THURSDAY, APRIL 14, 1892.

A REMARKABLE BOOK ON THE HABITS OF ANIMALS.

The Naturalist in La Plata. By W. H. Hudson, C.Z.M.S. With Illustrations. (London: Chapman and Hall, Ltd., 1892.)

THIS volume deserved a more distinctive title, since it differs widely from the several works of other naturalists with which it may be classed judging from the title-page alone. It is, in fact, so far as the present writer knows, altogether unique among books on natural history. It is to be hoped that its success will be proportional to its merits, and that it will form the first of a series of volumes, by means of which residents in the various extra-European countries will make known to us the habits of the animals which surround them. What renders this work of such extreme value and interest is, that it is not written by a traveller or a mere temporary resident, but by one born in the country, to whom its various tribes of beasts, birds, and insects have been familiar from childhood; who is imbued with love and admiration for every form of life; and who for twenty years has observed carefully and recorded accurately everything of interest in the life-histories of the various species with which he has become acquainted. When we add to this the fact that the writer of this volume is well acquainted with the literature, both old and new, bearing upon his subject; that he groups his facts and observations so as to throw light on obscure problems, and often adduces evidence calculated to decide them; and, in addition to all this, that the book is written in an earnest spirit and in a clear and delightful style, it becomes evident that not all who attempt to follow in his steps can hope to equal their forerunner.

As every chapter of the book contains new and interesting matter, it is difficult to convey an adequate idea of it by partial extracts or by an enumeration of its chief topics; but the attempt must be made. The first chapter gives us a general sketch of the "Desert Pampas" and its forms of animal life. The viscacha, the coypu, and the tucu-tucu—three strange rodents—are brought vividly before us by a description of some of their more prominent habits; the edentate armadilloes appear in a new light, since one of them, the hairy armadillo, is shown to be a dominant species holding its own against enemies of higher type, so omnivorous that it can live on almost everything from grass to flesh, the latter either found dead and in all stages of decay or captured by means of its own strategy. It is so agile that it catches mice, so strong and well armed that it kills poisonous snakes, and having killed them cuts them in pieces and swallows as much as it needs. Mr. Hudson adds:—

"It is much hunted for its flesh, dogs being trained for the purpose; yet it actually becomes more abundant as population increases in any district; and, if versatility in habits or adaptiveness can be taken as a measure of intelligence, this poor armadillo, a survival of the past, so old on the earth as to have existed contemporaneously with the giant glyptodon, is the superior of the large-brained cats and canines."

Equally extraordinary are the still lower opossums, one of which is semi-aquatic and apparently adapted to its surroundings, while the other species (*Didelphys azaræ*) is in every way adapted to an arboreal life, yet it is everywhere found in this level treeless district, which leads to one of our author's suggestive remarks:—

"For how many thousands of years has this marsupial been a dweller on the plain, all its best faculties unexercised, its beautiful grasping hands pressed to the ground, and its prehensile tail dragged like an idle rope behind it! Yet, if one is brought to a tree, it will take to it as readily as a duck to water, or an armadillo to earth, climbing up the trunk and about the branches with a monkey-like agility. How reluctant Nature seems in some cases to undo her own work! How long she will allow a specialized organ, with the correlated instinct, to rest without use, yet ready to flash forth on the instant, bright and keen-edged, as in the ancient days of strife, ages past, before peace came to dwell on earth!"

But we must pass on from this mere preliminary chapter to more solid matter, only noting that we have a vivid sketch of the great rhea or American ostrich, of the flamingo, the swans, and the noble crested screamer, all of which are being exterminated by increasing population and improved weapons; and this leads to a noble protest against this extermination, of which we can only quote the concluding words:—

"Only when this sporting rage has spent itself, when there are no longer any animals of the larger kinds remaining, the loss we are now inflicting on this our heritage, in which we have a life-interest only, will be rightly appreciated. It is hardly to be supposed or hoped that posterity will feel satisfied with our monographs of extinct species, and the few crumbling bones and faded feathers which may possibly survive half-a-dozen centuries in some happily-placed Museum. On the contrary, such dreary mementoes will only serve to remind them of their loss; and if they remember us at all, it will only be to hate our memory, and our age—this enlightened, scientific, humanitarian age, which should have for its motto, 'Let us slay all noble and beautiful things, for to-morrow we die.'"

A chapter devoted to the puma is full of new and interesting matter. This animal ranges from British Columbia to the Straits of Magellan, but throughout this vast region there seems to be no authentic record of its ever attacking men except in self-defence. This has led to its being thought to be cowardly, whereas it is one of the bravest of the feline race, since it constantly attacks and conquers the jaguar whenever the two inhabit the same district, while in North California it is the enemy of the grizzly bear, and is again always the victor. In the Pampas, where it is common, the fact that it never attacks man, in however helpless a position he may be, is so well known, that the Gaucho confidently sleeps on the ground, although he knows that pumas are close by; while it is said that a child may sleep on the plain unprotected in equal security. Many curious anecdotes are given in illustration of this remarkable trait of so powerful and, as regards all other large Mammalia, bloodthirsty a creature. And the curious thing is that it seems to be no dread or dislike of man that leads to the peculiarity, but rather some strange feeling of affection, or sense of pleasure in man's vicinity, shown in many curious ways, which has led the Pampas-dwelling Gauchos to call it "the friend of man."

