THURSDAY, DECEMBER 28, 1876

DR. SCHLIEMANN'S DISCOVERIES AT MYCENÆ

OF all the archæological discoveries which this nineteenth century has witnessed, that which Dr. Schliemann has just reported from Mycenæ will certainly be regarded as among the most important. Indeed, as throwing a light on those early days of Greece, the glories of which are reflected in the Homeric poems, it will stand pre-eminent, and cast even the researches made by the same ardent explorer at Hissarlik into the shade. There was in that case always some degree of uncertainty, and even his most sincere admirers and sympathisers could not but feel that among the successively disinterred cities it was doubtful which, if indeed any, was the Troy of the Iliad, and whether "the treasure of Priam" was in reality that of the unburied father of Hector.

At Mycenæ, on the contrary, the claim of the ruins which bear that name to be regarded as the representatives of the ancient city founded by Perseus, the massive walls of which were built by the Cyclopes, appears to be indisputable. It is true that Strabo relates that not a vestige of the town had survived to his time, but the account of Pausanias fully identifies the spot where modern geographers place Mycenæ as having been in his days the traditional site of the city.

"In returning to Tretus, on the way to Argos, the ruins of Mycenæ are," he says, "seen on the left, nor is there anything recorded of greater antiquity in the whole of Argolis. When Inachus was king he called the river which flows by after his name, and consecrated it to Juno. In the ruins of Mycenæ is the fountain called Perseia. There are also the underground buildings of Atreus and his sons, in which were kept their treasures. There is, too, the tomb of Atreus and of all those whom Ægistheus slew at the banquet after their return with Agamemnon from Troy. As to the tomb of Cassandra, it is disputed by the Lacedæmonians who live about Amychi. But there is the tomb of Atreus himself and of the charioteer Eurymedon, and that in which Teledamus and Pelops lie together (who were the twin sons of Cassandra, and were slaughtered as infants by Ægistheus at their parents' tomb), and the grave of Electra. But Clytemnestra and Ægistheus were buried a little without the walls as they were not thought worthy to be interred within, where Agamemnon himself, and those who were slain with him, lie."

Such was the legend 1,700 years ago, and making all allowance for the reconstruction of history or legend to which local guides are so prone, there is enough to show that a strong tradition remained upon the spot of an early race of kings whose deeds were famous in the then remote days when the Iliad was composed.

Even now the gate with the lions still stands in the Cyclopean walls, the subterranean buildings and various sepulchres still exist, and the tradition of the treasures of Atreus and his sons appears not to have been without a good foundation. Who were the occupants of the tombs now rifled by Dr. Schliemann must of course be conjectured, but he seems to have brought to light more than one of the kings of the golden city, more than one *βασιλῆα πολύχρυσοιο Μυκήνης.*

Until we receive photographs of the various objects discovered in the tombs it is idle to speculate upon their forms, which are of course but vaguely described in a hurried account such as that furnished to the *Times* by Dr. Schliemann. Though many of them appear to be novel in character and the general contents of the graves rich beyond all comparison, yet the results of the excavations do not as yet appear to be at all out of harmony with what might have been predicated of the contents of a royal tomb belonging to what prehistoric archæologists would term the close of the Bronze period of Greece—a country where notoriously much allowance must be made for Egyptian influences. The bronze knife, the curious bronze dagger, the bronze swords and lances, the former having scabbards ornamented with gold, the gold-covered buttons, which from the description would seem to be not unlike those found by Sir R. Colt Home in some of our Wiltshire barrows, the long flakes or knives of obsidian, the style of ornamentation of the gold with impressed circles and spiral lines, are all in keeping with such a period. But though in general harmony with what might have been expected, there are, as already observed, also important and special features of novelty in the discovery.

The unprecedented abundance of the gold ornaments, the masks, the great diadems—which possibly may throw some light on the Scandinavian bronze ornaments which go by that name, and also on the Irish gold "minds" and the golden crosses in the form of laurel leaves—the silver sceptres with the crystal balls, the engraved gems, the vases, the great gold pin with the female figure crowned with flowers—possibly the Juno Antheia worshipped in the city of Argos—in fact the whole find will attract the attention of both classical and prehistoric antiquaries.

The pottery discovered appears also to be of peculiar fabric and material, and will no doubt contribute much to our knowledge of ancient fictile art. As all the originals will go to enrich the already important Museum of National Antiquities at Athens, it will be mainly from photographs and drawings that these wonderful objects will be known in this country. Let us in passing express a hope that the photographic and artistic representations of the Mycenæ treasure may be more satisfactory than those which constitute Dr. Schliemann's Hissarlik Album.

With regard to the antiquity to be assigned to these interments, it will be well to bear in mind that they lay at a considerable depth below the slabs first discovered by Dr. Schliemann, the ground beneath which he originally regarded as virgin and undisturbed; that above these slabs lay a great thickness of *débris*, probably accumulated at a time when the city was inhabited, and yet that Mycenæ was destroyed by the Dorians of Argos, about B.C. 468, at a period so early in Greek history that no authenticated coins of the city are known. It seems to have been from the depth at which the interment lay that they escaped the researches of former excavators, including Lord Elgin, upon the site. The reputed tomb of Theseus, which was rifled by Cimon the Athenian the year after the destruction of Mycenæ, must have lain nearer the surface, but the bronze spear and sword which were found in it, and which were brought with the bones in triumph from Scyros to Athens, point to its having belonged to much the same period. The spear of Achilles in the temple of Minerva at Phaselis, and the sword of Memnon in the temple of Æsculapius at Miomedia, were also of bronze, of which metal, as Pausanias observes, all the weapons of the heroic age were made. Had Augustus but known of the buried treasures of Mycenæ when he was collecting the *Arena Heroum* for his museum at Caprea, the researches of Dr. Schliemann might have been in vain.

As it is, he is to be congratulated not only on the extent and importance of his discoveries, but also on his investigation having brought to light those horned Juno idols which he anticipated finding. His theory of some of the owl-like figures from Hissarlik bearing reference to the name of γλαυκῶπις Ἀθήνη has met with more ridicule than it deserved, and if the discovery of these horned figures of βοῶπις πότνια Ἥρη should be substantiated, Dr. Schliemann will be fairly entitled to claim the victory over his adversaries. Under any circumstances both he and his no less enterprising helpmeet deserve the most cordial thanks of all scholars and antiquaries. J. E.

PESCHEL'S "RACES OF MAN"

The Races of Man and their Geographical Distribution. From the German of Oscar Peschel. (London: Henry S. King and Co., 1876.)

THIS book appears from the preface to be founded on General A. von Roon's "Ethnology as an Introduction to Political Geography," though it is substantially a new work intended to form a complete manual of ethnology. The actual title is somewhat misleading, as no special prominence is given to problems of geographical distribution, while languages, myths, and mere tribal distinctions, are treated with great and somewhat bewildering detail. The perusal of a work like the present, which, with great labour attempts to bring together in a compact form, all the existing information as to the physical and mental characteristics of the various races of mankind, impresses one painfully with the still chaotic state of the infant science of anthropology. With an overwhelming mass of detail as to secondary and often unimportant characters, we find a frequent want of exact knowledge as to the chief physical and mental characteristics of the several races and sub-races.

Language, myths, habits, clothing, ornaments, weapons, are described in detail, while we are left without any sufficient information as to the stature, bodily proportions, features, and broad mental characteristics of many important groups of men. The reason is obvious. The former class of facts can be readily obtained by passing travellers; while the latter require the systematic observation of an intelligent resident and more or less skilled anthropologist, and can only be arrived at by means of careful measurements and long-continued observations. It is not sufficiently considered that in almost every part of the world there is more or less intermixture of races, brought about by various causes—as slavery, war, trade, and accidental migrations. Hence in many cases the passing traveller is altogether deceived as to the characters of the race, and any observations he may make are of little value. It is only by a long residence among a people, by travelling through the whole district they inhabit, and by a more or less accurate knowledge of the surrounding tribes with whom they may be intermixed, that the observer is enabled to disentangle the complexities they present, and determine with some approach to accuracy the limits of variation of the pure or typical race. Unfortunately this has yet been done in comparatively few cases; but anthropologists are now becoming impressed with its importance, and we may soon hope to obtain a body of trustworthy materials, which may enable us to determine, with more confidence than is yet possible, the characters and the affinities of many of the best marked races of mankind.

We will now give a sketch of the mode in which the subject is dealt with in the present work, and point out some of the more striking merits and defects it possesses. The first and larger portion of the book treats of the various physical and mental characteristics of mankind, the latter portion being devoted to a systematic review of the races and tribal divisions. The introductory chapter treats of man's place in nature, origin, and antiquity; and while adopting the developmental theory as regards animals, argues with more or less force, against the Darwinian theory of the animal origin of man and especially against the influence of sexual selection. The hypothetical continent—Lemuria—is suggested as the most probable birthplace of the human race, and it is explained that this locality is "far more orthodox than it might at the first glance appear, for we here find ourselves in the neighbourhood of the four enigmatic rivers of the scriptural Eden—the Nile, the Euphrates, the Tigris, and the Indus." The unity of mankind as constituting a single *species*, is strongly urged, while the evidences of his antiquity are briefly but forcibly set forth. We are glad to see due weight given to Horner's borings in the Nile valley, which we have always thought have been unduly depreciated. It is well remarked that the suggestion of the piece of pottery found at a depth of 39 feet having fallen into an ancient well or tank, is altogether groundless, because this is only one out of a large number of fragments of bricks and pottery found at various depths over an extensive area, and there is certainly no reason why the one found at the greatest depth should have fallen into a well rather than any or all of the others. It seems not to have been considered, by those who have advanced this view, that a well at Memphis, close to the Nile, could not have been very deep, and that if it had been it would probably have been in use for many centuries, and would have become the receptacle, not of a solitary fragment of pottery, but of a whole collection of utensils, ornaments, and domestic implements, such as invariably fall into wells in the course of time. Moreover, a well 40 feet deep in the soft alluvium of the Nile must certainly have been lined with stone or brickwork, and have been protected at the top by some inclosure solid enough to have resisted the muddy inundation water, and it would almost certainly have been covered over to keep out sand and dust in the dry season. It would therefore be almost impossible to bore on the site of an ancient well without knowing it; so that no more hasty and unsound suggestion to avoid a supposed difficulty was ever made than this "well theory," and yet, strange to say, it has been almost universally adopted as fatal to all calculations founded on these careful borings. It seems to be thought that although we must have facts to establish a theory, we need only have suppositions to overthrow them.

The next chapter—on the Physical Characters of the Races of Mankind—treats pretty fully of the brain and cranium, and also of the hair, but far less satisfactorily (owing to absence of material) of other physical characters; and the conclusion arrived at is "that neither the shape of the skull nor any other portion of the skeleton has afforded distinguishing marks of the human races; that the colour of the skin likewise displays only various gradations of darkness, and that the hair alone comes to the aid of our systematic attempts, and even this not always, and never with sufficient decisiveness."

The next chapter treats of Linguistic Characters. While speaking favourably of the imitative and interjectional theory of language, its powers are unnecessarily "limited to events connected with the production of sounds, for no such representation is possible of that which is perceived by sight or the sense of touch." It has, however, been often shown that roots derived from sounds or emotions may soon be applied by metaphor, analogy, or contrast, to a wide variety of meanings; and it may perhaps be something more than a coincidence, that the languages which possess the smallest number of primitive sounds—the Polynesian—belong to an area where from the total absence of mammalia and paucity of birds and insects the variety of natural sounds is extremely small. The chapter which treats of Social and Religious Development is very voluminous, occupying considerably more than one-third of the whole work, while more than seventy pages are occupied with an account of the various religions, a large part of which is modern history and has the smallest possible connection with ethnology. This chapter is full of facts intermingled with a good deal of more or less doubtful philosophy. We may call attention, however, to the view that cannibalism is not a character of the lowest state of savagery, but is "more frequently encountered exactly among those nations and groups of nations which are distinguished from their neighbours by their abilities and more mature social condition." The ancient Mexicans, the Fijians, the Battas of Sumatra, as well as the Fans, Niamniams, and Monbuttos of Central Africa are adduced as examples, and as likewise proving that it is not the absence of animal food that has led to the formation of the habit. On the question of the first discovery of fire there is much wasted argument, founded on the erroneous assumption that to obtain fire by friction i a most laborious operation and always requires the combined labour of two persons (p. 143). On the contrary, either by the hand drill or by rubbing it is effected with great rapidity by one individual, and there is really no reason why it might not have been independently discovered in different parts of the world.

One of the best passages in this part of the work is that which treats of the influence of commerce on the migrations of nations (pp. 210–214). Humboldt has remarked that had not Columbus altered his course a few days before sighting America he would have landed in Florida, and the Spaniards would have peopled the United States instead of Central America, and the New World would now have had quite different ethnographical features. This was a very crude and unphilosophical remark of Humboldt's, for, as our author shows, the portion of America to be colonised by Spaniards was almost wholly determined by the presence of the precious metals. Wherever these were not found they marked on their charts as "worthless territories," and had they first discovered the present United States they would certainly have at once abandoned them. Agricultural colonies were not possible at that early period, and the first settlements of the French and English literally perished ot starvation. Tobacco as a valuable article of commerce first made Virginia flourish. The demand for codfish in France caused Canada to become a French colony. The Russians have settled wherever furs were obtainable. Spices caused the Portuguese and Dutch to settle in the far East, while in modern times the attraction of gold has led to the peopling of California with Anglo-Americans. This interesting discussion is summed up with the remark:—

"We thus see how much we owe to the rare and precious products of the animal, vegetable, and mineral kingdoms, as the means by which human culture was spread, and as the baits which attracted national migrations, and we perceive that the regions which were fortunate enough to possess such treasures were the first to be drawn into the sphere of a higher culture; the direction in which civilisation has moved has frequently been prescribed by this influence."

In the last part of the work, devoted to a detailed exposition of the races of mankind, we have a somewhat peculiar primary division into seven groups. The first includes the inhabitants of Tasmania and Australia; the second, the Papuans of New Guinea and the adjacent islands; the third, the Mongoloid nations, including the Malayo-Polynesians and native Americans; the fourth, the Dravida of Western India; the fifth, the Hottentots and Bushmen; the sixth, the Negroes; and the last, the Mediterranean nations, answering to the Caucasians or Indo-Europeans of other ethnologists. The Tasmanians are said to have "exactly resembled the Australians in all points, except that the growth of the hair was more Papuan in character." The supposed resemblance of Australians to the aboriginal inhabitants of Central India is set aside as entirely without foundation, while they are said to be decidedly nearest of kin to the Papuans. These latter are associated with the Negritos and the Andaman Islanders. Notwithstanding that a wide-spread relationship between Papuan and Polynesian languages is affirmed (p. 342), yet the Polynesians are associated with the Malays as a Mongoloid sub-race, the Malayo-Polynesians, an association which the present writer holds to be radically erroneous. The American tribes are treated as a single homogeneous group which entered the continent from the north-west, and little weight is given to the great differences of mental and physical character which exist and which are certainly greater than can be explained by a comparatively modern origin from a single stock. Very much yet remains to be done in determining the successive waves of migration which have flowed into the American continent, and we hardly think our author is justified in ranking the American aborigines as far higher than the negroes, on the ground that the former have, *quite independently*, reached a much higher civilisation. Throughout all this portion of the book a vast mass of information is given as to the tribal divisions, habits, languages, and migrations of the several groups; but these details often obscure those broader features of physical and mental peculiarity which are of most importance in arriving at correct conclusions as to the primary divisions of mankind and the true affinities of the various races.

