of multitudes of holiday folk, and, not being interfered with to any considerable extent, was at the same time available to the naturalist. The note of alarm must be sounded, or we may find ourselves worse off than in pre-Conservatorial times. The constitution of the Epping Forest Committee is apparently prejudicial to our interests if we may judge by the standard of past and present actions. Of this Committee the Verderers, who, as representing the Commoners and as residents in the Forest district, are best qualified to advise with respect to the management of the Forest, form but four of a Committee of sixteen. However enlightened the views of these gentlemen may be—and I only wish I could say that the present Verderers were unanimously of our way of thinking—they are thus liable to be outvoted. Another evil, and a most serious one so far as we are concerned, is that the Committee is practically a secret one—its proceedings are conducted with closed doors, and the people at large, whether naturalists or excursionists, have no means of making their voices heard. Whether this action is just in a case where the funds are derived from a public source it does not enter into my province to consider.

The views which I have now put forward are offered with the best of intentions with respect to the body Conservatorial. We cannot be unmindful of our obligation to the Corporation for having saved the Forest, but we appeal to them to assist in exalting the ideas of those who frequent this place as a holiday resort instead of pandering solely to the more degraded aspect of human nature. A day spent amid the natural beauties of our sylvan glades is the beau ideal of a holiday, intellectually, morally, and physically, to those whose pursuits keep them confined to the town. Let Epping Forest be preserved for the multitudes who have for so long enjoyed it rationally. The "recreation and enjoyment of the public" will thus become possessed of a higher meaning, and the naturalist while carrying on his studies as heretofore will be doubly grateful to those who have secured these time-honoured preserves as a public space free from all fear of inclosure or destruction. The ideas which I have attempted to formulate are I know entertained by large numbers not only of working naturalists, but also by the continually growing class of lovers of the country and of nature in general. It is becoming a matter of almost national importance that the surviving tracts of open country in the neighbourhood of all large towns should be rigidly preserved, and opinions in accordance with this have from time to time been forcibly expressed both with respect to our own Forest and all the common lands in the environs of London.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

CAMBRIDGE.—The following further appointments to Electoral Boards have been made:—

Professorship of Botany: Sir Jos. Hooker, Dr. F. Darwin, Dr. M. Foster, Prof. Oliver, Dr. Hort, Dr. Phear (Master of Emmanuel College), Rev. G. F. Browne, and Rev. M. J. Berkeley.

Woodwardian Professorship of Geology: Prof. Prestwich (Oxford), Rev. E. Hill, Mr. W. H. Hudleston, Mr. A. Geikie (Director of Geological Survey), Dr. Phear, Mr. R. D. Roberts, Mr. Ewbank, and Prof. A. Newton.

Professorship of Zoology and Comparative Anatomy: Prof. Flower, Prof. Moseley (Oxford), Dr. M. Foster, Prof. Huxley, Mr. J. W. Clark, Dr. F. Darwin, Prof. Humphry, and Mr. D. McAlister.

The Woodwardian Professor has been authorised to apply a sum equivalent to the late Assistant's stipend in payment of Demonstrators for this and the next term.

The regulations for the degrees of Doctor in Science and Doctor in Letters have been confirmed, with minor modifications.

The additional mathematical examination of candidates for honours in the "Little Go" is to be discontinued; Elementary Logic is to be hereafter allowed as a substitute for Paley's Evidences; Euclid is to be limited to the more useful propositions; algebra is to be increased in quantity; and the examination is to be held three times a year, the additional time being at the beginning of October.

The subject for the next Sedgwick Prize Essay, 1885, is "The Jurassic Rocks of the Neighbourhood of Cambridge."

The last Report of the Mathematical Board recommends that the Moderators and Examiners shall be the adjudicators of the Smith's Prizes, and that the Smith's Prizes be awarded on the results of Part III. of the Mathematical Tripos. This would give more distinction to the examination in the higher subjects. The concurrence of Professors Stokes, Adams, and Cayley in this recommendation is a strong point in its favour.