In the next chapter, entitled "A Wave of Life," we have a far broader subject touched upon and illustrated by a mass of curious observations. The interdependence and complex relations of species, so admirably portrayed by Darwin, are here brought vividly before us. We are told how, during a fine moist summer, when grass and flowers were abundant, mice increased to an abnormal extent, so that everywhere in the fields it was difficult to avoid treading on them, while dozens could be shaken out of every hollow thistle-stalk lying on the ground. The most incongruous animals swarmed to the feast which they provided. Dogs lived almost entirely on them, as did the domestic fowls, assuming the habits of rapacious birds. The cats all left the houses to live in the fields. Tyrant-birds and cuckoos seemed to prey on nothing else. Foxes, weasels, and opossums fared sumptuously, and even the common armadillo turned mouser with great success. Storks and short-eared owls gathered to the feast, so that fifty of the latter birds could often be seen at once, and they got fat and bred in the middle of winter, quite out of their proper season, in consequence. The following winter was a time of drought, the grass and herbage had all been consumed or was burnt up, and the mice, having no shelter, and being obliged to search for food, soon fell a prey to their numerous enemies, and were almost wholly exterminated. Their vast increase, by bringing together innumerable enemies, was the cause of their succeeding decrease. As Mr. Hudson well remarks:—

"Here, scene after scene in one of Nature's silent, passionless tragedies opens before us, countless myriads of highly-organized beings rising into existence only to perish almost immediately, scarcely a hard-pressed remnant remaining after the great reaction to continue the species."

We cannot stop to notice a tithe of the curiosities of natural history with which this volume abounds, such as the poisonous toad which kills horses, and the wrestler frog, which gives a sudden pinch to an enemy with its muscular fore-legs, and then escapes; the huge venomous man-chasing spider, a species of Lycosa, which actually pursues men on foot and on horseback; the strange dread which gnats, mosquitoes, and sand-flies have of dragon-flies, so that a single individual of the latter insect will cause clouds of the tormentors instantly to disappear; the interesting discussion on parasite problems, and the wonderful storms of dragon-flies which *precede* wind-storms from the interior; the new and interesting cases of mimicry and of warning colours; and the delightful chapter on the crested screamer, the author's prime favourite among all the denizens of the Pampas, which, though possessing a body as large as that of a swan, yet soars up into the air like a lark, and in flocks of thousands, when so high as to appear only specks in the blue sky, pours forth its song in silvery sounds delightful to listen to. These and many other matters of interest must be studied in the book itself, since we must devote the remainder of our limited space to some valuable observations and discussions on certain instincts, by which new light is thrown on several disputed questions.

The chapter on "Fear in Birds" is especially interesting, since the result of the author's observations is opposed to the view held by Darwin and Herbert Spencer as to their instinctive fear of man or birds of prey antecedent to experience or parental teaching. The one thing that is instinctive is the alarm caused by the warning note of the parent. This produces an effect even before the chick is hatched, for, in three different species belonging to widely separated orders, Mr. Hudson has watched the nest while a young bird was chipping its way out of the egg and uttering its feeble *peep*, when, on hearing the warning cry of the mother-bird, both sounds instantly cease, and the chick remains quiescent in the shell for a long time, or till the parent's changed note shows that the danger is over. Young nestling birds take their food as readily from man as from their parents, till they hear the warning cry, when they immediately close their mouths, and crouch down frightened in the nest. Parasitical birds which do not recognize the warning cries of their foster-parents show no fear. The young parasitical cow-bird takes food from man, and exhibits no fear although the foster-parents are hovering close by screaming their alarm notes. So, a young wild dove, reared from the egg by domestic pigeons which, never being fed, were half wild in their habits, never acquired the wildness of its foster-parents, but became perfectly tame and showed no more fear of a man than of a horse. He had none of his own kind to learn from, and did not understand either the voices or the actions of the dove-cot pigeons. Mr. Hudson has also reared plovers, tinamous, coots, and many other wild birds from eggs hatched by fowls, and found them all quite incapable of distinguishing friend from foe, while some, such as the rhea and the crested screamer, are much tamer when young than domestic chickens and ducklings.