It is impossible here to notice the many interesting questions which arise as we peruse the mass of facts and opinions set forth in such a work as this. Although unequal in treatment, and in many respects imperfect, it exhibits much labour and research, and treats in more or less detail every branch of the great and rapidly-developing science of anthropology; and it forms on the whole as good a manual of the subject as we are at present likely to obtain from a single author. It is to be hoped that when another English edition is required some well-instructed anthropologist may revise and edit the work, so as to modify (by means of footnotes or otherwise) the unusual treatment of many questions of which our author gives a more or less one-sided exposition.[1]

ALFRED R. WALLACE

[1] The translation is from the second edition, yet there are a considerable number of errors and oversights, some of which it may be useful to point out. First we must notice that the copious table of contents is rendered quite useless by the absence of a single reference to the pages at which the several chapters and sections begin or end. Among errors of fact we notice (at p. 2) that the Hylobates is said to "stand far nearer to man than the other three highest apes;" at p. 20, that the Dutch are not acclimatised in the East; at p. 117, that the Malays always use the word *stone* in counting as "three *stones* chickens," the fact being that *stone* or *seed* is used for inanimate objects only, *tail* for living things, as "three *tails* chickens," &c.; at p. 204 "the Sunda, Banda, and Molucca Islands," are said to have formerly bound together Asia and Australia, but by subsidence have become "groups of islands in a shallow sea;" and again, at p. 205, the Gulf of Mexico and Caribbean Seas are both said to be *shallow*, and to show a former connection with the continent; p. 343, Papuans are said to smelt iron ore; this I think is quite erroneous, though on the coast they work iron brought them by the Malays and traders; at p. 344 the Papuans are said to cultivate *trees*, and to possess "only seedless varieties of the bread fruit," the exact contrary being the fact; at p. 413 guinea-fowls are put as natives of the New World, and "prairie dogs" as domestic animals; at p. 414 the "ounce" is put for the "jaguar;" at p. 423 "(*Crax*) guinea-fowls," are said to be bred for food. Of oversights or mistranslations we notice at p. 85, lines 10-11, figures which are quite unintelligible; p. 366, line 1, "allows too long" is a bad translation; p. 368, line 2, "outbreak of the pestilence" refers to the nutmeg disease.—A. R. W.

OUR BOOK SHELF

Ostriches and Ostrich Farming. By Messrs. De Mosenthal and Harting. 8vo. pp. i.-xxii., 1-246. (London: Trübner and Co., 1876.)

IF ornithologists have regretted the apparent retirement of Mr. Harting for the last few years from the field of scientific research, they will find on consulting the present volume that his devotion during that time to popular science has not impaired his powers, but has perhaps tended to increase the gift which he always possessed in a high degree, of being able to present to his readers the details of science in interesting and attractive language. We have been induced to make the above remarks, inasmuch as no one would suspect that under the above title is comprised a very complete monograph of the *Struthionidæ* from the pen of Mr. Harting, but such is really the case, for, out of a volume of some 250 pages, three-fourths are occupied with the history of the ostrich and its kindred. This portion of the work is entirely written by Mr. Harting, and, like everything he undertakes, is executed with thorough conscientiousness. The true Ostriches (*Struthio*), the Rheas (*Rhea*), the Emu (*Dromæus*), the Cassowaries (*Casuarius*), and the *Apteryges* are all passed in review, and a complete monographic account given of each; the history of the ostrich and its distribution in times past and present being very exhaustively compiled. We can heartily commend the illustrations in this volume, very good full-page drawings of the principal Struthious forms, having been designed by Mr. T. W. Wood, while the Zoological Society has allowed the woodcuts which have illustrated Dr. Sclater's various memoirs on the *Struthionidæ* to be utilised, so that a very complete monograph of these birds is the result.

Mr. De Mosenthal's portion of the work is confined to the practical "Ostrich Farming," and seems to be extremely well worked out, giving a history of the development of the pursuit from its first commencement. The author's personal experience has been confined to South Africa, where ostrich-farming has acquired its chief importance, but the statistics of the exportation of feathers from the other parts of Africa show that at present the greatest trade is done through Egypt, the annual value of the exports from this country being 250,000*l.* The Cape comes next with exports to the value of 20,000*l.* less, while from Barbary the value is 100,000*l.* annually, from Mogador 20,000*l.*, and Senegal 3,000*l.* The whole of the process of the artificial incubation of the eggs is described with minuteness, and altogether the contribution is most entertaining and instructive. The volume concludes with an appendix giving consular and other reports, all of which supply important statistics and interesting historical matter bearing on the subject.

Die Darwin'sche Theorien und ihre Stellung zur Philosophie, Religion und Moral. Von Rudolf Schmid, Stadtpfarrer in Friedrichshafen. (Stuttgart, 1876.)

A GLANCE through this book will not satisfy the reader that the great problems of modern thought are to be settled even by the well-meant essays of a well-read pastor. It is one of the "reconciliations" of science and religion, so common in England, but less so in Germany, where people are in general unwilling to check views on scientific questions by their relation to theology. The author impresses on his readers that the theory of universal law is compatible with the Christian doctrine of miracles, and that the Darwinian hypothesis of development may really receive strong support from the doctrine of human development in a future state. But his arguments prove little or nothing one way or the other. Next, turning to the Creation, we find him placidly remarking that the order of its stages is given differently in Genesis and again in Job, his inference being that neither order is "binding on us." The six days, in his opinion, are not natural days, nor are they geological periods, for neither would this fit with the geological evidence; he therefore concludes that they are "divine days," whatever that may mean. Such reading ought to suggest to religious minds the serious question whether disbelief can do so much harm as the habit of perverting and mystifying belief. We may hope that when theologians have become more familiar with the theory of evolution as manifested in the development of religious ideas themselves, their reconciliation of man's religious tendencies with his scientific knowledge may be placed on a higher basis than in such attempts as this, of which the weakness is only made more conspicuous by its good intention.

E. B. T.

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.*]

Sea Fisheries

As an enthusiastic amateur sea-fisher some twenty years ago on the Canadian coast of what the Americans call the "herring-pond," perhaps you will allow me to make a remark or two on Mr. Holdsworth's letter in NATURE, vol. xv., p. 135. Long absence from that happy hunting-ground has not beclouded my memory, for I often in imagination fight again my battles with halibut and skate, lobster and cod, and the words "sea fisheries" have not altogether lost their charm; but I confess I wholly overlooked Prof. Newton's interesting letter on the subject, and turned back the file of NATURE and read the letter in connection with Mr. Holdsworth's. The theory of the former appears to me to be the correct one; the Atlantic sea fishery is being gradually played out.

I doubt whether we can anywhere along its extensive coast now meet with "shoals" of mackerel or "schools" of herring several miles in breadth, forming a mass of so compact a nature that small vessels had almost as much difficulty in getting through them as Sir George Nares had in getting through the so-called palæocrystic ice, or hear of single hauls of 1,000 barrels! And yet such was possible not twenty-five years ago.

The great mischief is done, certainly in America, by trawling. This must be evident if one will but consider the *modus operandi*, by which the female fish are captured just before they have deposited their spawn, a few thousand fish so taken representing the non-existence of many millions. The subject has received the most serious attention of the Canadian Government, and has by it been brought under the notice of the United States and French authorities.

Mr. Holdsworth appears very much amused to find that Prof. Newton has discovered a use for dogfish over and above his own instance, in which it served as "salmon" for the Preston weavers. But as we have never heard that the fishermen of Morecambe Bay were charged with feloniously administering a poison to the said weavers, we must conclude that dogfish is a wholesome, but perhaps not a toothsome, article of food.

Mr. Holdsworth says that with this exception he has never heard of a case in which "the hated dogfish was not knocked on the head and thrown overboard whenever there was a chance of so doing." I can tell him one. Along the American coast the dogfish is certainly knocked on the head, but the fishermen there know its value too well to throw it overboard; they keep it, and it yields an oil; and of the many millions of gallons of "fish-oil" in the returns, "dog-oil" forms no inconsiderable portion.

There can be no doubt that the American fishermen, if they had had their say in creation, would have vetoed dogfish; but as they had not, they came to the conclusion that there was doubtless some wise purpose even in that creature: a thorn in the flesh to try their tempers and their nets, but one which they forced to bear fruit.

If it is true that the nets of the Donegal fishermen in 1875 were constantly full of dogfish, and they driven to their wits' end, I hope some Donegal reader of NATURE will kindly read them this letter; it may be the means of opening up a glorious future for Ireland. Perhaps too some Lancashire reader will give the Morecambe Bay fishermen a hint, in case the Blackburn weaver should hereafter have a surfeit of "salmon," and those practical jokers' occupation be gone.

May I in conclusion be allowed to dissent from Prof. Baird's plural of "alewife?" He calls it "alewives." There is nothing of the meaning of *wife* in the word. This species of herring, which usually goes by the name of *gaspereau*, is also called *alewife*, which is a corruption of the Indian word for a fish, *aloof*. The plural, I think, should be "alewifes." B. G. JENKINS

Dulwich, December 18

Sense of Hearing in Birds and Insects

I do not know whether ornithologists are acquainted with the peculiar manner in which curlews frequently obtain their food on sandy flats which have been left bare by the tide. The birds force their long bills into the wet sand as far as the nostrils, and then again withdraw it, leaving a small hole, which, when probed, is found to be only just large enough to have taken in the bill. The animal, therefore, can only have made a single prolonged push without adding any lateral or exploring movements of the bill, as birds which feed in mud may be observed to do. Now it cannot be supposed that curlews adopt this mode of feeding without obtaining from it some degree of profit. Neither can it be supposed that they make their thrusts into the sand at random; for, their bills being so pointed and slender, the birds would usually require to make a vast number of ineffectual thrusts before they happened to hit upon a worm or other edible object. The question therefore is, How do the birds know the precise spots where their victims lie buried in the sand? That this knowledge is not derived by sight I am quite sure, for I have repeatedly observed innumerable curlew marks of the kind described occurring on tracts of sand which, in virtue of their high level, presented a perfectly smooth and uniform surface. I can therefore only suppose that the birds are guided in their probings by their sense of hearing. Doubtless it is difficult to believe that this sense is so delicate and precise as to enable the curlew to perceive so exceedingly slight a sound as that which must be caused by the movement, say, of a small worm at a distance of ten or twelve inches from the surface of the sand, and at the same time to localise the exact spot beneath the surface from which so slight a sound proceeds. I cannot see, however, that any other explanation is open, and perhaps the one now offered may not seem so incredible if we remember the case of the thrush. No one, I think, can observe this bird feeding and doubt that it finds its worms and grubs almost exclusively by the sense of hearing. And if the distance which it runs between successive pauses for listening represents—as we cannot but suppose it must—the diameter of the circle within which this bird is able to hear the movements of a worm, I think that the hypothesis I have just advanced with regard to the curlew ceases to be improbable.

It seems worth while to add a few words with respect to the sense of hearing in insects. So far as I am aware, the occurrence of such a sense in this class has never been actually proved, although on *à priori* grounds there can scarcely be any doubt concerning the fact of some insects being able to hear; seeing that in so many species stridulation and other sounds are made during the season of courtship. In the case of moths, however, I believe that sounds are never emitted—except, of course, the death's-head. It therefore becomes interesting to observe that an auditory sense is certainly present in these insects. Several kinds of moth have the habit of gently, though very rapidly, vibrating their wings, while they themselves are at rest on a flower or other surface. If, while this vibrating movement of the wings is going on, the observer makes a sudden shrill note with a violin or fife, &c., the vibrating movement immediately ceases, and sometimes the whole body of the insect gives a sudden start. These marked indications of hearing I found invariably to follow a note with a high pitch, but not a note with a low one. GEORGE J. ROMANES

"Towering" of Birds

I HAVE read Mr. Romanes' communication on the "towering" of grouse and partridges with much interest. As he requests further information, may I be permitted to contribute the following:—I once observed a pheasant which, after being shot, flew apparently untouched for about one hundred yards, then towered ten or fifteen yards, and fell dead. As a rule birds that have towered are picked up dead, as Mr. Romanes states; but such is not invariably the case. A correspondence took place in the *Field* some weeks since in answer to the question: "Do towered birds *ever* rise again," and several replies were elicited in the affirmative. The conclusion warranted by that correspondence seemed to be that towering arises from at least two distinct kinds of injury. In the first, the common form, the bird is struck in the *back*, and is always found precisely where marked down. It seems to me that in this kind of towering the *perpendicular* flight may be attributed to a cause perhaps other than, or at all events additional to, *pulmonary* hæmorrhage. I consider that hæmorrhage is a necessary factor, and Mr. Romanes makes out a very strong case in favour of its being into the lungs. That the movements of the wings are convulsive, and the explanation of the towering, I am not inclined to dispute, but I think it has yet to be proved that the convulsive flapping of wings (the directing power of the brain being in abeyance) always produces perpendicular and never merely erratic flight. Every towering bird acts in a precisely similar way. Are we to take it for granted that in asphyxia it is only certain sets of muscles, and these always in the same and to an equal degree, that are spasmodically affected? I have noticed that a towering bird very often has his legs hanging straight down (I do not allude to those cases where they are palpably mutilated), and it strikes me as being likely that paralysis of the legs and lower part of the back may have something to do with the flight being upward. A man who has paraplegia always complains that he cannot move his legs because they are *so heavy*. This sensation would doubtless be felt by a bird paralysed behind, and this, in addition to the loss of its steering apparatus and the co-operating contractions of the posterior muscles, would produce a loss of balance with much the same effect as though the after parts had really become disproportionately heavy. I have no desire to be dogmatic, but merely offer this as a possible assisting factor in some cases.

In towering from the second kind of injury, the bird can and sometimes does fly away from the place where it fell, and, after retrieving, concordant testimony shows lesion in the neighbourhood of the *eyes*, whence blindness has been assumed to be the cause. The fact that this very rarely occurs, perfectly agrees with the objection that the smallness of the head is adverse to the theory of cerebral injury being the invariable cause. It has further been noticed that these birds seldom move until they are touched. Whether, attention having been drawn to this subject, future observers will detect a difference in the towering of birds that may, and those that cannot, rise again, is hard to say, but I hope, in the interests of science, all pertinent observations will be communicated and admitted into the columns of NATURE.

Faringdon, Berks, December 11 J. HOPKINS WALTERS

The Tasmanians

I SEE it stated in NATURE, vol. xiv. p. 242 (which has just reached us), that M. Castelnau, French Consul at Sydney, states in a letter "to the Geographical Society of Paris, read at its last sitting, that the only four Tasmanians living were presented at the last levée held by the Governor of Tasmania."

I cannot imagine how M. Castelnau can have allowed himself to propagate such an error. It is quite true that four Tasmanian aborigines were presented at a governor's levée, but the presentation occurred just ten years ago, and all the four have long since been gathered to their fathers.

In reference to the last paragraph in your note, I regret to say that we really "have seen the last of them." The sole survivor of this singular race, a female, by name Trucanini, died a few months ago at the age of seventy or thereabouts. The "penultimate" aborigine was King Billy, who preceded Trucanini to the grave three years ago. W. W. SPICEY

Hobart Town, October 21

Algoid Swarm-spores

IN a note on algoid swarm spores, published in NATURE, vol. xv. p. 15, reference is made to the new investigations of M. Sachy, who considers the motion and accumulation of spore as due to currents produced by differences of temperature in the water, and not at all to the action of the light causing the living swarm-spores to move. I do not know the experiments by which this result has been reached; but the following seems to me a confirmation of the new theory.

At a distance of about 5 feet from the window of my room is placed a cylindrical glass vessel of 1 foot in diameter, and containing only some sphagna and microscopical crustacea. This aquarium has been kept unshaken for four years.

Now a great quantity of green alga is collected on the side opposite to the window, while the side turned towards the light is covered with a considerable number of little particles of an amorphous matter, arranged in pretty regular cloudy forms, containing nothing but *débris* of plants or animals, and a few desmidiæ.