The report of the Moderators and Examiners in the last Mathematical Tripos, the first under the new system, gives particulars about Part III., to which only the Wranglers are admitted. Of the twenty-nine Wranglers, sixteen presented themselves for Part III., of whom two were not finally classed. In order to give opportunity to a candidate who had confined his reading mainly to one group of the higher subjects to employ his whole time in questions in that group, the examiners in the five bookwork papers gave at least four questions in each group which came into the paper, and fixed five as the limit of questions to be answered. In the fifth paper, subjects for essays were chosen from each group. . The majority of candidates attempted too many subjects, and their answers as a rule were poor and meagre. The Examiners are far from satisfied with the average performance of the candidates in Part III., but they expect better results when the new system is better understood, especially the encouragement given to limiting reading in the higher subjects to one or two groups.

FREE admission to the lectures and courses of practical instruction in the Normal School of Science and Royal School of Mines at South Kensington and Jermyn Street will be granted to a limited number of Teachers and Students of Science Classes under the Science and Art Department, who intend to become Science Teachers. The selected candidates will also receive a travelling allowance, and a maintenance allowance of twenty-one shillings per week while required to be present in London. The courses given and the duration of each are as stated below:—Chemistry: Part I., October to February; Parts II. and III., October to June. Physics: Part I., October to February; Parts II. and III., October to June. Biology: October to June. Geology: Part I., February to June; Part II., October to February. Mechanics: Part I., February to June; Parts II. and III., October to June. Metallurgy: October to June. Mining: October to June. Agriculture: October to January. Attendance is required from 9 or 10 a.m. to 4 or 5 p.m. daily, in addition to the time necessary in the evening for writing up notes, &c. Students will be required to attend the Classes for Mathematics, Geometrical Drawing, and Freehand Drawing, so far as may be considered necessary. Candidates for these Studentships must send in their applications before May 31, on Science Form No. 400, copies of which may be obtained on application to the Secretary, Science and Art Department, South Kensington. When the same student is a candidate for more than one course, the order of preference should be given. It should, in all cases, be stated for which course or courses the student is a candidate.

SCIENTIFIC SERIALS

American Journal of Science, February.—Henry Draper, by G. F. B.—Fauna at the base of the Chemung group in New York, by H. S. Williams.—Geological chemistry of Yellowstone National Park.—Geyser waters and deposits, by H. Leffmann.—Rocks of the Park, by W. Beam.—Electromagnetic theory of light; general equations of monochromatic light in media of every degree of transparency, by J. W. Gibbs.—The rainfall in Middletown, Connecticut, from 1859 to 1882, by H. D. A. Ward.—Discoveries in Devonian Crustacea, by J. M. Clarke.—Observations of the transit of Venus, 1882, made at the Lick Observatory, by D. P. Todd.—The antennæ of Meloë, by F. C. Hill.—Hypersthene-Andesite, by W. Cross.—Method for determining the collimation constant of a transit circle, by M. Schæberle.

The American Naturalist, December, 1882, contains:—A pilgrimage to Teotihuacan, by R. E. Hills.—On the grey rabbit (*Lepus sylvaticus*), by Samuel Lockwood.—The Palæozoic allies of Nebalia, by A. S. Packard, jun.—American work on recent mollusca in 1881, by W. H. Dall.—The organic compounds in their relations to life, by L. F. Ward.—The reptiles of the American Eocene, by E. D. Cope.

January, 1883, contains:—The history of anthracite coal in nature and art, by Jas. L. Lippincott.—The development of the male prothallium of the field horse-tail, by D. H. Campbell.—On the geological effects of a varying rotation of the earth, by J. E. Todd.—On the bite of the North American coral snakes (*Elaps*), by F. W. True.—Achenial hairs and fibres of Compositæ, by G. Macloskie.—Instinct and memory exhibited by the flying squirrel in confinement, with a thought on the origin of wings in bats, by F. G. King.—The extinct Rodentia of North America, by E. D. Cope.

February, 1883, contains:—The Kindred of Man, by A. E. Brown.—Indian Stone Graves, by C. Rau.—On organic physics, by C. Morris.—The mining regions of Southern New Mexico, by F. M. Endlich.—The extinct Rodentia of North America, by E. D. Cope.—Spencer and Darwin.—The Beastiarians.