Mr. Hudson concludes that birds learn to distinguish their enemies, first from parental warnings and later by personal experience, and he considers that this view is confirmed by the different behaviour of birds in the presence of various species of the hawk tribe, the amount of alarm shown being exactly proportionate to the degree of danger. Some hawks never attack birds, others only occasionally. The chimango kite is chiefly a carrion-feeder, and its presence excites no alarm among small birds. One of the harriers is so like the chimango in some states of plumage that the latter is sometimes mistaken for it, and a certain amount of fear is exhibited, which, however, soon passes away on discovering the real nature of the intruder. Buzzards are still more feared than harriers, as they are more destructive to birds, and they cause a somewhat greater amount of alarm. But most dangerous of all is the peregrine falcon, and, however high in the air this may be, the feathered world is thrown into the greatest commotion, all birds, from the smallest up to species as large as duck, ibis, and curlew, rushing about as if distracted. Even when the falcon has disappeared, the wave of terror excited by it subsides but slowly, and the birds continue for a considerable time to be wild and excited. Now, this nicely-measured alarm, proportioned to the danger to be apprehended from the different species, can hardly be due to inherited instinct, even if this could explain the general dread of raptorial birds; and, taken in connection with the numerous other facts in the habits of young birds, leads to the conclusion that fear of enemies is wholly the result of education and experience.

Perhaps the most interesting chapter in the whole volume, the fullest in new matter, and the most important in its bearing on a much-disputed theory, is that on "Music and Dancing in Nature." The result of Mr. Hudson's long-continued observations is that almost all mammals and birds have the habit of indulging occasionally in more or less regular performances, with or without sound, or composed of sound only, some being only discordant cries and choruses or uncouth irregular motions, while the more aërial, graceful, and melodious kinds exhibit more complex and more beautiful forms. It is among birds that this habit is most fully developed and presents itself in the most graceful or fantastic performances. Great numbers of birds of very different forms and habits—hawks, vultures, ibises, spoonbills, and gulls—circle about in the air, singly or in flocks, and apparently for the mere delight in aërial motion. Sometimes they rise to vast altitudes, and float about in the air in one spot for an hour or longer at a time, hundreds of birds gliding in and out among each other with perfect precision as in a set dance. Ibises and ducks have special performances of their own, but perhaps the most curious are those of some species of rails. The ypecaha rails have meeting-places on smooth level ground near the water and well surrounded by dense beds of rushes. One bird sounds a note of invitation; others from all sides come hurriedly to the place, where they begin a strange screaming concert, rushing about all the time. The cries they utter somewhat resemble human screams of terror, frenzy, or despair, mingled with half-smothered cries of pain and moans of anguish. This exhibition lasts a few minutes, after which the assembly peacefully breaks up.

The singular wattled, wing-spurred, and long-toed jacanas have a different kind of meeting. They usually go singly or in pairs; but occasionally, in response to a call by one of them, all who are within hearing leave off feeding and fly to one spot, where they walk about with their beautiful wings erect or half open, or waved up and down with a slow and measured motion. With these two species both sexes join in the display; but that of the spur-winged lapwing is altogether peculiar, inasmuch as it takes place with three individuals only. These birds live in pairs, and at intervals during the day or on moonlight nights, one bird will leave his mate and fly to another pair a short distance off. These will receive the visitor with signs of pleasure. First going to meet him, they place themselves behind him, and all three march rapidly, uttering special notes. Then they stop; the leader stands erect with elevated wings uttering loud notes, while the other two, with puffed-out plumage, standing side by side, stoop forward till the tips of their beaks touch the ground, and with a low murmuring sound remain for some moments in this strange posture. Then the visitor goes back to his own ground and mate, and later on they receive a visitor, whom they treat in the same ceremonious fashion. They are said to be so fond of this form of visiting that they indulge in it all the year round, and the illustration representing it is a most curious and fantastic picture of bird life.

A considerable number of Passerine birds also have curious displays, which are here described, as well as songs of a most remarkable character. Some sing alone, others in concert; in most instances the voice is at its best during the mating period, but in one of the smaller finches the song is at that time feeble, while at a later period it becomes far more powerful and melodious. There is one species, the white-banded mocking-bird, which is considered to exceed all other songsters in the copiousness, variety, and brilliant character of its music. By the half-hour it will first imitate with great accuracy the songs of many other species—a strange and beautiful performance; but this is merely the prelude to its own song, which is "uttered with a power, abandon, and joyousness resembling, but greatly exceeding, that of the skylark singing 'at Heaven's gate'; the note issuing in a continuous torrent; the voice so brilliant and infinitely varied that, if rivalry and emulation have as large a place in feathered breasts as some imagine, all that hear this surpassing melody might well languish ever after in silent despair."