These particles, which cannot be considered as *living matter*, arise from the light mud which covers the sand at the bottom of the aquarium. The right and left sides of the vessel remain quite clean.

I should much like to know if any of your readers have observed similar facts. E. RODIER

29, rue Saubat, Bordeaux, December 17

Meteor

I SAW the meteor spoken of by your correspondent (*ante*, p. 170) at Blackwater on Wednesday the 13th inst. at 4.45 P.M. as I was passing down St. James's Square. It was apparently of somewhat greater magnitude than the planet Jupiter, and passed from north to south, till it disappeared behind the houses.

Your correspondent will find two notices of the same meteor in the *Times* of the 15th inst. P. L. SCLATER

ON THE RELATION BETWEEN FLOWERS AND INSECTS[1]

THE habit possessed by our honey-bee of feeding itself from flowers, and its corresponding faculty of deciding amongst different species and divining the situation of the honey, is, in the first instance, derived from the common parents of all the Hymenoptera. It probably even comes from such remote ancestors as the leaf-cutting wasp, from them passes to the gall-flies, the ichneumons, and the hunting-wasps, from which latter it goes to the allied species of ants and bees. We may see all these families of Hymenoptera feeding on the honey and pollen of flowers, and manifesting a certain, if not always very obvious, intelligence in choosing the flower to be visited.

The various families of wasps differ amongst each other as to their ingenuity in finding the honey, but it is in the bees that we first arrive at the more complex use of the food, *i.e.*, not merely for the insect itself, but also for its young, combined with such intelligence in its discovery, as proves that the most highly developed form of insect is the one which profits by the honey lying most concealed. The following observations may throw some light on the foregoing statements:—

I come to the conclusion that the Hymenoptera enumerated have a certain degree of intelligence, at least with regard to honey that is in sight, from never having seen leaf-cutting wasps or ichneumons, and still less hunting-wasps or bees, seek honey so long in flowers where it does not exist as is the case with some species of beetles, which feed frequently or exclusively on the nourishment derived from flowers.

However, even very highly-organised insects are at times misled, and Dr. Müller cites one case in which *Melampyrum arvense* was surrounded by a crowd of ichneumons, bees, &c., seeking the honey in vain, the only one which succeeded in obtaining it being *Bombus hortorum*, which has the longest proboscis of all our humble-bees.

It cannot be said either of the leaf-cutting wasps or of the gall-flies that they attain a high degree of intelligence in finding concealed honey, and to these we may add the ichneumons which are frequently found on plants with the honey easily seen (Umbelliferæ, Listera, Ruta, &c.), much more rarely on those where it is partially concealed (Cruciferæ, Spiræa, Salix), and quite as an exception on those in which it is completely hidden (Gypsophila, Malva, Mentha.)

When once a family of Hymenoptera has attained to the point of intelligence of providing food for its young and placing it along with the eggs, we see it develop greater dexterity in its search for honey. In comparing, for instance, the statistics of the visits of the leaf-cutting wasp and the hunting-wasp, we find that even the most developed leaf-cutting wasp only attempts to rob those flowers whose simple form renders the honey easy of access. Even those of Bryonia and Reseda seem unattainable by them. On the contrary, we see the hunting-wasps attack not only these, but also flowers specially adapted to the movements of the fossorial Hymenoptera, for example, Echium, the Labiates, and the Papilionaceæ, and also the pendent bells of Symphoricarpus, which only allow ingress to the honey from below. It must be deduced from the above statements that flowers and the insects which visit them are adapted to each other, and have gone through corresponding degrees of development at each period of the world's history. For example, if my view of the origin of the Hymenoptera is correct, there has been a time when species with an ovipositor were the only Hymenoptera; and when only regular, open, turned-up flowers of as low a form as Salix existed, while Reseda, Echium, the Labiates, the Papilionaceæ, &c., &c., have been developed at a later period after the species of Hymenoptera had developed to the point of preparing a place for their young.

We may therefore see how through the transition of hunting-wasps to the habits of bees, and further within the bee-like family, dexterity in acquiring the food has increased. The species perhaps most nearly allied to the ancestors of the bee—Prosopis—is, as to its organisation,

[1] Abstract of an article in the *Bienen Zeitung* by Dr. H. Müller.

on the same footing with the hunting-wasp, and, as to the length of its tongue, is even but little more highly developed. The assiduity with which it visits the flowers, its practice in seeking those where the honey is concealed, its well-established habit of feeding its young entirely on food derived from flowers, all place it above the average of its ancestral species. Even, however, among these ancestral species—the hunting-wasps—are certain kinds whose love for flowers has far surpassed their power of rearing a family, and these, favoured by their large size and length of tongue, have attained still greater dexterity in getting at concealed honey than Prosopis.

Out of eighty-five visits to flowers by different species, there were of Prosopis :—

On flowers with the honey apparent, 19 = 22·4 per cent.

On flowers with the honey somewhat concealed, but still fairly apparent, 19 = 22·4 per cent.

On flowers with the honey concealed, but easily reached through the formation of the mouth, 28 = 32·9 per cent.

On flowers with the honey entirely concealed, which are specially adapted to the burrowing Hymenoptera, 8 = 9·4 per cent.

On flowers without honey, or at least only having pollen as far as Prosopis is concerned, 11 = 12·9 per cent.

Some of the hunting-wasps appear to show even more intelligence than Prosopis in the search for honey, and this will appear still more forcibly if we leave out the flowers which only yield pollen, when the total result is for the wasps 35·3 per cent., for the Prosopis 48·6 per cent.

The following table will show at a glance how far the hunting-wasps are above the leaf-cutting wasps, how far the former are surpassed by Prosopis, and how far the hunting-wasps, most eager for flowers, again surpass the Prosopis.

	a	*b*	*a*+*b*	*c*	*d*	*c*+*d*	*e*	*f*
Leaf-cutting wasps	69·1	16·3	85·4	13·0	0	13·0	0	1·6
Majority of wasps indifferent to flowers	55·3	17·8	93·1	24·0	1·0	25·0	1·9	—
Principal hunting wasps ...	44·7	19·0	63·7	30·0	4·8	34·8	1·5	—
Prosopis	22·4	22·4	44·8	32·9	9·4	42·3	12·9	—
The wasps most eager for flowers	10·8	23·1	33·9	49·2	16·9	66·1	—	—

If we look down the perpendicular lines of this table from top to bottom we shall see the frequency of the visits to the flowers with the honey apparent (*a*) even if we add the visits to the flowers with the partially seen honey ($a + b$) steadily decline, though the visits to the flowers with partially concealed honey (*b*) steadily increase. In still more rapid ratio the frequency of the visits to the honey entirely concealed, increases ($c + d$), both in the case of those flowers whose honey is easily attainable through the simple form of the corolla (*c*), and those specially adapted to the burrowing Hymenoptera (*d*).

With regard to the flowers yielding only pollen (*e*), the Prosopis shows a remarkable advance on the other Hymenoptera, probably caused by the great need the young fed from flowers have of the pollen.

The results of a careful series of observations, prolonged over a course of five summers, brings us to the following conclusions :—

1. The Tenthredos stand, as regards the rearing of their young and in their general intelligence, as well as in their capacity of finding and acquiring concealed honey, the lowest of all the Hymenoptera we have considered. They visit flowers with the honey altogether apparent much more frequently than those with the honey wholly or partially concealed, and the latter only in the case of those with a low and simple organisation.

2. The hunting-wasps, which, as has been previously shown, stand decidedly above the Tenthredos, show also a decidedly higher power of finding honey. Even when the most intelligent and flower-loving families are excluded, a high percentage among the hunting-wasps is found visiting flowers with concealed honey, and a lower visiting flowers where the honey is apparent; they even seek some flowers whose formation shows them to be adapted to the fossorial Hymenoptera. All this progress appears still more remarkable when we compare the whole group of Tenthredos with the whole group of hunting-wasps.

3. Prosopis, the least highly-developed bee, and one which does not stand higher than the hunting-wasps, either in general capacity or in care for its young, is yet compelled, through the greater requirements of the latter and their need of pollen, to visit both flowers with concealed honey and flowers which only produce pollen.

4. Certain species of hunting-wasps stand above the Prosopis, both in size and in the length of the proboscis; these, however, only seek food from flowers for themselves, and not for their young.

We may now hope through the following steps to obtain some idea how the honey-bee has acquired its peculiar capacity for finding concealed honey.

All our European bees, except Prosopis and the parasitic species, have their hairy covering specially adapted to collect pollen. This apparatus forms a characteristic by which they are divided into two families, namely, those which collect the pollen with a brush on the lower side of the body, and those which collect it with the pencil-like hairs of the hind legs.

In the former family there are various degrees of development in the pollen-collecting apparatus, difficult alike to describe or distinguish; and as the relationship of these species to the honey-bee is but remote, we may content ourselves with glancing at this group as a whole.

The second group, on the contrary, offers a steady series of degrees of development which we may now compare with each other and with Prosopis.

Passing over the first step—sphecodes, we come to Andrena and Halictus, whose size and length of proboscis places them distinctly above Prosopis. Their visits to flowers rise from 7·4 per cent. in the case of flowers with the honey altogether apparent, to 51·6 per cent. to the flowers of complex form and with the honey entirely concealed.

The genera Eucera, Anthophora, and Sarapoda reach the highest point of intelligence as regards flowers of all our native bees, the length of their proboscis varying from ten to 21 mm., one of the humble-bees (*Bombus hortorum*) being the only one that can in this respect compare with them.

The three above-mentioned genera, out of fifty-six visits to flowers, paid none to those with the honey apparent, but 91·1 per cent. to those with either concealed honey of complex form, or with both characteristics united.

There is no further example of increased development of the proboscis in this family, but they have attained a further step in the transformation of the thigh brushes into pollen-baskets, and above all in the establishing the community of life and of labour which distinguishes the humble hive bees. From observations made on the latter, however, it appears that increased development shows a certain return to the flowers containing more visible honey, the honey bee, out of 520 visits observed, going to such flowers at the rate of 0·8 per cent., the hive-bee, 194 visits being observed, at the rate of 3·1 per cent.

The following table is fuller than the previous one :—

	a	*b*	*a*+*b*	*c*	*d*	*c*+*d*	*e*	*f*	*g*
Tenthredos	69·1	16·3	85·4	13·0	0	13·0	0	—	1·6
Hunting-wasps	44·7	19·0	63·7	30·0	4·8	34·8	1·5	—	—
Solitary bees ... ... Prosopis	22·6	22·6	45·2	33·3	7·1	40·4	11·9	2·4	0
Andrena and Halictus	7·4	26·5	33·9	40·2	11·4	51·6	9·6	2·0	2·9
Cilissa ... ... Panurgus, Dasypoda Rhophites ... ... Halictoides	0	9·6	9·6	65·4	17·3	82·7	5·8	0	1·9
Eucera Anthophora ... Saropoda	0	5·4	5·4	5·4	85·7	91·1	3·5	0	—
Osmia Chalciodoma... Diphysis, Megachile	0·5	10·1	10·6	27·4	43·7	71·1	13·0	3·4	1·9
Social bees	0·8	8·3	9·1	26·3	55·6	81·9	4·0	4·8	0·2
Bombus apis	3·1	15·5	18·6	25·3	34·5	59·8	13·4	7·2	1·0

Explanation of Table—

a, flowers with honey apparent; *b*, partially apparent; *c*, honey concealed but easily reached; *d*, concealed but adapted to a short proboscis; *e*, flowers only possessing pollen; *f*, useless attempts to get honey by making a hole, as on Dielytra; *g*, flowers without honey.

The visits to the flowers with partially apparent honey $a + b$ steadily diminishes from the Tenthredos to Andrena and Halictus, but so that the diminution of the visits entirely refers to the flowers with the honey apparent, while, on the contrary, the flowers with honey partially hidden are visited with still greater frequency.

In the case of some solitary bees, the disinclination to flowers with the honey apparent has reached to their total abandonment.

The transition to social life brings the development in the second group, of which we have been treating, to an end, as, in proportion as the number of individuals in a community increases, the necessity for food forces them to seek honey where they can, and it is indeed touching to see the unwearied diligence with which the hive-bee will collect almost imperceptible drops of honey from even the smallest flowers.

The perfection which the family of bees, viewed as a whole, has attained, beginning with Prosopis, and rising to the most perfect of the solitary bees belonging to the group which collect pollen on their hind legs, consist:—

1. In the increasing development of the pollen-bearing apparatus.
2. In the prolongation of the lower part of the mouth.
3. In the increasing size of the individuals.

The first is seen best in the humble and hive-bees; the third is very marked in the humble-bee, while the length of the proboscis reaches its furthest point in Anthophora. The hive-bee has a more perfect pollen apparatus than the humble-bee, but is inferior to the latter in size and length of proboscis, and only succeeds in obtaining more honey through its more populous communities.

It is well known that as a rule every hive-bee occupied in seeking food from flowers specially devotes itself to a particular species, passing by others, however rich in pollen or honey. The advantages of this arrangement are obvious, much fewer visits being made in vain to flowers already plundered, and much greater dexterity being attained in the case of flowers with complex forms.

Two questions remain to be decided—

1. Does each individual bee collect pollen and honey from a single plant only (to which it has become adapted by instinct, *i.e.*, by inherited custom)?

2. Does the hive-bee possess a greater degree of intelligence in deciding among the different species of plants than the humble-bee and other lower forms?

The first question must be met with a decided negative; the second, as far as observation has yet gone, cannot be answered with certainty. It would scarcely be of advantage to the bee-community, whose object is the exploitation of as many flowers as possible, if its instincts as to special tribes were hereditary.

It is, on the contrary, to be observed in the hive-bee that each bee makes various essays before deciding on any special tribe of flowers. For example, we have seen a hive-bee in vain attempt to obtain the honey of *Iris pseudacorus*, and then fly to *Ranunculus acris*, which it sucked at for some time. Another more than once bored through the spur of *Orchis latifolia*, loading its head with two little clubs of pollen, and then flying to the flowers of *Lychnis floscuculi*.

A third, wandering over a field full of weeds, visited one after another *Veronica hederæfolia*, *Lithospermum arvense*, *Sisymbrium thalictrum*, and *Viola tricolor*.

These and similar facts show that there can be no question of inherited preferences for certain plants in individual bees, and that the fact of each bee being devoted to certain plants is only to be ascribed to the subordination of the interests of the individual to that of the state. The humble-bee approaches the hive-bee in the peculiarity of keeping to certain species, as well as in the number and keeping of its community. However, though chiefly confining itself to the plants accessible to it alone, as for example, *Lamium album*, &c., there are fairly numerous cases in which the humble-bee goes to other plants, and its baskets are often found full of very varied kinds of pollen.

Even in solitary bees, the special preference for special kinds of flowers is a frequent habit. For example, *Andrena hattorfiana* is found on *Scabiosa arvensis*, *Cilissa melanura* on *Lythrum salicaria*, &c.; but this preference evinced by some solitary bees for a single species of flower sufficing all their needs is radically different from the practised and exhaustive pillage of all flowers by a bee community, in which special individuals are told off to gain the produce, however small, of special families of plants. At first I believed I could answer the other question propounded above, *i.e.*, whether the hive-bee promises a higher degree of intelligence in distinguishing different genera of plants than the humming-bee and other lower forms, in the affirmative, on the ground of the following observations:—In a field grown over with weeds I saw one of our more intelligent humble-bees, *Bombus agrorum*, visit without distinction the little whitish flowers of *Viola tricolor* var. *arvensis*, and those of *Lithospermum arvense*, the same size and colour, but evidently differing in form, while avoiding all other plants. I had, indeed, seen the hive-bee mistake the flowers of *Ranunculus arvensis* for those of *R. bulbosus*, those of *Trifolium repens* for those of *Trifolium fragiferum* many times, but had then never seen it make so great a mistake as that I have recorded of the humble-bee. From this I concluded that the hive-bee is more practised in distinguishing various species than the humble-bee. As, however, I later saw the hive-bee go from the blue violet to a hyacinth of the same colour, and back again, I felt convinced that the grounds of my conclusion were somewhat defective, and I can only leave the decision of this question to further observations. As far as my own experience is concerned, I am inclined to believe that the hive-bee, as well as all other bees which we see preferring special families of plants, are much more led by colour and size than by any clear apprehension of the form of the flowers.