Annalen der Physik und Chemie, No. 2.—The electric conductivity of some cadmium and mercury salts in aqueous solutions by D. Grotrian.—On the change of the double refraction of quartz by electric forces, by W. C. Röntgen.—On the optical behaviour of quartz in the electric field, by A. Kundt.—On the function of magnetisation of steel and nickel, by H. Meyer.—Contributions to the history of recent dynamo-electric machines, with some remarks on determination of the degree of action of electromagnetic motors, by A. von Waltenhofen.—On the viscosity of salt solutions, by S. Wagner.—Researches on the absorption of gases by liquids under high pressures, by S. v. Wroblewski.—Strecker's memoirs on the specific heat of gaseous biatomic compounds of chlorine, bromine, iodine, &c., by L. Boltzmann.—On the luminosity of flames, by W. Siemens.—Distillation in vacuum, by A. Schuller.—Researches on the elasticity of crystals of the regular system, by K. R. Koch.—On absolute measures, by C. Bohn.—Correction of the method adopted by R. Kohlrausch in his researches on contact-electricity, by E. Gerland.—The volume-change of metals in melting, by F. Nies and A. Winkelmann.—Correction, by A. Guebhard.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, February 22.—"Preliminary Note on the Action of Calcium, Barium, and Potassium on Muscle." By T. Lauder Brunton, M.D., F.R.S., and Theodore Cash, M.D.

It has been shown by Ringer that calcium prolongs the contraction of the frog's heart. This prolongation is diminished by the subsequent addition of potash.

It occurred to us that calcium and potassium salts might exercise a similar action on voluntary muscle. On trying it we found this to be the case. Calcium in dilute solution prolongs the duration of the contraction in the gastrocnemius of the frog. Potassium salts subsequently applied shorten the contraction. We have been led to try the effect of barium on muscle by considerations regarding the relations of groups of elements, according to Mendelejeff's classification, to their physiological action. These considerations we purpose to develop in another paper. The effect of barium is very remarkable. It produces a curve very much like that caused by veratria, both in its form and in the modifications produced in it by repeated stimuli. We have found that the veratria curve is restored by potash to the normal in the case of the gastrocnemius, just as Ringer found it in the case of the frog's heart. The peculiarity which barium produces in the gastrocnemius is also abolished by potash. We have tested a number of other substances belonging to allied groups, and find that some of them have a similar, though not identical, action with barium. The results of these experiments, as well as the general considerations to which we have already alluded, we purpose to discuss in another paper.

"On the Formation of Uric Acid in the Animal Economy, and its Relation to Hippuric Acid." By Alfred Baring Garrod, M.D., F.R.S.

The paper is divided into an introduction and three parts. The introduction contains the results of a series of experiments upon the solubility of uric acid and its most important salts, at the temperature of the body; and upon the effects of mixing the urates of sodium and ammonium with the phosphates and chlorides of the same bases.

Part I. contains observations upon the physical and microscopic characters of the urinary excretions of birds, reptiles, and some invertebrata, as well as chemical investigations of such excretions, and of the blood of the same classes of animals, with a view to the detection therein of uric acid. Part II. deals with the formation of uric acid in the animal economy. The rival theories are discussed, and from the consideration of the very large quantities of uric acid, in proportion to the body-weight, excreted by many of the lower animals, as well as the inability of the kidneys to excrete uric acid which has been taken by the mouth or injected into the blood, the author is led to the opinion that the uric acid is a product of changes which take place in the kidneys itself, and is not merely filtered off from the blood. This view receives further support from the fact that, whilst the kidneys excrete ammonium urate, uric acid when found in the blood is in the form of the more stable sodium urate.

It is further shown that when solutions of hippurates are mixed with solutions of urates, the salts exert an influence upon each other, and details of experiments to demonstrate this action are embodied in an appendix.