Mr. Hudson's conclusion as to the meaning of the various actions and vocal performances that he describes, and of which only a few cases have been here referred to, is as follows:—

"I wish now to put this question: What relation that we can see or imagine to the passion of love and the business of courtship have these dancing and vocal performances in nine cases out of ten? In such cases, for instance, as that of the scissors-tail tyrant-bird, and its pyrotechnic evening displays, when a number of couples leave their nests, containing eggs and young, to join in a wild aërial dance; the mad exhibitions of ypecahas and ibises, and the jacanas' beautiful display of grouped wings; the triplet dances of the spur-winged lapwing, to perform which two birds already mated are compelled to call in a third bird to complete the set; the harmonious duets of the oven-birds, and the duets and choruses of nearly all the wood-hewers, and the wing-slapping aërial displays of the whistling widgeons; will it be seriously contended that the female of this species makes choice of the male able to administer the most vigorous and artistic slaps? . . . There are many species in which the male, singly or with others, practises antics or sings during the love-season before the female; and when all such cases, or rather those which are most striking and *bizarre*, are brought together, and when it is gratuitously asserted that the females *do* choose the males that show off in the best manner or that sing best, a case for sexual selection seems to be made out. How unfair the argument is, based on these carefully selected cases gathered from all regions of the globe, and often not properly reported, is seen when we turn from the book to Nature, and closely consider the habits and actions of all the species inhabiting any one district. We see then that such cases as those described and made so much of in the 'Descent of Man,' and cases like those mentioned in this chapter, are not essentially different in character, but are manifestations of one instinct, which appears to be almost universal among the higher animals. The explanation I have to offer lies very much on the surface. . . . We see that the inferior animals, when the conditions of life are favourable, are subject to periodical fits of gladness, affecting them powerfully, and standing out in vivid contrast to their ordinary temper. And we know what this feeling is—this periodic intense elation which even civilized man occasionally experiences when in perfect health, more especially when young. There are moments when he is mad with joy, when he cannot keep still, when his impulse is to sing and shout aloud and laugh at nothing, to run and leap and exert himself in some extravagant way."

And after showing how this impulse of joy is manifested in different animals according to their peculiarities of structure and habit, and after giving a number of other illustrative cases, he thus concludes:—

"I am convinced that any student of the subject who will cast aside his books, and go directly to Nature to note the actions of animals for himself—actions which, in many cases, appear to lose all significance when set down in writing—the result of such independent investigation will be a conviction that conscious sexual selection on the part of the female is not the cause of music and dancing performances in birds, nor of the brighter colours and ornaments that distinguish the male."

Other chapters of almost equal interest are those on the habit of the huanaco to go to certain places to die, and on the strange instincts of cattle, such as the excitement caused by the sight and smell of blood, that produced by scarlet clothing, and the persecution of the sick and weakly of the herd. These subjects are discussed with a fulness and originality the result of long personal observation, and will command the careful attention of those who are interested in the mental phenomena presented by animals. It remains only to add that the book is beautifully got up, that the text is singularly free from misprints, and that the numerous illustrations—photographic reproductions of drawings—are at once delicate and characteristic. Never has the present writer derived so much pleasure and instruction from a book on the habits and instincts of animals. He feels sure that it will long continue to be a storehouse of facts and observations of the greatest value to the philosophical naturalist, while to the general reader it will rank as the most interesting and delightful of modern books on natural history. ALFRED R. WALLACE.

THE PREVENTION OF INFLUENZA.

A Study of Influenza, and the Laws of England concerning Infectious Diseases, &c. By Richard Sisley, M.D.Lond., M.R.C.P.Lond. (London: Longmans, Green, and Co., 1892.)

UNDER the above title Dr. Sisley has collected papers read by him during the past twelve months before the Society of Medical Officers of Health, the Epidemiological Society, and the Congress of Hygiene. To these are appended extracts from the different Acts bearing on infectious disease, the provisional memorandum on epidemic influenza just issued by the Local Government Board, and sundry other matters connected with the subject. The work makes no pretence to be a study of influenza from the clinical or pathological standpoint; it deals simply with the prevention of the disease in epidemic form, and the legal machinery at our command for that purpose.

It may, at first sight, seem strange that, when, during the latter part of 1889, we watched the epidemic wave sweeping gradually over Europe towards our own shores, no one dreamed of taking any action with a view to staying the plague. But we must remember that it was a disease new to the modern generation of physicians—a disease with which the sanitary science of the present day had never had to cope—a disease whose cause was wholly unknown, and whose infectious character was imperfectly recognized, or even denied. Two years and more under the yoke have given only too abundant opportunity to investigate it from every point of view, and it is not too much to say that the Local Government Board Report by Dr. Parsons, issued last year, contains the most admirable and exhaustive study of influenza which has appeared in any European language. Yet the actual nature of the virus remains still an only partially solved problem: bacteriological research points to a definite bacillus as the probable organism, but till its natural history has been more thoroughly worked out, we must be content to fight the foe in the dark.