A. J. G. D.

AN ACCOUNT OF DUPLEX TELEGRAPHY

THE introduction of the duplex system of working not only upon land-lines, but on sub-marine cables, is without doubt the most important advance recently made in electric telegraphy.

Duplex telegraphy may be defined as the art of telegraphing in opposite directions simultaneously along one line wire.

It is claimed by M. Zantedeschi in papers read before the Academy of Sciences, Paris, in 1855, that as early as 1829 he had suggested and demonstrated the possibility of working "duplex;" but until the year 1853 there do not appear to have been any noteworthy attempts made to effect it practically. In that year, Dr. Gintl, a director of Austrian telegraphs, described a system of duplex telegraphy to the Academy of Sciences, Vienna, and practically tested it on the land-lines between Vienna and Prague.

The principle underlying this and all other systems, is that the outgoing currents at a station shall not sensibly affect the receiving instrument there, while, at the same time, the latter is free to be affected by the incoming currents, so to speak, from the other station. That is to say, no signals are made at a station by its own sending currents, unless when these are interfered with by the sending currents of the other station.

Gintl's plan was as shown in Fig. 1. The receiving instrument, R 1, was wound by two separate wires, one long and thin, the other short and thick. The long wire, shown by a full line, was connected at one end to the line L, and the short wire, shown by a dotted line, was connected at one end to a local, or, as it was called, a "compensating" circuit. Both of these wires were connected at their other ends to a signalling key or sending instrument, K, having duplicate points. Two batteries, B and B′, one large and the other small, were also connected to this key in such a manner that on making contact the current from the larger battery B passed through the long coil of the instrument into the line, while at the same instant the current from the smaller battery B′, passed through the short coil and compensating circuit. These two currents were so adjusted as to balance each other in their effects on the indicator of the receiving instrument, and no signal was therefore made by the outgoing or signalling current from the battery B. Such was Gintl's arrangement at both stations, S and S′. Confining our attention to any one of these stations, say S, we see that as long as only S is sending, the receiving instrument at that station is unaffected, but when S′ is also sending at the same time, the currents in the line from S′ must interfere with the currents in the line from S, either aiding or opposing these according to the poles of the battery which are applied, and thereby disturbing the balance of currents on the receiving instrument at S, causing it to make signals. And we see also that these signals are entirely under the control of S′—that when S′ applies his battery to the line, S's instrument will make a signal, and that when S applies his battery to the line, S′'s instrument will make a signal, or that when either put "earth" to the line, that corresponding "spaces" will be recorded. The currents do not cross each other in the line, as was sometime thought, but they interfere with each other in such a way as to disturb the electric balance which independently exists at either end.

One objection, however, to this plan of Gintl's was that the lever of the key during sending interrupted the line circuit when it was between the earth and battery contacts; and another more serious objection lay in maintaining the equivalence of the two currents, as the smaller battery working through the shorter circuit lost power more rapidly than the signalling battery.

Gintl, however, in the following year (1854) obtained better success with a Bain's chemical printing instrument. Here he made the two currents oppose each other upon the chemically prepared paper and no stain was produced by the outgoing current. The sending current from the other station neutralised to a certain extent the outgoing current and the *local* current then overmastering it stained the paper and produced signals.

Early in 1854, while Gintl was still engaged in experimenting with the Bain's instrument, a great improvement was effected on his plan by Herr Carl Frischen, a telegraph engineer of Hanover. Frischen dispensed with the second battery B′ and split up the signalling current itself, causing one part to pass round one coil of the receiving instrument into the line and the other part to pass round the other coil of the instrument into the local or compensating circuit. Instead of making the two wires of the instrument dissimilar, like Gintl, he made them both alike, so that the instrument was practically wound by equal wires in opposite directions and thereby rendered *differential*. He inserted into the compensating circuit a rheostat or set of resistance coils whose resistance could be adjusted to equal the electric resistance of the line. His arrangement at either station is shown in Fig. 2. Here R I is the differentially wound receiving instrument, B is the battery, and R is the rheostat or artificial line as it was called, because of its being intended to imitate the actual line. K and E are as before, the sending key and earth plates respectively. In the act of sending a message, on making contact between the key and battery at *a* the current flowing into the apparatus divides itself at the point *b*, and part passes through the right coil of the instrument into the line, while part passes through the left coil into the local circuit. But the resistance of the local circuit being made equal to that of the line and the two coils of the instrument being electrically equal one *half* of the current will flow through one coil and the other *half* through the other coil. The coils being oppositely wound these currents will neutralise each other in their effect on the indicator or needle of the instrument and no signal will be produced as long as they flow freely. We have seen, however, that the sending at the remote station may either oppose or assist that part of the current entering the line. Thus the balance is disturbed and signals will be made on the receiving instrument of one *kind* or another according as the line current or the local current overbalance each other.

In sending by this method of Frischen's the line circuit is never completely interrupted, but it will be observed that according to the position of the key the line is either applied "to earth" direct or through the battery, or through the resistance R, and this leads to a troublesome variation in the signals.

Frischen's method was re-invented a few months subsequently by Messrs. Siemens and Halske of Berlin, who patented it in England, where, however, they were forestalled by a week by Mr. Stirling Newall, of Gateshead, whose patent bears date October 30, 1854. Newall describes substantially the method of Frischen-Siemens, and in 1855-56, successful experiments were made under his patent on the Manchester and Altringham line; but when he came to make trials upon the longer line between Birmingham and London, the *static* charge and discharge of the line was found to make false signals. Condensers or accumulators of electricity were applied to correct this disturbance with promising results, but the expense of constructing large condensers was objected to and their use was prematurely abandoned.

At this time there was a great deal of activity in the direction of duplex working displayed both at home and abroad. Besides the names mentioned, Messrs. W. H. Preece, Highton, De Sauty, and others in this country, Edlund, Bosscha, Kramer, in Germany, and Farmer, in America, were all more or less engaged in the work. In 1856 a good many lines were worked on the duplex principle in Prussia, but the time was not yet ripe for its successful introduction, and it gradually fell into disuse again. Some desultory activity was still shown here and there, however, showing that the idea had not been lost sight of. In 1862 Mr. William Hinckling Burnett patented a method of working two or even three distinct systems of telegraphy by the use of currents of different degrees of force, and in 1863 M. Maron, of Berlin, appears to have first placed the receiving instrument in the diagonal of a Wheatstone's balance. This has been called the Wheatstone bridge method in the recent revival of duplex, and it may be shown as follows, Fig. 3.

Here *r* and *r′* are two of the branch resistances of a Wheatstone's balance; the line and artificial line, or rheostat, R, forming the other two branches. The receiving instrument, R I, is inserted in the "bridge" wire. In sending, the current from the battery B splits at *b*, and part passes by *r* into the actual line, while part passes by *r′* into the artificial line. If *r* be equal to *r′*, and the actual line be equal to the artificial line, the current will divide itself equally, and the potentials, or, as it may be called, the electric levels, at *c* and *d*, will be equal, and there will be no tendency for a current to flow through the cross channel or "bridge wire," and the receiving instrument will not, therefore, be affected. When, however, the line currents are interfered with by the sending currents of the distant station, this balance will be disturbed, currents will flow through the "bridge wire," *c d*, and the receiving instrument will signalise. The resistance, *w*, may with some slight advantage be made equal to the battery resistance. It will be seen that in the balance method, as in the differential method, the principle consists in dividing the signalling current between two circuits whose electrical properties are practically the same, and so placing the indicator between these as to cause them to neutralise each other's effect upon it.

The credit of reviving the lagging interest in duplex telegraphy appears to be due to Mr. Joseph Barker Stearns, of the Western Union Telegraph Company, United States, who, in 1868, experimented on the New York to Boston line, and subsequently achieved considerable practical success on the overland lines of the company with which he was connected. In 1872 Stearns came to England and patented his system, which practically embraced the differential and Wheatstone balance methods, as described, with the addition of a novel sending key and a condenser attached to the rheostat or artificial line.

With the differential method his arrangement is as shown in Fig. 4, where K is the new sending key, and C is the condenser. The advantage of Stearns's key is that the manipulating lever, *a* (which is permanently connected to the battery B), makes contact with the lever *b* (which is permanently connected to the receiving instrument), before *b* is disconnected from the earth wire *w*, so that, in sending, the line may always be "to earth,"

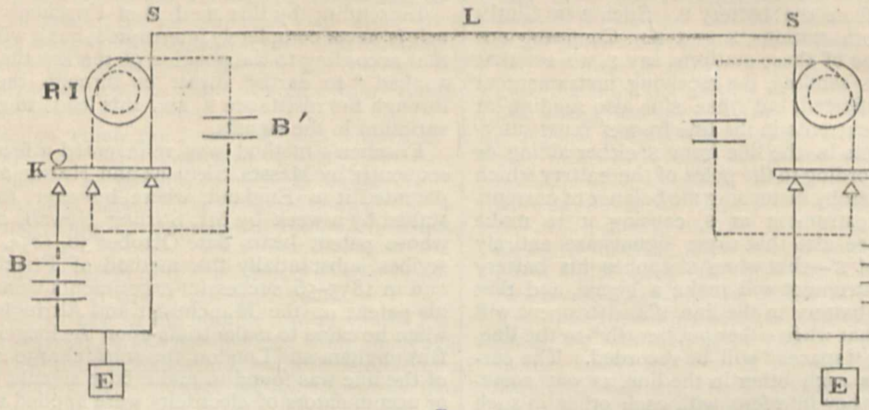

FIG. 1.

either through the battery B, or the earth wire *w*. Thus the evils of both Gintl's and Frischen-Siemens's methods are obviated, inasmuch as the line circuit is not only never interrupted, but the resistance of the earth connection may be kept the same by keeping *w* equal to the resistance of the battery. In order to prevent the wasting of the battery while it is short-circuited for a moment through the key, the resistance, *w′*, may be added to the battery resistance, and *w* then made equal to both.

The condenser was applied, as in the experiments made under Newall's patent, to correct the effects of the static induction of the line upon the instrument. Condensers or accumulators had been in common telegraphic use for producing induction since Bagg's patent in 1858 and

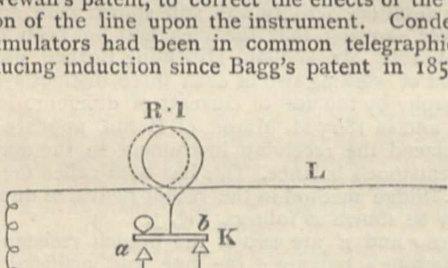

FIG. 2.

Varley's in 1860, and it is obvious that the sudden inductive charge and discharge of the line could be counterfeited by attaching a condenser or other inductive apparatus to the artificial line. This inductive effect is in general only sensible on land-lines upwards of 300 miles long. The induction between the wire and earth is then sufficient to maintain a sensible static charge on the wire, independently of the signalling *currents*, so that on working the sending key, and thus charging the line, the sudden static charge is for a moment added to the signalling current or dynamic charge; and, on the other hand, when the key is made to earth the line, this static charge flows back again out of the line to earth. Thus two sudden jerks or "kicks," as they are called, are produced on the electric balance, and false signals are thereby made. When, however, a condenser or other inductive apparatus is added to the artificial line, so as to give it induction, too, the charge and discharge "kicks" of the artificial line may be made to counterbalance those of the actual line. In short, it is clear that if the electrical properties of the artificial and of the actual line in induction, resistance, and insulation are approximately equal, a duplex balance can be effected between them.

Stearns's key and earth connections were subsequently

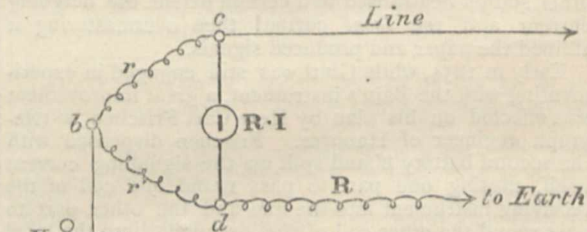

FIG. 3.

in the same year (1872) re-invented by Herr J. F. Naes, of Rotterdam.

In 1873 Mr. George Kift Winter, Telegraph Engineer of the Madras Railway of Arconum, British India, patented in England a method of duplex by opposed batteries, a principle which it appears had been previously applied by Mr. Moses G. Farmer, of New York, in 1858. Winter's method consisted in keeping the batteries at both ends of the line continually applied to it, so that their like poles opposed each other and a standing balance was maintained on the receiving instrument at either station, which could be disturbed by the operator at the other station. This arrangement is shown in Fig. 5.

Here, as will be seen, the batteries are equal and are constantly connected to the line, so that their like poles oppose each other through the differential coils of the receiving instrument and the line. Thus the balance is maintained. But when at station S, for instance, contact is made with earth by the keys K, the battery B will be cut off from the line, and the current from station S′, no longer opposed, will make a signal on the instrument there. Winter's method was tried with some success in India. Up to this time experiments had been for the most part confined to land-lines.

Attention now began to be turned to submarine cables, and Winter proposed the use of secondary batteries, made of plates of one metal (as lead) immersed in a single fluid (as sulphuric acid), in order to provide the large electric induction necessary to the artificial line, or by application in some particular way to the receiving instrument, so as to counterfeit the induction "kicks."