Linnean Society, February 15.—Sir John Lubbock, Bart., F.R.S., president, in the chair.—Mr. Jenner Weir exhibited a perfect hermaphrodite butterfly (*Lycæna icarus*), and a blue male and brown female of the same species for comparison. The hermaphrodite in question possesses two spotless blue wings on the left, and two spotted brown wings on the right, thus being intermediate in colour between the two sexes.—Dr. W. C. Ondaatje exhibited a collection of thirty species of Ceylon corals, of which twenty were of a stony character. The series agree in the main with those of the Indian fauna; four are new species, viz. two of *Cœloria*, one of *Pavonia*, and one of *Alcyonium*, the two latter however showing most affinity to forms met with in islands of the Pacific Ocean.—Mr. T. Christy called attention to examples of Carnauba palm leaves and to the wax of the tree; and he also showed specimens of a hybrid Primula (*P. japonica* and *P. sinensis*) with double whorls of flowers.—Mr. J. G. Baker read his third contribution to the flora of Madagascar. In this he gives descriptions of the new Incompletæ and Monocotyledons contained in the collections recently made in Madagascar by the Rev. R. Baron and Dr. G. W. Parker. The only new genus is *Cephalophyton*, a Balanophorad used in medicine, of which the material is not complete. Most of the new species belong to widely spread tropical genera, such as *Ficus*, *Loranthus*, and *Croton*. Cape types are represented by *Faurea*, *Peddiea*, *Dais*, *Kniphofia*, and *Dipcadi*, one species of each, and by four Aloes. Of *Obetia*, a genus of arborescent stinging-nettles known only in Madagascar and the neighbouring islands, there are four new species. The Bamboo common in the woods of Imerina proves to be conspecific with that of the interior of Bourbon. There is a curious *Exocarpus* with phyllocladea, nearly allied to species from Norfolk Island and the Malay archipelago.—Mr. C. B. Clarke has contributed a complete synopsis of all the species of *Cyperus* known in Madagascar and the neighbouring islands.—Mr. George Murray read a paper on the outer peridium of *Broomeia*. This gasteromycetous fungus, which is nearly related to *Geaster* consists of a mass of individuals closely seated together on a corky stroma. These individuals have been found up till now with only one peridium, and the Rev. Mr. Berkeley, who first described the plant in 1844, treated the stroma as the homologue of an outer peridium. Mr. Murray has found on some specimens recently brought from Dammara Land a true outer peridium common to all the individuals. From an examination of it he is able to throw light on the mode of development of this fungus.—A paper was read on the "Manna" or Lerp insect of South Australia, by Mr. J. G. Otto Tepper. This contained observations on the insect in question and on the peculiar saccharine substance derived from it, which is deposited on Eucalypt trees.—Mr. W. B. Hemsley read a communication on the synonymy of *Didymoplexis*, and on the elongation of the pedicle of *D. pallens*. The latter saprophyte orchid is widely scattered in tropical Asia, though apparently nowhere very common. It is remarkable for the elongation of its pedicles after flowering. At the time of flowering the pedicles are shorter than the flowers, which are less than half an inch long; but afterwards they elongate, sometimes as much as a foot. The object seems to be to carry the ripening fruit clear of the wet decaying vegetable matter in which the plant grows.

Zoological Society, February 20, W. H. Fowler, F.R.S., president, in the chair.—Prof. F. Jeffrey Bell exhibited a selection of microscopical preparations received from the Zoological Station at Naples, and made some remarks upon them.—Mr. J. J. Weir exhibited and made remarks on an apparently hermaphrodite specimen of *Lycænea icarus*.—Mr. Sclater gave an account of the birds collected by Mr. H. O. Forbes, F.Z.S., during his recent expedition to Timor Laut, and exhibited the specimens. The species were fifty-five in number, sixteen of which were described as new to science under the following names:—*Ninox forbesi*, *Strix sororcula*, *Tanygnathus subaffinis*, *Geoffroius tenimberensis*, *Monarcha castus*, *Monarcha mundus*, *Rhipidura hamadryas*, *Myiagra fulviventris*, *Micrœca hemixantha*, *Graucalus unimodus*, *Lalage mœsta*, *Pachycephala arctitorquis*, *Dicæum fulgidum*, *Myzomela annabellæ*, *Calornis crassa*, and *Megapodius tenimberensis*. The general facies of the avifauna as thus indicated was stated to be decidedly Papuan, with a slight Timorese element, evidenced by the occurrence of certain species of the genera *Geocichla* and *Erythura*; while the new owl (*Strix sororcula*) was apparently a diminutive form of a peculiar Australian species.—Prof. F. Jeffrey Bell read the second of his series of papers on the Holothuroidea. The present communication contained the descriptions of some new species which the author had discovered while examining the specimens of this group contained in the collection of the British Museum.—Dr. Hans Gadow read a paper on the suctorial apparatus of the Tenuirostres, pointing out that the tubular structure of the tongue in this group is produced by the overgrowth of the horny lingual sheath, the edges of which curl upwards and inwards.—A paper was read by Mr. L. Taczanowski, C.M.Z.S., Curator of the Museum at Warsaw, in which he gave the descriptions of some new species of birds in the collection made by Dr. Raimondi during his recent explorations in Peru. The species in question were seven in number, belonging to six genera, namely, *Carenochrous seebohmi*, *C. dresseri*, *Phytotoma raimondi*, *Ochthœca jelskii Upucerthia pallida*, *Cynanthus griseiventris*, and *Psittacula crassirostris*.—Mr. Taczanowski also read a communication from Dr. Dybowski, in which the sexual differences between the skulls of *Rhytina stelleri* were pointed out.—A communication was read from Mr. G. B. Sowerby, jun., containing the descriptions of nine new species of shells and of the opercula of two known species.