Dr. Sisley has not reprinted his papers in chronological order, though it is convenient to consider them thus. In that read before the Epidemiological Society in May 1891, he treats of the spread of influenza by contagion, strongly advocating the view that this is the most important factor in the diffusion of the disease. He bases his belief on very conclusive grounds, and few will now be found to disagree with him. Dr. Parsons's Report, appearing some time after this paper was read, has so abundantly confirmed the opinion, that it may be trusted that, whatever part seasonal and climatic influences may play as favouring causes, "telluric" theories have had their day. The disease is, in fact, an acute specific fever infectious in a somewhat high degree, and, in virtue of its short incubation period, diffusing itself with unusual rapidity.

Only an abstract is given of the paper read by Dr. Sisley before the International Congress of Hygiene last August. It deals with the prevention of the spread of epidemic influenza, and advocates general hygienic measures, the possible employment of prophylactics, and especially the avoidance of infection.

The essence of the book lies, however, in the paper read before the Society of Medical Officers of Health in January of the present year. Here Dr. Sisley discusses the application to influenza of the existing sanitary laws of England, and it cannot be said that his conclusions are of a very reassuring character. It is instructive to observe that the difficulty lies in this—that nobody knows whether influenza is a "dangerous infectious disease" within the meaning of the Acts, or not. Common-sense might have supposed that a disease which the Registrar-General declares to have been directly or indirectly responsible for some 27,000 deaths in England and Wales in a single year, would not inaptly be described as dangerous; but the point has not as yet been settled in a court of law, and it is possible that legal opinion might take a contrary view. Should its dangerous character be upheld by law as well as medicine, the provinces have at least the Public Health Act of 1875 to fall back on, and can thus enforce isolation of early cases. London, under its new Act, is apparently helpless; and, as it would take twelve days to add influenza to the list of notifiable diseases, it is clearly unwise to wait for a fresh outbreak before taking such a step, if it be determined to take it at all. It cannot be doubted that efficient isolation of early cases would be the most important method of averting an epidemic; the difficulty lies in a matter which Dr. Sisley has not dealt with—namely, the diagnosis of such cases. Medical men now recognize as slight instances of epidemic influenza cases which in non-epidemic times would be passed over as mere "feverish colds"; yet all such cases would have to be isolated in view of a threatened epidemic.

The extracts from the various Sanitary Acts appended to these papers form a very convenient work of reference for those interested in the subject, while the counsel's opinion on the powers of sanitary authorities as to influenza leave us very much where we were before. Dr. Sisley has, however, done valuable service in calling public attention to the inadequacy of our existing sanitary laws as a means of checking the spread of such a disease as influenza, and many will cordially indorse his opinion that "much improvement in this respect is not to be hoped for until the sanitary service is consolidated, and becomes one fold under one shepherd—a Minister of Public Health."

OUR BOOK SHELF.

Anthropogeographie. Zweiter Theil. "Die Geographische Verbreitung des Menschen." Von Friedrich Ratzel. (Stuttgart: J. Engelhorn, 1891.)

THE first part of this work was published about nine years ago, and is still highly valued by all who care to study geography and anthropology from strictly scientific points of view. The present volume will also be found worthy of the author's reputation as one of the foremost authorities on all questions relating to the connection between man and the physical conditions by which he is surrounded. In the first part Dr. Ratzel deals with the habitable part of the globe, tracing the process by which man has taken possession of it, indicating the development of his ideas regarding it, and noting the characteristics of its northern and southern borderlands and of its vacant spaces. The second part he devotes to various aspects of statistics, discussing, among other things, the relations between density of population and degrees of civilization. In the third part are considered the traces and works of man on the surface of the globe—a subject which leads the author to treat of cities and their importance as historical centres, of ruins, roads and other means of communication between communities, and geographical names. The fourth and last part relates mainly to ethnographical questions, including questions as to the diffusion of ethnographical characteristics, and the origin of ethnographical affinities. The work is not only full of thought and learning, but has the advantage of being written in a fresh, clear, and vigorous style.

Within an Hour of London Town: Among Wild Birds and their Haunts. By "A Son of the Marshes." Edited by J. A. Owen. (Edinburgh and London: W. Blackwood and Sons, 1892.)

"A SON OF THE MARSHES" is now so well known that any new book by him is sure to find readers and admirers. He does not, of course, make important contributions to science. His writings merely record the impressions produced upon him by various aspects of nature in which he happens to be especially interested. But his impressions are so thoroughly true, and are presented in so vivid a style, that they may always be studied with pleasure. Even his talk about very common things has a certain charm, for he observes them accurately, and brings out by skilful touches their relations to other things that are not quite so intimately known. The present volume has all the characteristics of his previous books, and should do a good deal to foster in the mind of "the general reader" a liking for some of the more attractive facts and ideas of natural history.

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 intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Exchange of Professorial Duties.