Stearns, also, in the same year, took out further patents principally for the purpose of extending his system to cable work. For example, he patented combinations of condensers and resistance coils to represent an artificial

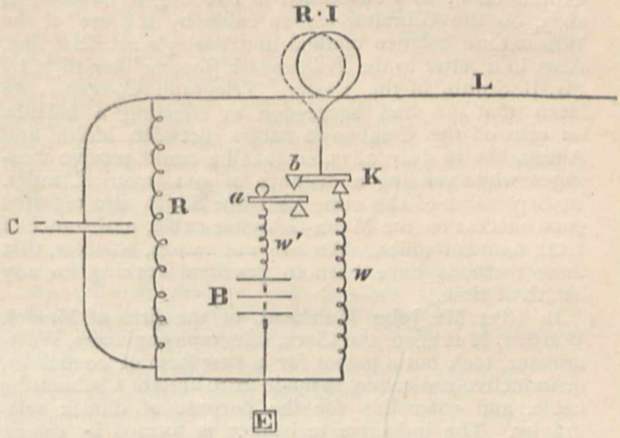

FIG 4.

cable. This, however, had been done as early as 1862

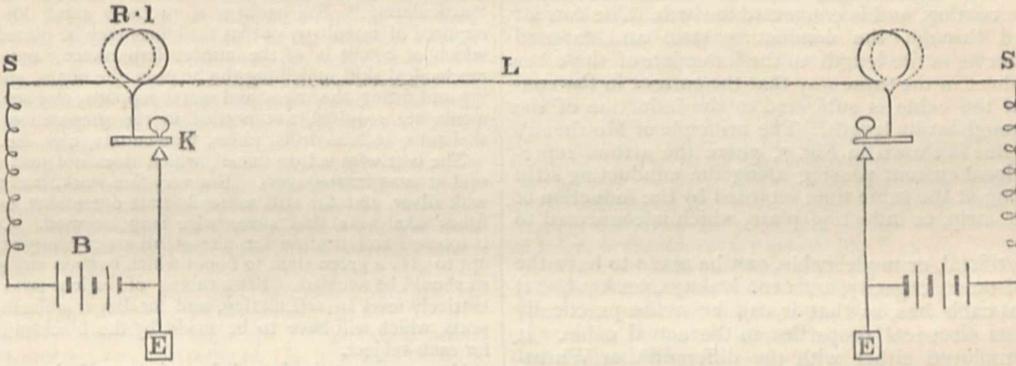

FIG. 5.

by Varley, for the purpose of making an imitation cable for use as a "test" circuit. Varley distributed his condensers along his resistance circuit in the manner shown in Fig. 6, so as to approximate to the uniform distribution of resistance and capacity in a submarine cable; but Stearns confined himself to attaching his condensers all at one point of his rheostat, and modifying their charges in various ways by means of resistance coils. Stearns also proposed various additional arrangements for superimposing "kicks" on the receiving instrument which should counterbalance the inductive "kicks" known to be very violent and difficult to obviate on submarine cables. He also describes a method of constructing his condensers in the form of a submarine cable; and, apparently for the purpose of economising material, he further proposes to employ Gintl's original plan of two

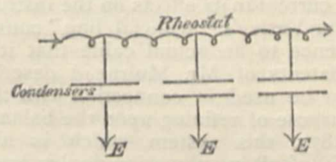

FIG. 6.

batteries; but in this case the stronger battery would be used to charge the artificial line, so that, with less capacity

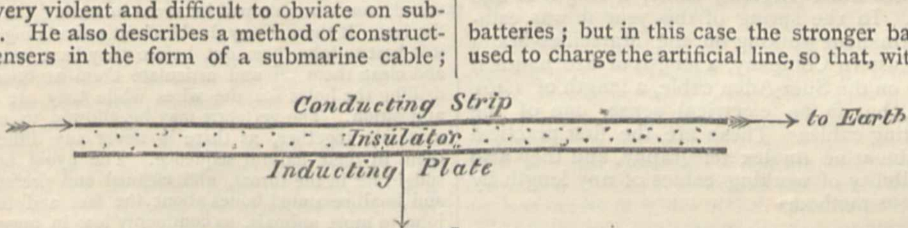

FIG. 7.

than the actual line, its inductive "kick" might be made equivalent to that of the latter. In fact, Stearns and Winter appear, naturally enough, to have striven rather to effect the duplex balance by some *device* or by an artificial line approximately *similar*, instead of aiming at one approximately *equal* to the actual cable.

In 1874 Mr. Louis Schwendler, of Calcutta, patented a system founded on the Wheatstone balance principle, and applicable to submarine cables by the use of resistance coils and condensers, or of a cable itself as an artificial line; but Schwendler's system is only novel for the ratios between the resistances of the balance which it lays down. The best results are said to be given when the resistances r', R and w, Fig. 3, are each one-half of the resistance of the line, and r is made equal to one-sixth of the resistance of the line.

The first successful trials in submarine duplex that we hear of are mentioned in the *Journal of the Society of Telegraph Engineers* for 1874. From this it appears that Messrs. De Sauty and Harwood, both of the Eastern

Telegraph Company (which had been encouraging experiments), had succeeded in effecting a balance, in 1873, on the Gibraltar-Lisbon cable by the use of the Wheatstone balance method and Varley's artificial line. Also, in a letter to the *Telegraphic Journal* for 1874, by Mr. B. Smith, of the Eastern Telegraph Company, we learn that he had succeeded in effecting a balance on one of the Company's cables between Malta and Alexandria in July, 1873, so that he could receive messages while sending a distance of 911 nautical miles. In September of the same year Mr. Smith also reported good success on the Malta-Gibraltar cable, a distance of 1,121 nautical miles. We are not aware, however, that these methods have been in practical working for any length of time.

In 1874 Mr. John Muirhead, of the firm of Messrs. Warden, Muirhead, and Clark, telegraph engineers, Westminster, took out a patent for a new form of condenser, or inductive-resistance, so made as to imitate a submarine cable, and ostensibly for the purpose of duplex telegraphy. The inductive resistance is formed by taking two strips of tinfoil and laying one over the other separated by an insulator. One strip forms the conducting circuit of the artificial line, the other forms the outer, or inductive coating, and is connected to earth. The current is passed through the conducting strip and exposed throughout its entire length to the induction of the other strip or sheet in the same way that the current in the conductor of the cable is subjected to the induction of the earth throughout its length. The principle of Muirhead's artificial line is shown in Fig. 7, where the arrows represent the local current passing along the conducting strip while being at the same time retarded by the induction of the other strip, or inducting plate, which is connected to earth.

This artificial, or model cable, can be made to have the same resistance, capacity, and even leakage, per knot, that the actual cable has, so that it can be made practically equal in its electrical properties to the actual cable. It may be employed either with the differential or Wheatstone balance methods. In either case the local current passes through the conducting strip to earth, experiencing the same resistance and retardation that the signalling current experiences in the cable. It therefore balances the signalling current in its effects on the instrument. Its advantage over Varley's "artificial line" consists in the closer equivalence to an actual cable that it admits of. Subsequent patents of Mr. Muirhead describe various adjustments to be used in connection with the artificial line for the purpose of refining upon the balance.

In July, 1875, this system, which is hitherto the most successful of all in submarine duplex, was first tried on the Marseilles-Bona (Algeria) cable, a length of 448 nautical miles. In the spring of this year it was established for permanent working on the Marseilles-Malta cables of the Eastern Company, a length of 826 nautical miles, and also on the Suez-Aden cable, a length of 1,461 nautical miles, but in an electrical sense, one of the longest of existing cables. These are the first practical successes in submarine duplex telegraphy, and they also prove the feasibility of working cables of any length by this advantageous method.

MUSEUM SPECIMENS FOR TEACHING PURPOSES[1]

II.

ARTICULATED or mounted skeletons are divided into two classes: 1. Natural; 2. Artificial. The two processes may, however, be more or less combined in certain cases.

Natural skeletons are not macerated. The bones are merely cleaned by the hand, assisted by scalpel, scissors, and brush; the subject being placed in water during the intervals of the operation, to get it free from blood, and to soften the parts removed. Everything having been taken away, except the bones and the ligaments which unite them, the skeleton is fixed in the required attitude by external supports, and allowed to dry. This process is commonly adopted with very small mammals, birds, reptiles, and especially fish. It has the advantage of involving less labour and skill in articulation, and of affording a trustworthy record of the number and relations of the bones, especially the vertebræ, about which, in an artificially articulated skeleton, unless prepared by very competent hands, there always may be doubt. On the other hand, such skeletons are far less useful for the study of the details of their structure, they not only cannot be taken to pieces, but the extremities of the bones are actually concealed by the dried ligaments. The latter, moreover, often become brittle with time; and in the case of the smaller specimens, will break unless handled with great care. In such cases it is often advisable to strengthen them with isinglass, or when more support is required, some strands of cotton-wool steeped in melted isinglass or glue make excellent artificial ligaments.

2. Artificial skeletons are those in which the bones have all been separated and completely cleaned by maceration, or one of the processes substituted for it, and then joined together again by wire. The reconstruction of such skeletons is technically called "articulating." To perform it properly some knowledge is required of osteology, so that the bones may be placed correctly, which of course is of the utmost importance, and also some mechanical skill in drilling the holes in the bones, and in adapting and fitting the wires and metal supports, and several instruments are required, not needed in the preparation of natural skeletons, such as drills, pliers, wire-cutters, files, &c.

The best wire is iron-tinned, which does not rust, and is now sold at most ironmongers. For very fine work, iron wire plated with silver, and for still more delicate operations, especially in fishes' skeletons, thin silver wire may be used. Copper wire is too soft and flexible for almost all articulating work, and is apt to give a green stain to bones which contain any grease, and so should be avoided. Brass tubing of various sizes is now extensively used in articulating, and for larger animals, iron supports, which will have to be made by the blacksmith specially for each subject.

However great the knowledge of the articulator, it is always best to take precautions before macerating an animal, that there should be no mistakes in arranging the bones properly, especially in the case of rare and little-known specimens. The skin and the greater part of the soft parts having been removed, and the bones roughly prepared as for a natural skeleton, should then be divided into several parts. The sternum with the costal cartilages should be removed by cutting through the latter at the junction with the ribs, and cleaned in water without macerating, and then allowed to dry in their natural form on a block of wood, cut to the requisite shape and size. If this part goes into the macerating vessel, the cartilages will be lost, and the thorax can then only be restored in an imperfect manner. The limbs should be separated, and if each is macerated in a separate vessel, much trouble will be saved in sorting the small bones of the feet. If there is any doubt about articulating them correctly, it is best to take them out before they have actually separated, and clean them off and articulate them at once, at all events drilling the holes for the wires while they are still in natural apposition. The vertebræ may be allowed to come apart and macerate together, as there is never any difficulty in placing them in their natural sequence. The hyoid bones should be sought for in the throat, and cleaned and preserved separately, and small sesamoid bones about the feet and behind the knee-joint in most animals, so commonly lost in museum specimens, should be looked for and preserved, as well as the rudimentary clavicles of the carnivora and the pelvic bones of the whales and porpoises. When the relations of any bone to another, especially of the sesamoids above spoken of, or the chevron bones under the caudal vertebræ, are likely to be lost in maceration, they should always be observed, and either notes or drawings made of them, or they should be marked with fine holes, made with an Archimedian drill (an essential instrument to the articulator). By making two holes on different bones opposite to one another before the bones are separated, or several holes arranged in patterns, most important records can be preserved, and such small holes do not damage the bones, as they can be filled up afterwards with putty, or frame-makers' composition.

[1] Lecture at the Loan Collection of Scientific Apparatus, South Kensington, July 26, 1876, by Prof. W. H. Flower, F.R.S., Conservator of the Museum of the Royal College of Surgeons of England. Continued from p. 146.

The perfection of a skeleton, an object always to be aimed at, will greatly depend upon the attention paid to all the small precautions just named, and others which will suggest themselves in the course of the process.

In skeletons, as ordinarily articulated, the principal object seems to be to preserve the general appearance of the framework of the animal and to make the whole firm and strong, at the same time showing as little as possible of the supports necessary to hold it together. Every bone, even to the skull and lower jaw, is immovably fixed, and strong wires, or irons, according to its size, are made to traverse the interior of the limb bones, fixed into the stand below, and connected with the main support, which runs along the centre of the bodies of the vertebræ from head to tail.

Such skeletons are little better for the detailed study of osteology than are natural skeletons, and they are inferior, inasmuch as there is no guarantee against errors on the part of the articulator, unless he be of known knowledge and experience.

The improvements in articulating skeletons that I am about to bring before your notice were commenced about twelve years ago, and are mainly due to the ingenuity and skill of the veteran articulator to the Museum of the Royal College of Surgeons, my namesake, Mr. James Flower, who has successfully put into practice various ideas and suggestions which have occurred to me during the time of my conservatorship.

The object aimed at is to mount a skeleton which will give a perfect idea of the form and proportions of the animal and show the bones in their relative position, and at the same time allow every part of each bone to be separately examined. Any portion which is required for examination must be made capable of being removed without disturbing the rest of the skeleton. The skull, the lower jaw, the different vertebræ, the pelvis, the limb bones must be all separable.

Such a skeleton of course cannot be supported on its own limbs, like one of the old kind, as the bones of all the extremities may be removed one by one if necessary, leaving the trunk *in situ*. It will also be somewhat less firm and stable, and must be treated with care, as in fact a delicate and somewhat complicated instrument would be.

The details by which this principle is carried out vary greatly, and must be adapted to every different animal, and may probably be yet still further modified and improved. The illustration sent to the Exhibition is a very fair example. It is a skeleton of a scaly anteater or pangolin (No. 3,812). The two principal mechanical arrangements adopted are simple enough.

They are, first, the use of brass tubes, into which wires of corresponding size are made to slide. This is the best method of connecting two parts, which have to be separated at pleasure. When necessary the tubes and wires may be flattened to prevent them turning. The principal supports are made of tubes fixed into the wooden stand below, and into the upper end of which a short wire fixed in the bone to be supported slides. These tubes can readily be riveted to each other so as to make a branched support when required.

The second mechanical contrivance consists in the use of twisted or plaited wires as a means of movable connection between bones which need not be completely separated, but only bent upon each other as by a hinge. For instance, the principal bones of the limbs are connected by a strand of wires, twisted together like a rope, passing on one side of the joint. Each end is inserted in a hole drilled in the bone, and fixed by means of small wedges of wood or metal. These joints are so stiff as to remain in any position in which they are placed, and yet are perfectly flexible and durable. The vertebræ are connected, by being fixed by wires, on to a plaited band, passed along the inferior surface of their bodies, where nothing of importance is concealed by it. Since this skeleton was mounted it has, however, been found better in many cases to run the plaited wire through the canal, so that it is perfectly out of sight. Though neatness in the mountings of a skeleton is certainly a desideratum, it is better to have any number of external supports to the bones, than either to fix immovably or to mutilate them, as was often done in the old plan, in order to allow of the introduction of the concealed supports.

The ribs, sternum, and sternal ribs are usually mounted in one solid piece, separable from the vertebral column, so that the articular ends of all the ribs can be easily examined. In some cases it is found better to string the vertebræ upon a stiff rod, or several pieces of rods, connected by sliding joints, from which they can be removed in succession. In fact, as before said, the modifications of these processes are numerous, but they can best be appreciated by examining a few mounted specimens, and may be further developed by the suggestions of experience.

In addition to the complete mounted skeleton, museums will be expected to have separated portions of the bony structures exhibited in a manner that the student can study them. The skull especially must be treated in this way. For many years skulls of various animals have been prepared at Paris "*à la Beauchène*," and there are some good examples in the Exhibition contributed by Tramond, ncluding an entire human skeleton (No. 3,913, also 3,915 and 3,918, skulls of man and turtle).[1]

All the bones are separated and fixed by brass bands and wires, at short intervals from each other, so as to allow of their complete form being examined.

The sliding joints formed of brass tubing will be found a great improvement in such specimens, as it allows the complete removal of any portion required for more particular examination. An example will be seen in the skull of a sheep (No. 3,819), contributed by Mr. E. T. Newton, of the Museum of Practical Geology.

A single bone is best mounted by driving a sharpened wire into its lower surface, which wire slides into a tube of corresponding diameter fixed in the wooden stand ; in this way all the series of separate bones in the Museum of the College of Surgeons are mounted. The stands are made of turned wood, circular, polished, and black. All the brass work in them and the mounted skeletons is coated with a layer of black japan varnish.

I must not omit to mention a method of mounting skeletons devised and recommended by Prof. Huxley, the details of which have been developed by Mr. Newton from processes initiated at the College of Surgeons. There is an example in the Exhibition in the skeleton of a dog, No. 3904*a*. Each of the bones of the skeleton is mounted separately with wire and tubing, as in the single bone just spoken of, but they are arranged on a single flat board in definite order, the vertebræ in succession along the middle, and the limbs on each side, each bone being near its actual position of the body. Skeletons so prepared can be arranged one above the other in a cabinet, each board running on ledges in the sides of the cabinet like drawers. They are very convenient for study and demonstration, especially for advanced students ; but they are not so suitable for public museums or for elementary teaching, as they convey no idea of the general appearance, form, and proportions of the animal from which they are prepared.

Certain portions of the skeleton, especially of the lower vertebrates, are never ossified, but remain permanently in a cartilaginous condition, and when dried, shrivel and contract into small shapeless masses. But it would be often desirable, in a dry skeleton, to keep them if possible, if only to preserve the positions and relations of the surrounding bones. For instance, the axial portions of the skeleton of many fishes' heads are entirely cartilaginous, and so are the carpal bones of the crocodile. Such parts ought to be modelled either in soft wood or in the composition of whiting, resin, and linseed oil used by the picture-frame-makers, which is soft and plastic when recently made, but sets to an almost stony hardness. Specimens of the application of such modelling may be seen in the Museum of the College of Surgeons.