Entomological Society, February 7.—J. W. Denning, M.A., F.L.S., president, in the chair.—Two Members and one subscriber were elected.—Mr. J. R. Billups exhibited a species of *Conocephalus* which was found in a greenhouse at Lee and kept alive some time.—Mr. F. P. Pascoe read some comments on a letter recently contributed to NATURE by the Duke of Argyll, respecting a moth observed by him at Cannes.—Mr. E. A. Fitch exhibited three species of *Hymenoptera* from Ambarawa, Sumatra.—M. L. Peringuey communicated notes on the habits of three species of *Paussus* observed by him at the Cape of Good Hope.

Mineralogical Society, February 15.—Mr. W. H. Hudleston, F.G.S., president, in the chair.—Prof. Church exhibited and described a specimen of siliceous matter obtained by Mr. Vicary from the Upper Greensand of Haldon, which contained 98 per cent. of silica.—The President then read a paper on a recent hypothesis with respect to the diamond rock of South Africa. A discussion ensued in which Profs. Rupert Jones, John Morris, and Church took part.—A paper from Mr. J. H.

Collins was read on the minerals of Rio Tinto. The President, Prof. Morris, and Mr. Kitto joined in the discussion.

Meteorological Society, February 21.—Mr. J. K. Laughton, F.R.A.S., president, in the chair.—Rev. W. R. C. Adamson, R. P. Coltman, W. F. Gwinnell, Capt. C. S. Hudson, T. Mann, F. G. Treharne, and W. Tyson, were elected Fellows.—The following papers were read:—Notice of a remarkable land fog bank, "the Larry," that occurred at Teignmouth on October 9, 1882, by G. W. Ormerod, M.A., F.M.S. The "Larry" is a dense mass of rolling white land fog, and is confined to the bottom of the Teign Valley, differing therein from the sea fog which rises above the tops of the hills; it appears about daybreak, and has an undulating but well-defined upper edge, which leaves the higher part of the hillsides perfectly clear. The author gives an account, illustrated by photographs, of the remarkable fog bank that occurred at Teignmouth on the morning of October 9.—Barometric depressions between the Azores and the continent of Europe, by Capt. J. C. de Brito Capello, Hon. Mem. M.S. The author gives the tracks of several depressions from the Azores to Europe, and shows that if there had been a telegraphic cable, nearly every one of them could have been foretold in England.—Weather forecasts and storm warnings on the coast of South Africa, by Capt. C. M. Hepworth, F.M.S.—Note on the reduction of barometric readings to the gravity of latitude 45°, and its effect on secular gradients, and the calculated height of the neutral plane of pressure in the tropics, by Prof. E. D. Archibald, M.A., F.M.S.

Physical Society, February 24.—Prof. Clifton in the chair.—New members: Prof. A. W. Scott, M.A., Mr. F. E. M. Page, B.Sc.—Mr. Lewis Wright read a paper on the optical combinations of crystalline films, and illustrated it by experiments. He exhibited the beautiful effects of polarisation of light and the Newtonian retardation by means of plates built up of thin mica films and Canada balsam. The wedges thus formed gave effects superior to those of the more expensive selenite and calcite crystals. The original use of such plates is due to Mr. Fox, but Mr. Wright showed many interesting varieties of them, including what he termed his "optical chromotrope," formed by superposing a concave and ¼ wave-plate on each other. Norenberg's combined mica and selenite plates were also shown. Mr. Spottiswoode praised the results very highly, and pointed out their value to the teacher and student as showing how the effects can be produced step by step. The phenomena can be shown by an addition to the ordinary microscope, costing some two guineas, as made by Messrs. Swift and Sons.—Mr. Braham then gave an experimental demonstration of the vorticle theory of the solar system by rotating a drop of castor oil and chloroform in water until it threw off other drops as planets.