THE proposal of my friend Prof. Anderson Stuart, explained in the subjoined letter, seems to me one which may very probably commend itself to the professors and governing bodies of some of our Universities and University Colleges; and I therefore venture to ask for its publication in NATURE. By correspondence twelve months in advance, such an exchange as is here suggested could be arranged (with the assent of Senate, Council, or other authority), and would undoubtedly, where practicable, be of very great interest and advantage, not only to the teachers concerned, but also, in no less degree, to their classes.

E. RAY LANKESTER.

Oxford.

Shepheard's Hotel, Cairo, February 13, 1892.

DEAR PROFESSOR RAY LANKESTER,—In conversations with teachers in Europe during my two visits (1890–91, 1891–92) they have again and again said how much they would like to visit the colonies for pleasure, health, or the opportunity of study, as the case might be; but of course they could not, being bound by their duties. On the other hand, the benefit to the colonial teacher of a periodical visit to the older centres of learning has all along been recognized.

Soon after my return to Sydney in March 1891, it occurred to me that it would be easy to secure at once a visit of a European teacher to the colonies and of a colonial teacher to Europe by *a temporary exchange of duties.* Every now and again it happens that a teacher must provide for the duties of his office by a substitute, as is done by the colonial teacher when absent on leave, and by the European teacher most frequently, perhaps, when ill. Why, then, should not two teachers in a subject, who could trust each other, agree to apply for leave of absence, each proposing the other as his substitute for the time specified? I cannot see that any governing body could reasonably object to the proposal, and so the arrangement would be concluded.

Immediately on my return to Europe in October last I spoke of the matter, and amongst others to yourself; and since then I have discussed it with many friends, one of whom referred to it approvingly at a recent meeting of the Royal Colonial Institute. The project becomes the more feasible the more one studies the details of carrying it out. Practically one's attention is confined to America and Australasia. A study of the periods of the University terms, and of the steamship time-tables, shows that it is feasible for the latter, which is by far the more distant—about five weeks.

Of the pleasures of the voyage, and of the advantages to be derived by the residence in the other land, I need not speak, for each may form his own estimate of these; but that "there is something in" the thing I am persuaded, and I should be glad of your help in ascertaining what that something may be.

I am, dear Professor Ray Lankester,

Yours faithfully,

T. P. ANDERSON STUART,
Professor of Physiology, University of Sydney.

Magnetic Storms.

EXACTLY twenty-seven days from the magnetic storm and splendid aurora of February 13–14, which has already been mentioned in NATURE, there was on March 12 another very fine aurora in the United States and Canada, and it also was accompanied by a powerful magnetic storm. This correspondence to the time of a synodic revolution of the sun, to which attention has been called by the writer many times within a few years past, is interesting, showing as it does that the motion of rotation is concerned to an important extent in the recurrence of magnetic storms and their accompanying auroras. The evidence is accumulating constantly showing that solar disturbances have their maximum effect upon terrestrial magnetism when at the eastern limb and at or near the latitude of the plane of the earth's orbit. If the great sun-spot to which the aurora of

February 13 has so generally been ascribed was really responsible for that outbreak, there should have been a series of displays, for this spot was very large and apparently active throughout its transit. As a matter of fact, whatever auroral effect the disturbed region in its vicinity was able to exercise fell about February 2–4 and February 29. Upon the latter date there was a fine display, but upon the former it was generally cloudy. M. A. Veeder.

Lyons, N.Y., March 23.

Pilchards.

I was very sorry to find from Mr. Dunn's letter (p. 511) that I had not reported his evidence on the occurrence of young pilchards with perfect accuracy. He admits that the misunderstanding was probably not altogether my fault. It seems that in the days before the railway existed in Cornwall, and when seines were largely used at Mevagissey for the capture of pilchards, small pilchards under 8 inches in length, of the same size as French sardines, were often taken in vast numbers, but were either allowed to escape, or used only as manure. The sentence in my article, therefore, which states that Mr. Dunn had never seen such pilchards must be corrected, and I make the correction most willingly, regretting that I should have unconsciously misrepresented Mr. Dunn's statement.

But I must warn your readers against the idea that my article on the growth of the pilchard contained nothing which Mr. Dunn had not discovered and made known years ago. The letter to which he refers in Buckland's "Familiar History of British Fishes" deals with the subject of curing pilchards in oil, and contains nothing whatever about the rate of growth of the fish. It merely mentions that if small fish were wanted they could be had in quantities: "Some seasons their smallness is a pest to the fishermen, and millions have been returned to the sea after being inclosed in the seines, because of being no money value." But Mr. Dunn acknowledges that I correctly reported him as saying that no such small sardines have been taken since the factory at Mevagissey was started, and that no pilchards of the same size as French sardines have ever been tinned in Cornwall. As for his exhibit of a series of pilchards from those an inch in length up to the two years old full-grown fish, I find that it is only catalogued in the Polytechnic Society's Report, and that no dimensions are mentioned, nor any description given. My published evidence on the rate of growth in this species was therefore by no means superfluous, and I am glad to find that my conclusions confirm those which he had already formed, but for which he had sought no satisfactory means of publication. I have often received and acknowledged with the greatest pleasure valuable information from Mr. Dunn: in this instance I was unaware that he had collected any evidence on the subject beyond that which I acknowledged in my article.