Besides the skin, and the skeleton, many other parts of the body are frequently preserved in a dry state in museums. When bottles and spirits were very dear this method was much more attended to than at present, and it was extensively used for injected preparations, showing the course of the blood-vessels, and even dissections of muscles and nerves, as well as for the hollow viscera, such as the stomach, cæcum, &c., which were inflated, dried, and then varnished. There are many objections to such preparations. All soft and fleshy parts, when dried, contract so much as to give little idea of their appearance in the recent state, and in doing so disturb the relations of the parts in contact with them. Inflated organs, which look very well for a time, are apt to collapse, and they are all liable to decay and to perish from the attacks of insects. To guard against this it is absolutely necessary that the preparations should be thoroughly soaked in alcoholic solution of corrosive sublimate, or some other such poison, before the drying process commences. In Italy, especially in the Museum of Comparative Anatomy at Pisa, I have seen beautiful and very instructive specimens of viscera preserved in a

[1] I should also call attention to a beautiful human skeleton by the same exhibitor, for the purpose of practising dislocation (No. 3,914), in which the principal bones are connected by coiled spring wire. This method has long been used on a partial scale, as for attaching the lower jaw to the skull, but is not so convenient as the one described above, as the elasticity of the spring is always an impediment to the free examination of the bones.

dried state, and it is to be regretted that none have found their way into this Exhibition, as they might have stimulated us to endeavour to do something to improve the art, which in most of our anatomical museums is now almost obsolete.

The methods of preserving the hard parts of invertebrate animals, such as insects, molluscs, and coral animals, in a dry state, are so generally understood, and so fully described in many special treatises,[1] that there is no occasion to detain you with them at present. The best illustration in the present collection of this branch of the subject is the very valuable and instructive preparation of the Exoskeleton of the common lobster (No. 3904 *e*) prepared by Mr. E. T. Newton, and exhibited by Prof. Huxley, which is a model of a class of preparations which might be largely employed in teaching zoology. I may also call attention to a small series of preparations contributed by Prof. H. Landois, of Münster (No. 3878), which purport to show something of the life history and habits of several species of insects, an idea which might be more fully carried out in biological museums, and to the typical collections of the shells of molluscs exhibited by Mr. R. Damon (Nos. 3808 to 3811).

(*To be continued.*)

[1] The most recent being "Notes on Collecting and Preserving Natural History Objects," edited by J. E. Taylor, Ph.D., and published by Hardwicke and Bogue, London, 1876.

OUR ASTRONOMICAL COLUMN

THE NEW STAR IN CYGNUS.—On the evening of December 13 this star, as regards brightness, was about midway between 75 Cygni and Bessel's star, Weisse XXI. 1004, the *Durchmusterung* magnitudes of which are 5·2 and 6·5 respectively, giving for the new star a magnitude of about 5·8 to 6·0, as stated last week. On December 20 it was not more than 0·25m. brighter than Bessel's star, indeed at moments it was difficult to say which was the brighter of the two; its present rate of decline is therefore slower than during the first ten days after the discovery. In the foggy sky of December 20, there was a yellowish tinge in its light, not perceptible in Bessel's star. A further careful search through our star-catalogues has failed to reveal any previous observation of a star in this position. It falls in one of the two zones, the re-observation of which has been undertaken at Bonn.

THE BINARY STAR 6*p* ERIDANI.—It may be hoped that some one of our southern observers is putting upon record measures of this double star, of which, so far as we know, none have been published since those of Mr. Eyre B. Powell at Madras, at the beginning of 1861, when the angle of position was 253°, and the distance 4''·9. Altering the node in Capt. Jacob's second orbit to 109° 40', and assuming the peri-astron passage to have occurred 1817·64, with a period of revolution of 117·48 years, the measures from 1835 to 1861 are very closely represented, without change in inclination, distance of peri-astron from node, or semi-axis major. Dunlop's measures in December, 1825, which are of doubtful interpretation, would, with Jacob's correction, differ 6½° from the computed angle. Later measures than those of 1861 are required for a decision on the true form of orbit. α Centauri and *h* 5114 (R.A. 19h. 17m. 50s., N.P.D. 144° 34' for 1876) are equally to be recommended to the close attention of the southern astronomer.

When a systematic remeasurement of the double stars of Sir John Herschel's Cape catalogue, which are out of reach in these latitudes, is undertaken (and we know of no more desirable or more interesting work in the miscellaneous astronomy of the other hemisphere), a large accession to the list of binaries may be anticipated. Perhaps M. O. Struve has not—in 24 Comæ Berenicis—detected the most rapid of the revolving double stars, which it may remain for a southern observer to bring to light.

PERIODICAL COMETS IN 1877.—Of the known comets of short period only one—that of D'Arrest—has been predicted for the ensuing year, though if the elements of De Vico's comet of 1844 have not undergone a violent change since that appearance, it may be expected to be in perihelion also within the next twelvemonths.

D'Arrest's comet will arrive at its least distance from the sun on May 10, but will not be nearest to the earth until October; its positions when observations should be most feasible, are not favourable for observers in the northern hemisphere. M. Leveau's elaborate ephemeris affords every possible assistance towards its detection. At its last visit in 1870 this comet was excessively faint, and was not observed at more than four or five of the numerous European Observatories.

Surely there must soon be an end of the dearth of discoveries of new comets which has prevailed since the beginning of December, 1874.

ANCIENT SOLAR ECLIPSES.—In NATURE (vol. xv., p. 116), Sir George Airy notes a difference in the path of the shadow in the total eclipse of B.C. 763, June 14, given in this column (p. 65) from that defined by a direct calculation from Hansen's Tables. In explanation of this difference it should be stated that our elements of the eclipse of B.C. 763, as also (with one exception) for other eclipses to which we have from time to time referred, are obtained by the use of Damoiseau's Lunar Tables of 1824, with the main arguments, and one or two of the principal equations adapted to the elements resulting from Sir George Airy's laborious discussion of the observations of the moon at the Royal Observatory, Greenwich, from 1750 to 1830, combined with M. Leverrier's Solar Tables, and the introduction of Hansen's last values of the terms in longitude, anomaly and node depending on the square of centuries.

METEOROLOGICAL NOTES

THE STORM OF MARCH 12, 1876.—We turned with considerable interest to the account of this storm, which passed over the south of England on March 12, as published in the *Journal* of the English Meteorological Society for July. The interest was all the greater, seeing that the account was drawn up, at the request of the Council of that Society, by Mr. Scott, assisted by Messrs. Gaster and Whipple, that descriptions of the same storm had been previously published by Prof. Quetelet, Dr. Neumayer, and the late M. C. Sainte-Claire Deville, and that another paper on the same subject was intimated by Dr. Buys Ballot. The widespread interest which this storm has called forth is seen at once on looking at the nine weather maps and tables of Mr. Scott's paper, which show it to be one of the most remarkable storms of recent years, whether regard be paid to the rapid rate of its propagation eastwards, estimated by Dr. Neumayer at seventy-seven miles per hour over part of its course; to the rate of the barometric fluctuation, almost unprecedented in these islands, the bar meter at Kew having risen 0·407 inch during the two hour from 2 to 4 P.M.; or to the violent contrasts of temperature and weather on the two sides of the storm at comparatively short distances apart. To illustrate the subject with greater fulness a woodcut is given showing the automatic registrations of the different meteorological instruments at Kew, and tables of pressure and temperature for every ten minutes during the most interesting phase of the storm. To these curves a noteworthy and novel feature is added in the form of a curve showing the electrical changes from positive to negative, and *vice versâ*, at the time. The *hourly readings of their self-recording instruments* for March were moreover published shortly after by the Meteorological Office. On turning to these two barometric records taken from the same instrument at Kew, referring to the same time, and published by the same authorities, and comparing them together, we meet with nothing but confusion. Of the whole of the eleven instances on which readings are printed in the two records for the same instants of time, no two agree, the eleven differences being in order, + 0·006, − 0·024, − 0·008,

−0·040, −0·020, −0·001, −0·040, −0·004, −0·012, −0·027, and +0·003 inch. Whether or not the readings in the paper be reduced to sea-level, no information being given on this point, the whole observations of at least one of these two records are entirely wrong. In explanation of discrepancies previously pointed out, it was stated by the office that the original photographs may not admit of a precision closer than 0·020 inch. In this case, however, such an explanation is out of the question. Equally loose and inaccurate are the descriptions of the Kew curves, even though the main design of this costly system of registration is to furnish data for exact comparisons being instituted among the different meteorological elements. Thus it is stated that the electricity, having been strongly negative, returned again to positive between 6 and 8 A.M., whereas the change occurred all but instantaneously about 6.45 A.M.; that simultaneously with the time of maximum temperature, about 12.20 P.M., the wind, which had been west "suddenly became north," whereas the change was not of such a character as to be described by the words simultaneous and sudden, seeing that about fifteen minutes elapsed as the wind veered from west to north; that "the barometer rose rapidly until 4 P.M., at an average rate of about 0·005 per minute," whereas this rapid rate of increase of pressure was spread over no more than the fifty minutes from 2 to 2.50 P.M. It is needless to remark that the data of this singular storm thus put before us are worse than useless and it may be also stated that a number of the barometric observations at Kew, as published in the *Hourly Readings* for March, are of such a character as to render a verification by comparison with the originals very desirable.

DIURNAL BAROMETRIC RANGE AT LOW AND HIGH LEVELS.—We have recently received from Mr. W. W. Rundell, a paper on this important subject, published about two years ago in the *Journal* of the Meteorological Society of London, based on observations made under the direction of Gen. Myer during May, 1872, on Mount Washington, New Hampshire, at heights of 2,639 and 6,285 above the sea, hourly from 6 A.M. to 6 P.M., and at 9 and 12 P.M., and at Portland, Maine, 54 feet above the sea and near the coast, at 7 and 8 A.M., and at 2, 5, 9, and 12 P.M. The means of atmospheric pressure, temperature, and humidity, are given for the different hours of observation, to which are added interpolated values for the hours of the day for which no observations were made, by drawing a fair curve passing through the observed values plotted off on a moderately large scale. These various averages are laid down in sets of curves accompanying the paper. The point of interest raised by such a discussion consists in the presentation of these three vital meteorological elements at three stations not far apart from each other, but very differently situated as regards height above the sea, and the probability that some light may thereby be thrown on one of the most difficult problems in physics. On examining the curves the attention is at once arrested by the remarkable character of the curve of the diurnal barometric range at Portland, which represents the morning maximum as occurring at 6 A.M., and the afternoon minimum at 2 P.M. Deductions of a somewhat large nature are drawn from the times of occurrence of these and others of the maxima and minima of the paper tending to show that they stand to each other in certain definite relations. Since, however, the facts of observation afford no instance of the morning maximum occurring in May at such places as Portland at 6 A.M., and the afternoon minimum at 2 P.M., we were led to calculate afresh the averages from Gen. Myer's figures with the result that the averages of the six hours of observations published in the paper are all in error in amounts varying from +0·027 inch to −0·004 inch. The fresh averages, it may be remarked, give an amplitude of range and hours of occurrence of the extremes accordant with what has been observed in latitudes and situations similar to that of Portland in May. It is obviously premature to discuss the various points raised until the necessary data be put in order before us, and the interpolated values for the unobserved hours be laid down on a method based on a wide knowledge of observed values for the same hours at places similarly circumstanced.

THE CLIMATE OF GENEVA.—A large work on this subject has just been published by Prof. Plantamour, in which are discussed with clearness, precision, and great fulness, the observations made at the observatory during the past fifty years, on temperature, pressure, moisture, rainfall, winds, clouds, and thunderstorms. The hourly averages of the different elements of each month for each year and for groups of years are given, as well as the averages for each day of the year, and the average or sums of the pentades and months for the long periods during which the observations have been made. There is thus amassed in a handy form in one volume of 263 pp. 4to., data for the elucidation of the climate of this part of Switzerland, as well as for larger inquiries which fall to be dealt with by comparative meteorology, and for the investigation of many cosmical questions. Among the specialties of the climate of Geneva, the most interesting, perhaps, are those which arise from its position with reference to its lake. The variations in the direction and force of the wind during the day show land and lake breezes of a strongly marked character—the breeze from the lake prevailing at those hours of the day when the temperature of the land is in excess of that of the lake, and the land-breeze during the rest of the day. In December, when the land at no hour of the day is warmer than the lake, no breeze from the lake prevails. In January, however, the breeze from the lake begins slightly to prevail, and in an increasing degree in succeeding months, forming a marked feature in the climate of the town during the greater part of the year, and leaving its impress in nearly all directions on the different meteorological elements. During the winter months, when no breeze from the lake prevails, or but a feeble one, the vapour curves show only one daily minimum, occurring about sunrise, and one maximum about 2 P.M.; whereas during the other months, from March to October, there occur two daily minima, one about or shortly before sunrise, and the other from 2 to 4 P.M., and two maxima, one from 8 to 11 A.M., and the other from 6 to 10 P.M., according to season. Equally marked are the curves of the hourly variations of cloud, the maximum during the winter months occurring about sunrise and the minimum about sunset. During the warm months, however, there are two daily maxima and minima—the first maximum occurring about or shortly after sunrise, and the second, which is by far the larger of the two, about 6 P.M., and the two minima shortly after midnight and from 9 to 11 A.M. These variations in the moisture of the air of Geneva are attributed by Plantamour to the condensation and evaporation which take place at the surface of the earth, and to the ascending and descending aërial currents consequent on the diurnal march of the temperature. These are undoubtedly true causes concerned in bringing about diurnal hygrometric changes, but they are insufficient to explain the strongly-marked double maxima and minima observed at Geneva. This will be evident by a simple reference to the hygrometric curves for such places as Valentia, Toronto, and Oxford, which either exhibit no second maximum at all, or if they do, so faintly marked as to form no outstanding feature of the curves. The explanation, in all probability, of this peculiarity of the Geneva hygrometric curves is to be found in the relative size of Lake Geneva which is just large enough to occasion a strong breeze during the day from the lake *all round its shores*. On the setting in of the breeze, the air having been some time previously resting on the surface of the lake is therefore moist, and while this continues the first daily maximum is reached. As, however, the breeze continues, *the air feeding it must necessarily, owing to the com-*

parative smallness of the, lake come from higher strata of the atmosphere, and since this air has been but a brief time in contact with the surface of the water the lake breeze becomes constantly drier till the afternoon minimum from 2 to 4 P.M. The breeze thereafter diminishes in force, the air consequently becomes moister till the greater maximum is attained about the time of the day when the breeze from the lake falls to a calm. This special feature of the climate of Geneva well deserves the closest investigation, particularly in its relations to the curves of temperature, pressure, and clouds. Among the other points discussed may be mentioned an examination of Deville's cold and warm periods of the year by the long series of the Geneva Observations; a comparison of the temperature of the water of the Rhone, as it issues from the lake, with that of the air, showing the mean annual temperature of the water to be 3°·7 higher than that of the air, a point of some importance in connection with questions affecting oceanic circulation; the distribution through the year of strong northerly and southerly winds, and the variations, regular and irregular, in the amount and duration of the rainfall.