EDINBURGH

Royal Society, February 19.—Mr. A. Forbes Irvine in the chair.—Mr. G. Auldjo Jamieson read a long and interesting paper on land tenure in Scotland in the olden time, in which the author, after describing in detail the various ancient systems and the survivals of them that exist even now in different parts of the country, strongly deprecated the position taken by some that a return to the old systems would be beneficial.—Prof. Rutherford, in a paper on the microscopical appearances of striped muscular fibre during relaxation and contraction, maintained that the views held generally by physiologists as to which is the contractile portion of the fibre were quite erroneous. A great deal of the inconsistency that seemed to exist was due to difference in the appearance of muscular fibre according as it was relaxed or contracted; and previous observers had been unable to explain this simply because they had not hit upon an effective method of preserving the fibre in either condition. The paper was illustrated by enlarged diagrams and by microscopical preparations of the fibres in various conditions.

BERLIN

Physiological Society, February 9.—Prof. du Bois Reymond in the chair.—Dr. Walten, who was present as a visitor, gave a detailed account of his experiments upon the power of hearing in hysterical, hemianæsthetic persons. He has determined the presence of different degrees of deafness, in cases of partial and complete hemiæsthesias, in addition to the manifold motor and sensory hyperæsthesias and anæsthesias. In all cases anæsthesia of the external auditory meatus and of the membranum tympani existed on the affected side; the lesser degrees of deafness manifested themselves in the same way that senile deafness sets in, *i.e.* in interference with the propagation of sounds through the cranial bones, while direct hearing by the ear was still normal. When a higher degree of hysterical deafness was present, high tones could not be perceived by the ear. In extreme cases deafness is absolute on the affected side. All degrees of uni-lateral hysterical deafness could, like the remainder of the manifestations of hemiæsthesia, be transferred to the healthy side through the operation of a powerful magnet. Dr. Walten was able to measure the gradual decrease of deafness on the affected side and its gradual increase on the healthy side.—Dr. Martius, reasoning by analogy from the fact that a frog's heart cannot contract unless it is bathed in a nutritive fluid, from which it takes the energy required for its work, has tried to determine by experiment if other organs, *e.g.* the brain, require a continual supply of a nutritive fluid in order to keep up their activity. He therefore replaced the blood of frogs by a neutral salt-solution of the strength of 0·6 per cent., with which he washed out the blood-vessels until the fluid ran off free from blood, and as clear as water, and he observed the functions of the central nervous system in these frogs (salt-frogs). It was, however, soon discovered that all the blood had not been removed from the body by driving salt-solution through once, because, when the process was repeated after a few hours' time, the fluid flowed off deeply coloured with blood, and this process had to be renewed very frequently before the blood was reduced to a minimum. Hence, in the experiments with "salt-frogs," the brain was supplied by blood that was more and more diluted, and it reacted as follows:—After washing out the vessels once with salt-solution, the frog behaved like a brainless frog behaves. It sat still and did not make any spontaneous movements; it breathed normally, and exhibited the croak-reflex to perfection. After the vessels had been washed out twice, the croak-reflex had disappeared, and breathing was irregular and intermittent; finally, when the blood was still further diluted, respiration entirely ceased and the general reflex-irritability was greatly increased, as in frogs whose spinal cord is separated from their medulla oblongata. The conclusion to be drawn is that the brain, as well as the heart, requires the presence of a nutritive fluid from which it abstracts the energy for its work. The frogs that were operated upon recovered perfectly from the first stage in a few days' time, but did not recover from the later stages. It is evident that they bore the transfusion of such large quantities of salt-solution very well. On the other hand, they could not be used for experiments upon blood-transfusion, because they died even after very moderate transfusions of blood from other animals.

GÖTTINGEN

Royal Society of Sciences, December 27, 1882.—On an onyx cameo not hitherto known, with a replica of the representations on the upper and middle layers of the large Paris cameo of La Sainte Chapelle, by F. Wieseler.

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