But while correcting misunderstandings on my part, Mr. Dunn misunderstands part of my article far more seriously. I stated that the adult sardine of the Atlantic coast of France was of the same size as the full-grown Cornish pilchard, while the sardine of the Mediterranean, taken at Marseilles, was considerably smaller. I did not say that the English pilchard was "larger than those of other countries," and I did not say that the Spanish pilchard was smaller than the Cornish. My "informants" were Prof. Pouchet for France, and Prof. Marion for Marseilles; and the accuracy of their published observations on the mere question of size is not in the least affected by any grave doubts, however much italicized, on Mr. Dunn's part.

Plymouth, April 5. J. T. Cunningham.

Ornithology of the Sandwich Islands.

Your correspondents, Prof. Newton and J. E. Harting (p. 532), are a little hasty in their conclusions referring to the Banksian collection.

In order to make things clearer, I will go a little further back in the history of this matter.

When the Linnean Society removed from 32 Soho Square, Dr. Brown was left in possession of that portion which had been built upon and used by Sir Joseph Banks as his museum.

Mr. John Calvert, partly out of veneration for the old house where so many men of science had from time to time met together, and partly from want of additional space for his very extensive museum and library, secured a long lease of these premises, including the old museum; so by that arrangement Dr. Brown became his tenant. Now, it is a well-known fact that a portion of the Banksian collection was never removed from these premises, and remained the property of Dr. Brown, at the death of whom, Mr. J. Calvert arranged with Dr. Bennet (one of his executors), who had been for months removing van-loads of books, herbariums, and other articles of scientific interest, to purchase and take over, with the premises, various cases of birds, sundry articles, and the remainder and refuse of this large collection.

In two cupboards on the south side of the gallery were the ethnological relics collected during the voyage of the *Endeavour*, as well as many manuscripts in the autograph of Sir Joseph Banks, together with some of the catalogues of his collection.

On November 10, 1863, there was a sale at the rooms of Mr. J. C. Stevens by order of the Council of the Linnean Society. We soon detected the case of birds, which matched in every particular the cases that we purchased of Dr. Brown's executor; it had the same handwriting at the back, undoubtedly in the autograph of Sir Joseph. We also detected, in a cabinet of fossils and minerals which had belonged to Dr. Pulteney, one of the volumes of Sir Joseph Banks's catalogue, which matches the other volumes we had previously obtained: that volume still contains the stamp of the Linnean Society.

Lot 174 of this sale was a very large lot in boxes and a cabinet; added to which was a good proportion of the dirt and dust of bygone times. This collection had been formed by Dr. Maton with great care and industry, and contained various figured and type specimens, being all named in the quaint nomenclature of that period. At the bottom of one of the drawers of the cabinet was a letter in the autograph of the great Linnæus.

We purchased all these, together with others in that sale.

The Duchess of Portland, Sir Ashton Lever, and Sir Joseph Banks, were the great collectors of that period; and the Owhyhee case of birds might have been obtained by Sir Joseph either by purchase or otherwise at any date during his life. We have this case marked Owhyhee in the undoubted autograph of Sir Joseph Banks. The birds are all badly set up, and one has fallen from its perch, but underneath each one is a number which is referred to in one of Sir Joseph's catalogues.

In our Museum there are several thousand specimens which formed portions of the three collections just named, with regard to which we have absolute proof of identification, and in some cases the old lot tickets still remain.

As our museum is densely packed in several houses, and in some instances there are large cabinets four and five rows deep, it is not possible at a few hours' notice to dig out all and everything connected with this matter; but I will at the earliest opportunity bring the Banksian collection to the front, which I shall give a full description of in print, for the satisfaction of all those who are interested in the matter.

As to the collection of eggs of Mr. J. D. Salmon, we knew this collection well, but have never seen it since his death. There is not one single specimen in our museum that belonged to that collection, nor did we ever make a catalogue of the same, as the very exhaustive and elaborate catalogue made by the owner would be amply sufficient for all purposes.

Albert F. Calvert.

63 Patshull Road, N.W.

First Visible Colour of Incandescent Iron.

Having read in your number for March 24 (p. 484) a letter on the above subject, I thought it might prove interesting to try a similar experiment with the carbon filament of an ordinary incandescent lamp. That used was an Edison Swan 16 candle-power 80 volt, and the method employed to heat it was to pass a gradually-increasing current (supplied from accumulators), using a water resistance gradually diminished by the addition of very dilute sulphuric acid in sensibly equal portions. The room in which the experiment was performed was very carefully darkened, and the observers were kept in darkness some minutes before the current was switched on, the dilute acid being added, so that, after visibility had been reached, five additions should bring the lamp to dull redness (by diffused daylight. The number of the experiment being called out, each observer wrote this down, together with his impression of the colour, *in the dark*, so that the retina was not affected by any extraneous light throughout. Each observer closely inspected the filament till he felt satisfied as to the colour, and then rested his eyes in the dark till the next observation. There were twenty-five observers. The result seems worthy of notice.