CLIMATE OF LUND.—A paper of considerable value has been published by H. A. V. Tidblom, in *Lunds Universitets Arsskrift*, tom. xii., on the meteorological observations made at the observatory at Lund from 1741 to 1870. The observations, which are very fully discussed, embrace the temperature, winds, rain, snow, thunderstorms, and auroras, and their great value lies in the long period, viz. 130 years, over which they extend. The highest observed temperature during the 118 years ending 1870 was 94°·1, and the lowest – 13°·9, both occurring in 1845. Northerly and easterly winds prevail in winter and spring, north-westerly in summer, and south-westerly in autumn—these winds being of special interest from their relation to the prevailing winds in the south of Norway in the corresponding seasons. Hail falls on an average 5 days in the year, snow 37 days, and rain 122 days. March is the month of smallest and least frequent, and August of greatest and most frequent rainfall. Thunderstorms reach the maximum in the last half of July and first half of August, very few occurring from the middle of October to the middle of April. The greatest number of auroras occur in April and September, and the variations through the different years are very great, a remarkable maximum period occurring from 1776 to 1790, since which latter date the number has been singularly ew.

WEATHER SUMMARY.—M. H. Tarry's *Histoire de l'Atmosphère* for July and August, 1876, has been received. The publication, which recently began to be published in *Les Mondes*, aims at giving a summary and discussion of the meteorological elements of the northern hemisphere, which it is possible to collect within a month or two of their occurrence. It is thus calculated to be a useful supplement to the weather maps of Europe and America, and to the International Meteorological Observations of the United States, and as such it deserves the active support of the meteorologists of different countries.

INFLUENCE OF FORESTS ON OZONE.—In a note by M. L. Fautrat in the *Bulletin Hebdomadaire*, No. 475, of the Scientific Association of France, it is shown from observations made at Halatte and Ermenonville, that less ozone was observed in forests, particularly forests of pine, than in the open country, and more ozone at a height of 46 feet above the ground than near the surface.

NOTES

THE Loan Collection of Scientific Apparatus is to be finally closed on the 30th inst.

THE Danish Geographical Society enters upon its existence under royal auspices. In accordance with the invitation of the King of Denmark, the first public session was held in the royal palace at Copenhagen, on December 22, accompanied by appropriate festivities. The King has accepted the position of Protector of the Society, while the Crown Prince is active president.

THE veteran chemist, Prof. F. Wöhler, has been elected president of the German Chemical Society for the coming year.

A TELEGRAM received by M. Sidoroff from Capt. Wiggins, and communicated by the former to the St. Petersburg papers, announces that on December 13 Capt. Wiggins and his shipmaster, M. Svanenberg, left Krasnoiarsk on their way to St. Petersburg.

OUR readers may remember that at the International Conference on the means for exploring Central Africa thoroughly and systematically, held at Brussels last September under the presidency of the King of Belgium, invitations were issued to the different countries represented to form local committees for the furtherance of this object. The German National Committee was formed last week under the presidency of Prince Henry VII. of Reuss, and embraces many of the most distinguished names in the empire. A committee has already been intrusted with the duty of preparing the statutes for a permanent association, the German Society for African Exploration, which is to be under the patronage of the Crown Prince, and expects to enter vigorously and energetically upon its chosen field.

THE *Daily News* correspondent at Rome writes that the Marquis Antinori has sent to the Italian Geographical Society a long account of the journey of the Italian African Expedition of which he is leader. The expedition has, after many hardships and delays, reached Shoa, the king of which has received the members in his capital, Liccé, with the greatest hospitality. The Marquis has taken steps to make Shoa a scientific *entrepôt*, as a basis of operations for exploring the equatorial lakes. When the letter left the Marquis was preparing an extended scientific report of his journey to be forwarded to the Italian Society by a courier.

IN the last session of the Berlin division of the German and Austrian *Alpen-Verein*, Dr. Scholle delivered an elaborate address on the orography of the Bernese Alps. He regards them as distinguished from the mountains of other alpine regions by the following peculiarities:—The valleys are unusually deeply cut. The mountains inclosing these valleys are remarkable for their relative as well as their absolute heights, and the horizontal projection of their tops lies always at but a short distance from the bottom of the valleys. Finally, the topmost points of the mountains are generally visible from the valleys, and their commanding appearance imparts to the landscape its most picturesque and magnificent features.

THE *Bulletin* of the French Geographical Society for November contains a paper by Dr. Jules Carret on the Displacement of the Polar Axis, in which he gives a summary of arguments in favour of displacement which will appear at length in a work about to be published by him.

THE following particulars are given by Prof. Desor in the last number of the *Bulletin* of the Society of Natural Sciences at Neuchâtel, as to the burial-ground of the inhabitants of the lake-dwellings discovered last winter on the shores of the Lake of Neuchâtel at Auvernier. The burial-place is about 100 feet distant from the well-known lake-dwellings of this locality, at the foot of a hill, and it was shut up by some 7 feet of earth washed by rains from the slopes of the hill. It has a quadrilateral form (1·6 metre long and 1·12 broad), and is built of flat granitic stones covered with two large flag stones of gneiss, these last necessarily having been cut artificially. The burial-place thus belongs to that class of dolmens which are known in England as "stone-cists," and it establishes therefore a new link between the true dolmens and the lake-dwellings. Assiduously watching the excavation, Prof. Desor ascertained that he had really to do with a grave (that of a family, or of a clan), not merely with a receptacle of bones, the relative positions of bones proving that complete corpses were deposited in the grave, probably in a sitting position. The number of individuals buried must have been from fifteen to twenty. It was very difficult to obtain well-preserved skulls, the bones being much deteriorated and the excavations not having been made with the desirable accuracy; but some better preserved skulls show a close likeness to those found in other lake-dwellings, and especially to the skull of this kind described by MM. Rut imeyer and His in their "Craniologie Helvétique;" they belong to the mesaticephalous (semi-long) form known as the "Sion group," which form is also the true Helvetic. This form, which has been found in the stone age, continues to appear throughout the bronze and stone ages, constantly increasing in size, and showing a more and more developed, higher and broader, forehead; and it differs from the present Helvetic form not in kind but only by the degree of its development. The implements found in the grave are stone and bone implements belonging to the age of polished stone. But along with them were also found bronze implements (a perforated disc, a ring, and a pin), which thus establish the long missing link between the lake-dwellings of the stone age and those of the bronze age, both of which have representatives at Auvernier. The importance of the Auvernier grave is thus very great, as it gives new proofs in support of the alleged unity and continuity of races of prehistoric man during the stone age and that of the bronze. Some bronze implements implying a somewhat higher degree of culture, together with a bead of yellow amber and a skull, were found in the neighbourhood of the grave, on a somewhat higher level; they belong probably to a more recent period. It is proposed by the Neuchâtel Society to undertake further excavations in the same locality.

THE earthquakes which were felt in the Canton of Neuchâtel last spring (from April 2 to May 16) are the subject of two interesting communications by Prof. Desor and Dr. Tribolet, published in the last number of the *Bulletin* of the Neuchâtel Society of Natural Sciences (vol. x. part iii.). Dr. Tribolet, in addition to particulars of the earthquakes of this year, gives also a list of those known to have been felt in the canton since 1313. From this list we see that earthquakes were especially numerous during the seventeenth century, comparatively rare during the eighteenth, and totally wanting during the first half of this century, until 1852, when they begin anew to be frequent, twenty-four shocks having been felt from that year to the end of 1875. The earthquakes of last spring began with a strong one on April 2, at 5.55 A.M.; a second shock followed on April 30, and then, until May 16, no less than eleven shocks were felt in the canton at short intervals. The region of the shocks was generally limited, only two of them having been felt beyond the frontiers of the canton. As to their causes, Professors Desor and Studer, and Dr. Tribolet come unanimously to the conclusion that they have nothing to do with volcanic causes; but that the rocks of the Jura, forming a varied series of harder and softer strata, the latter mostly undermined by subterraneous streams and numerous caverns, it is very probable that the earthquakes are due to the crumbling of undermined strata, the seat of these crumblings being probably at a depth of about 1,400 feet, where friable dolomites and saliciferous marls are covered with hard muschelkalk. The exceptionally abundant rains of last spring must have contributed to the saturation of rocks with water.

PROF. LIVERSIDGE, of the University of Sydney, has published a report on the disease known as "rust" which has been causing great havoc among the sugar-canes in Queensland. This disease appears to have been first observed in the colony in 1870. Though most of the varieties of cane seem to have been more or less affected, the Bourbon was the one upon which the disease was first noticed, and this kind has since suffered more than any other; soil and climate have also assisted its progress in a marked degree; thus it is said to have been almost exclusively confined to dry, porous, sandy soil, and to have been more virulent after unusually wet and cold seasons. The juice obtained from diseased canes shows a lower density than that obtained from healthy ones, and the sugar is more difficult to make. With regard to his microscopical examination of the diseased canes, Prof. Liversidge says he failed to detect anything which could possibly be considered as the cause of the disease; though the canes were affected by minute fungoid growths, they were not sufficient to account for the actual disease, and were undoubtedly the consequence and not the cause. Red spots are found on all the plants, healthy as well as unhealthy, but more abundantly on the latter. It is to the presence of these red spots that the name of *rust* has been applied generally to the disease in Queensland. The fungoid growths are said to bear a very strong resemblance to a large group of very common microscopic fungi—the *æcidiacei*, to which order they are said probably to belong. Notwithstanding the prevalence of these fungoid bodies, and after a minute examination and analysis of various soils, the author of the report arrives at the conclusion that the disease has not been due to any one cause but rather to a combination of numerous complex, and more or less obscure causes, which are attributed to the system of cultivation adopted by the planters, the land being exhausted without a proper return being made to it.

IMPORTANT results have been obtained by parties of the United States Geographical Survey west of the hundredth meridian, under Lieut. George M. Wheeler, corps of engineers, in geology and natural history, Mr. H. W. Henshaw, the zoologist of the California Section, having made large collections of the vertebrate fauna, including every family of birds occurring in the West. The streams explored in Nevada and California were found to abound in fishes of the genus *Catostomus*, and among the specimens collected it is not improbable some species may be found that are new to science. In the reptilian collection are several snakes belonging to the genus *Eutania*, and a new species of lizard. In entomology the *Orthoptera* and *Coleoptera* are largely represented, including some rare species from the Alpine mountain region. Careful investigations were made in geology by Mr. A. R. Conkling, and the collections made taxed the facilities for transportation, the rocks gathered being chiefly igneous and metamorphic, including syenite, granite, basalt, &c. The predominating rock in the region thus far examined by the California scientific expedition is grey syenitic granite, containing numerous crystals of black hornblende. Several mines were explored and described in detail. In palæontology there were few collections, fossiliferous formations being rare. From the sandstone quarries in Ormsby County several specimens of the genus *Unio* were obtained, these tertiary fossils being the only representatives of extinct fauna observed.

WE have received a paper, "On the Larger Divisions of the Carboniferous System in Northumberland," by Mr. G. A. Lebour, being a reprint from the *Proceedings* of the North of England Institute of Mining and Mechanical Engineers, vol. xxv. Discussing the stratigraphical characters of the different members of the Carboniferous series, the author advocates a new subdivision of it into two stages, an Upper and a Lower, instead of the three adopted now; the blending together under a common name of "Bernician" of the Yoredale Rocks, the Scar Limestone series, and the Calcareous and Carbonaceous groups which are incapable of natural division, and the additions of the Tuedian and of the so-called Upper Old Red to the Lower Carboniferous beds. A plate showing the stratigraphical changes undergone by the Carboniferous series from Derbyshire to Berwickshire, on which the views of Mr. Lebour are based, accompanies the paper.

THE General Council of Hautes-Alpes has decided to organise a special meteorological service for the purpose of carrying out the system of weather-warnings for agriculture for that department analogous to what have been established in other departments of France. The height and other physical peculiarities of the department make this a valuable addition to this system of warnings which is being gradually established over France with marked success.

A MEMOIR on the Ophite of Pando, in the province of Santander, by Don Francisco Quiroga y Rodriguez, which has just been published in the *Anales de la Soc. Esp. de Hist. Natural.*, is of considerable interest to petrographers, as it discusses the microscopic structure and mineralogical constitution of a rock of decidedly peculiar character, and at the same time enables us to realise the points of resemblance and difference between it and the similar rocks of the Pyrenees, described by Prof. Zirkel, and those of the province of Cadiz, concerning which Mr. Macpherson has recently given us such very interesting details. The rock in question is suspected to be of Triassic age, and among other features of interest presented by it we may mention the existence in it of a mineral which appears to possess characters intermediate between those of augite and diallage.

THE following further Saturday evening lectures have been arranged forin connection with the South Kensington Loan Collection of Scientific Apparatus. We do not yet know whether the closing of the Collection will interfere with their delivery :—December 30.—Prof. W. F. Barrett, on "Some of the Practical Applications of Electricity as Illustrated by Instruments in the Loan Collection." January 6.—Alexander J. Ellis, F.R.S., on "The Nature of Chords in Music, illustrated by Appunn's Apparatus." January 13.—Dr. B. W. Richardson, F.R.S., on "Stephen Gray and the Discovery of Electric Conduction." January 20.—Prof. Garrod, on "The Instruments exhibited by M. Marey, specially with reference to the Flight of Birds and Insects." January 27.—W. Chandler Roberts, F.R.S., on "The Means adopted for securing the Accuracy of the Coinage." February 3.—Prof. Osborne Reynolds, on "Vortex Motion." It is intimated that the Collection will be closed after Saturday, the 30th inst.

WE are glad to see that an effort is being made to give the people of Hertford some knowledge of science, of the value of which they seem somewhat ignorant. Mr. Percy Smith and Mr. Vincent Elsden have commenced a course of experimental lectures on Chemistry and Physics, which, to judge from the syllabus, is likely to prove both interesting and instructive to those who are wise enough to attend.

THE curious phenomenon of a ball being supported in air by a strong air current directed obliquely 35° to 40° from the vertical, has lately been exhibited in Philadelphia. Various explanations of it have been attempted by engineers and others. M. Reuleaux (in *Poggendorff's Annalen*), rejecting previous explanations, offers the following :—The pretty thin air current, on reaching the ball, is deflected on all sides, and therefore more or less rarefied in its interior. Accordingly the atmosphere presses the ball in the direction of the greatest rarefaction, or the mean force of the rarefactions, towards the orifice. The weight of the ball acts vertically downwards. Equilibrium occurs between the obliquely-acting force of the current and the two forces just named, when the mean force of the latter is parallel to the action of the current. This can only take place when the ball has its centre under the axis of the current. There is then a pair of forces which put the ball in rotation. If the finger or a rod be brought to the place of supposed minimum pressure on the ball, the latter is forthwith driven off (as the vacuum is destroyed) or falls down.

FROM a recent report on the cultivation of the vine in Madeira we are told that the *Phylloxera vastatrix* has partially attacked and destroyed many plants in some districts, but the evil has no discouraged the renewal and extension of plantations. The improved method of treating Madeira wines have rendered them more agreeable to the prevailing taste of consumers, and the demand for them is steadily increasing in every market. In Teneriffe many landowners have likewise turned their attention again to the cultivation of vines, and the wines of the island are thus increasing annually in quantity. The *Oidium* is gradually dying out, and where it still appears is successfully checked by sulphuring. The *Phylloxera* has as yet not appeared in any of the vineyards.

FROM the Annual Report on the Brisbane Botanic Garden, we gather some valuable and interesting facts relating to the acclimatisation of economic plants. Of the three most extensively cultivated tropical plants—sugar, coffee, and tea, we learn that at present forty varieties of sugar-cane are grown in the garden, and that there is such a large and continuous demand for plants of such varieties as are known to be not yet subject to disease, that the director has recommended the setting apart from the Botanic Garden of a piece of ground to be used as a nursery for sugar and other plants of commercial value. It is satisfactory to know that with regard to coffee the plants of the ordinary kind (*Coffea arabica*) in the experimental plantatation are all healthy, and show not the slightest sign of disease either from the *Hemileia vastatrix*, or any other cause. The northern districts, especially the sheltered ridges of the Hubert and Endeavour rivers are said to be the most suitable to the profitable cultivation of coffee, and some thirty acres of land on the Lower Hubert is to be put under this cultivation during the ensuing season. Of the Liberian kind (*Coffea liberica*) some seeds have been sent from England, and these are growing into perfectly healthy plants, some of which, indeed, have been already distributed. Though the tea plantation is reported to be in a flourishing condition and numbers of plants have been distributed, the cultivation of tea, it is said, does not attract the attention it deserves owing to the high price of skilled labour required in the preparation of tea as a commercial article. Among other plants of interest introduced to the Garden may be mentioned the Paraguay tea (*Ilex paraguayensis*), which seems to be thoroughly well adapted to the climate of Queensland. Mr. Hill reports that the demand for it has of late very largely increased. The Balsam of Tolu (*Myroxylon toluifera*), the new tanning plant (*Balsamocarpon brevifolium*), the Sumatra rubber-plant (*Urceola elastica*), and the Siam Gamboge (*Garcinia morella*, var. *pedicellata*), all seem to be doing well. The consideration of the introduction of foreign grasses and other plants as well for fodder purposes as for renovating old pastures, has occupied some attention in Queensland, and the result is that many of our well-known meadow-grasses as well as the *Trifoliums Medicagos*, and *Melilots* have established a similar reputation in the new to that which obtains in the old. The only unsatisfactory part of Mr. Hill's report is that in which he tells us of the destruction and probable extermination of indigenous plants. Thus, in certain districts within the Colony, some trees formerly plentiful have almost disappeared, or are but rarely found. The Queensland Nut (*Macadamia ternifolia*) is an instance, in districts abounding with it some years ago, it is now difficult to find even a single specimen. This has been caused in consequence of numbers of them having been cut down chiefly by South Sea Islanders for the purpose of more easily obtaining the fruit at the expense of the destruction of the tree. A similar fate seems to await the *Cycas media*. It is found between Port Denison and Cooktown, and the flour obtained from its seeds forms one of the principal articles of food, in certain seasons, of the aborigines of that part of the Colony. During the visit of the North-East Coast Expedition of 1873, quantities of it were found in the deserted camps, and unless preventive measures are promptly taken, from the wholesale destruction now going on, it will speedily share the fate of the *Macaaamia.*

AT the two meetings of the St. Petersburg Chemical Society, September 28 and October 19, many papers of interest were read. We notice among them a valuable report of M. Bogussky on his researches into the velocity of chemical reactions and on its dependence upon the degree of concentration of the solutions; a paper of M. Alekséeff on the mutual solubility of soluble liquids, the conclusions of which were, however, warmly criticised; a paper of Prof. Butléroff on the di-isobutylene, classing this body among the homologues of the etylene series; and of M. Kovalefsky on the amount of mechanical power disengaged during chemical reactions, those of the sulphates of copper and zinc having been begun with in the course of researches undertaken by the author.

MR. THOMAS SOUTHWELL, of the Norfolk and Norwich Naturalists' Society, writes with reference to our notice of Mr. Marsham's "Indications of Spring" (NATURE, vol. xv. p. 128), that this remarkable series of observations commenced in the year 1736, is still continued by the Marsham family. In 1789 Robert Marsham communicated his observations to the Royal Society, they were read on April 2 and printed *in extenso*, in the *Philosophical Transactions* of that year. Robert Marsham died in 1797, and the observations were continued by his son Robert to the year 1810. From that time till 1836, no record was kept, but in the latter year a third Robert Marsham resumed them, by whom, and his son, the present Rev. H. P. Marsham, they have been continued to the present time.

THE experienced Arctic cruiser, Mr. Lamont, writes to the *Times* of Tuesday in reference to Dr. Petermann's recent letter to the Geographical Society, expressing his decided conviction, founded on his own extensive experience and that of many other practical Arctic men, that all round the North as round the South Pole, there lies an eternal mass of ice a thousand miles in diameter, and perhaps miles thick in the centre. He does not believe that either "ship, sledge, man, beast, bird, or balloon, will ever get across it."

THE additions to the Zoological Society's Gardens during the past week include two Bonnet Monkeys (*Macacus radiatus*) from India, presented by Mr. Peter Varwell and Mrs. Leopold Evans; a Chinese Eyebrowed Thrush (*Leucodioptron canorum*) from China, presented by Mrs. Arabin; a Short-eared Owl (*Otus brachyotus*), European, presented by Mr. Josh. Lee; three Golden Orioles (*Oriolus galbula*), a Redwing (*Turdus iliacus*) European, presented by Mrs. A. H. Jamrach; a Dunlin (*Tringa cinclus*), European, presented by Mr. F. Cresswell; a Snowy Owl (*Nictea nivea*) from Lancaster Sound; a King Parrakeet (*Aprosmictus scapulatus*) from New South Wales; a Greater Sulphur-Crested Cockatoo (*Cacatua galerita*), from Australia, deposited.

SCIENTIFIC SERIALS

Poggendorff's Annalen der Physik und Chemie, No. 11, 1876.—On the nature of elastic reaction, by M. Braun.—On the gliding of gas on glass walls, by M. Warburg.—Report on experiments of Dr. Root of Boston, on penetration of platinum by electrolytic gases, by M. Helmholtz.—Researches on the heat phenomena in the galvanic battery, and on electromotive forces, by M. Edlund.—Electro-magnetic properties of unclosed electric currents, by M. Schiller.—On the reply of M. Schlösser and the asserted preferability of ebonite for the discs of influence-machines, by M. Holtz.—Observation on the division, among two acids, of the positive metal in a galvanic battery, by M. Fuchs.—On phenomena of motion in electrified surfaces of mercury, by M. Herwig.—On the galvanic behaviour of gold, and a new kind of Nobili rings, by M. Schiel.

THE *Naturforscher* (November, 1876).—From this number we note the following papers of interest:—On the transparency of the water of Lake Leman, by F. A. Forel.—On the meteoric iron of Nentmannsdorf, near Pirna (Saxony), by F. E. Geinitz.—On the absorption of albumen by the leaves of *Dionæa muscipula*, by A. Fraustadt.—On the simultaneous occurrence of sugar and oxalate of lime in plants, by G. Kraus.—On electrical dust figures in space, by E. Lommel.—On some experiments with plants in coloured light, by G. Kraus.—On the dependence of the co-efficient of interior friction of gases from temperature, by A. von Obermayer.—On ascending air-currents, by Herr Crompton.—On microscopical inclosures in South African diamonds, by E. Cohen.—On the deterioration of air through artificial light, by Friedrich Erismann.—On the mechanics of breathing and the circulation of matter in the animal body, by E. Pflüger.—On the chemical composition of beech-leaves and fir-needles in different states of development, by L. Dulk.

Morphologisches Jahrbuch, vol. ii. part 3.—On the skin and dermal sense-organs of Urodela, by F. Leydig, with four plates.—On the metamorphosis of Echiurus, by W. Salensky, one plate, giving four stages of development.—On the exoskeleton of fishes, part 1; a long and valuable paper, by O. Hertwig, with six plates, dealing with the exoskeleton of Siluroids and Accipenseroids.—Prof. Gegenbaur has another contribution on the morphology of the limbs of vertebrates.—R. Wiedersheim discusses "the most ancient forms of the carpus and tarsus found in existing amphibia."

Zeitschrift für wissenschaftliche Zoologie, vol. xxvii. Part 3.—On the development of the lower jaw in Mammalia, by Dr. J. Brock; a histological memoir.—An account of the anatomy of *Rhynchelmis limosella*, with four plates, by Franz Vejdovski.—On the organisation and minute structure of the Daphnidæ and other Cladocera, by Dr. C. Claus, with four plates.—Description of a new hydroid polyp related to Allman's family Pennaridæ, by F. E. Schulze.

THE *Journal de Physique* for November, 1876, contains papers on illumination of transparent and opaque bodies, by M. Lallemand; application of very thin layers of gold to cathetometers and other instruments of measurement, by M. Govi.—On the distribution of magnetism in cylindrical bars, by M. Bouty.—On the physical properties of gallium, by M. Lecoq de Boisbaudran.

SOCIETIES AND ACADEMIES

LONDON

Mathematical Society, December 14.—Lord Rayleigh, F.R.S., president, in the chair.—Mr. R. F. Davis, B.A., and Mr. H. Weston Eve, M.A., head-master of University College School, were elected members.—Prof. H. J. S. Smith, F.R.S., read a paper on the conditions of perpendicularity in a parallelopipedal system (the subject was of interest to crystallographers as well as to mathematicians).—Mr. Glaisher, F.R.S., gave an account of a paper by Prof. Cayley, F.R.S., on the condition for the existence of a surface cutting at right angles a given set of lines. "In a congruency or doubly infinite system of right lines, the direction-cosines α, β, γ of the line through any point x, y, z, are expressible as functions of x, y, z, and it was shown by Sir W. R. Hamilton in a very elegant manner that in order to the existence of a surface (or what is the same thing, a set of parallel surfaces) cutting the lines at right angles, $\alpha dx + \beta dy + \gamma dz$ must be an exact differential; when this is so, writing $V = \int (\alpha dx + \beta dy + \gamma dz)$ we have $V = c$, the equation of the system of parallel surfaces, each cutting the given lines at right angles." The author obtains his results from the analytical equations of a congruency, viz., $x = mz + p$, $y = nz + q$, where m, n, p, q are functions of two parameters, and m, n, are given functions of p, q. The condition he gets for the existence of the set of surfaces is—

$$(1 + n^2)\frac{dm}{dy} - (1 + m^2)\frac{dn}{dx} + mn\left(\frac{dm}{dx} - \frac{dn}{dy}\right) = 0.$$

He verifies his results in the case of the ellipsoid.—Prof. Clifford, F.R.S., communicated two notes on the orthogonal transformation, and additions to former papers on transformation of elliptic functions.—Mr. Tucker read portions of papers by Mr. F. W. Frankland (New Zealand), on the simplest continuous manifoldness of two dimensions and of finite extent, (communicated by Mr. Spottiswoode, F.R.S.).—On the theory of electric images and its application to the case of two charged spherical conductors placed opposite one another, Mr. W. D. Niven.—On viscous fluids, and Quaternion forms of some general propositions in fluid motion, Mr. J. G. Butcher (communicated by Mr. G. H. Darwin). An easy method of finding the invariant equation expressing any poristic relation between two conics, Prof. Wolstenholme.

Geological Society, December 6.—Prof. P. Martin Duncan, F.R.S., president, in the chair.—Thomas Collinson, P. Lindsay Galloway, the Rev. George Middleton, S. H. Needham, Maskell Wm. Peace, Nathaniel Francis Robarts, and John Stirling, were elected Fellows of the Society.—The President announced the sad loss the Society had sustained in the death of Mr. David Forbes, F.R.S., one of its secretaries, which took place on the morning of Tuesday, December 5. On this account the only paper read was on the intrusive character of the Whin Sill of Northumberland, by Mr. W. Topley, F.G.S., Assoc. Inst. C.E., Geological Survey of England and Wales, and Mr. G. A. Lebour, F.G.S., Lecturer on Geological Surveying at the University of Durham College of Science, Newcastle-on-Tyne. The Carboniferous Limestone series of the north of England contains a bed (or beds) of basalt, known as the "Whin Sill," regarding the nature of which opinion has long been divided. Some writers regard it as truly interbedded and contemporaneous; others look upon it as intrusive, and as having been forced laterally between the planes of bedding. The latter opinion is that held by the authors. Amongst the practical miners of the north of England there are very few who will admit any doubt that the Whin lies evenly, and at one constant horizon, amongst the strata. Clear cases to the contrary are looked upon as merely local variations, possibly due to successive eruptions of submarine lava. The work of the Geological Survey has shown that the Whin Sill lies at different horizons in different places: sometimes it even lies above the Great Limestone itself. In other words, *the Whin Sill, which is supposed to mark the base of the Yoredale series, sometimes lies above the limestone which forms the top of that series.* With the disappearance of the supposed base-line of the Yoredales goes also any good reason for drawing a line here at all. The authors traced the Whin Sill through Northumberland, as far north as Dunstanborough Castle, showing the varying positions at which it occurs in the Limestone series, and noting points of interest in some of the sections. The Whin shifts its position amongst the strata to the extent of 1,000 feet or more. It frequently comes up in bosses through the bedded rocks, and bakes the beds above it quite as much as those below, especially when those beds consist of shale. As to the age of the Whin Sill, nothing definite can be said.

EDINBURGH

Royal Society, December 18.—Sir William Thomson, president, in the chair.—The following communications were read:—On the roots of the equation $\rho \phi \rho = 0$, by Gustav Plarr, communicated by Prof. Tait.—Applications of the theorem that two closed plane curves cut one another an even number of times, by Prof. Tait.—On the distribution of volcanic *débris* over the floor of the ocean—its character, source, and some of the products of its disintegration and decomposition, by Mr. John Murray, communicated by Sir C. Wyville Thomson.—On new and little-known fossil fishes from the Edinburgh district, No. 1., by Dr. R. H. Traquair.—Note on the Ruff (*Machetes pugnax*), by Prof. Duns.

MANCHESTER

Literary and Philosophical Society, November 6.—Charles Bailey in the chair.—Wealden fossils from Columbia, South America, by John Plant, F.G.S.—The raised beaches of County Antrim, their molluscan fauna, and flint implements, by Mark Stirrup, F.G.S.

November 14.—E. W. Binney, F.R.S., F.G.S., president, in the chair.—Notice of a passage in Clement of Alexandria on the origin of certain arts and customs, and their introduction into Greece, by William E. A. Axon, M.R.S.L., &c.

BOSTON

Natural History Society.—Mr. S. H. Scudder's contributions on the orthoptera continue to be among the most important papers published by this society. His "century" of new forms has reached its sixth decade. His latest published paper is entitled "Critical and Historical notes on Forficulariæ, including Descriptions of new Generic Forms, and an Alphabetical Synonymic list of the described Species." This extends over fifty pages, and will be of great use to entomologists.—W. H. Niles has contributed a paper on the geological agency of lateral pressure, exhibited by certain movements of rocks, referring especially to observations in sandstone quarries at Berea, Ohio, and in limestone quarries at Lemont, Illinois.

VIENNA

Imperial Academy of Sciences, October 19, November 16, 23.—The following are some of the papers read:—Researches on the contractility of the capillaries, by M. Stricker.—On the integration of linear differential equations of the second order through simple quadratures, by M. Winkler.—On the discriminants of the Jacobi covariants of three ternary quadratic forms, by M. Igel.—On the fresh-water fishes of South-Eastern Brazil, by M. Steindachner.—On the absorption spectrum of hypermanganate of potash, and its use in analytical chemistry, by M. Brücke.—On the magnetic observations of the Austro-Hungarian Polar Expedition, 1872-74, by M. Weyprecht.—On the action of bromine on succinimide, and a new way of forming fumaric acid, by M. Kisielinski.—On the velocity of propagation of sound-waves from explosion, by M. Mach.—Three papers by M. Velten (sealed packet). 1. On the transference of material particles by the electric current; 2. On the polar and magnetic behaviour of plant-cells; 3. On the magnetic behaviour of portions of the cell contents.—On the heat-conductivity of ebonite, by the Secretary.

GENEVA

Physical and Natural History Society, November 2.—M. Lucien de la Rive gave an account of his researches on the specular reflection of surfaces covered with hairs, these being considered as cylinders with circular base. The condition necessary for a cylinder to present an edge of specular reflection is that the axis of the cylinder be found in the plane normal to the bissectrice of the angle of the luminous and visual rays. It results that it is only possible to have a luminous angle by starting from a certain inclination of the visual ray. This principle is proved mathematically. It is applied to bodies of various forms, and explains the apparently abnormal play of light on children's heads, for example, and on any surface covered with hair. (Vide *Archives des Sciences Physiques et Naturelles*, t. lvii. p. 219, Nov. 1876).

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