(1) Of the twenty-five all agree that the colour of the filament is at first very pale. Thirteen call it very pale yellow, three call it white, seven a faint pink, two a bluish white.

(2) All agree that, as the temperature rises, the tint grows deeper and redder, passing through orange *before* reaching crimson. The words used to designate the final tint reached in the experiment vary from deep reddish orange to copper colour, dark red, blood red, crimson.

I may add that some of the observers had had considerable practice in observation, and their eyes were known to be normal so far as the perception of the tints of the visible spectrum is concerned. There is no reason to suppose that more than one, or two at most, possessed any abnormal sense of colour.

Assuming that in the cases of iron and carbon *light of greater frequency of vibration is emitted as the temperature rises, in addition to the light emitted at lower temperatures* (the vibrations causing which are merely increased in *amplitude*), is it not possible (1) that the *selective* power of the pigments of the retina at first scarcely comes into play, the slower vibrations acting on all to a certain extent, on the red more than the green, and the green more than the violet, in the normal eye? or (2) Does not the fact that all colours are more difficult to distinguish in a faint light, *e.g.* moonlight, make it likely that very weak irritation of *any part* of the retina (I mean a part which causes the sensation of light, and that coloured, when the irritation is stronger) is perceived as "light," the indication of specific absorption not being strong enough in comparison with the total amount of irritation to produce the sensation of any special colour in the light perceived? or lastly, if we do not make the above assumption, it would seem that iron and carbon at all events emit, when first visible, light of far wider limits of frequency of vibration than, so far as I know, is generally admitted.

Some photographic experiments which I hope may throw fresh light on the subject have been begun.

Eton College Laboratory, April 4. T. C. PORTER.

Self-Registering Weather-cock.

I SHOULD be grateful if any of your readers would kindly recommend me a simple, inexpensive instrument, to automatically register the movements of a weather-cock above the roof.

Such an appliance must roughly indicate the direction of the wind at the time being.

Some years ago, a London builder put me up a very expensive instrument, which, beyond making considerable noise, was utterly useless. J. LAWRENCE-HAMILTON.

30 Sussex Square, Brighton, April 11.

THE ROLLING OF SHIPS.

ONE fact that often strikes the thoughtful traveller by sea is that, notwithstanding the great and numerous improvements of recent years which have made life on shipboard pleasant and luxurious, little or nothing has been done to steady a vessel when she meets with waves that set her rolling heavily from side to side. The tendency seems to be rather in the direction of increased than of diminished rolling; for the steadying influence of sails, which makes the motion so easy and agreeable in a sailing ship, is fast disappearing in large steamers. Masts and sails add appreciably to the resistance of large fast steamers; so they have been cut down in size year by year till such fragments of sail as still remain are so small compared with the size of the ship as to retain little power to reduce rolling.

Shipowners and seamen do not show much sympathy with the discomfort and misery that rolling causes to most passengers. They perhaps get anxious about an occasional vessel that acquires the evil reputation of being a bad roller, because passengers may be frightened away and the receipts fall off in consequence; but beyond wishing, or attempting, to deal with abnormal cases, nothing seems to be thought of. Rolling is considered incurable, or as not of sufficient importance to trouble about. Yet there is nothing which would contribute so directly to the comfort of landsmen at sea, or do so much to change what is for many misery and torture into comfort, as to check and reduce as far as possible the rolling proclivities of ships.

The laws which govern rolling are now well understood, and it is strange that this knowledge has not enabled an effective means of control to be devised. What is stranger still is that well-known means of mitigating rolling—such as the use of bilge keels—are employed in but very few cases. A ship rolls about a longitudinal axis which is approximately at her centre of gravity, and the rolling is practically isochronous at moderate angles in ordinary ships. The heaviest rolling occurs when the wave-period synchronizes with the natural period of oscillation of the ship. Many vessels are comparatively free from rolling till they meet waves of this period, and if such meeting could be avoided, excessive rolling could be prevented. Some vessels have periods as long as fifteen to eighteen seconds for the double oscillation, and as these would require to meet with waves 1300 to 1500 feet in length, in order to furnish the conditions of synchronism, it is seldom that they suffer from heavy or cumulative rolling. Such waves are, however, not rare in the Atlantic.

The limits of heavy rolling are fixed, of course, by the resistance offered by the water and air to the transverse rotation of the ship, which is very great because of the large areas that directly oppose motion in a transverse direction. But for this resistance, and the condition that rolling is only isochronous within moderate angles of inclination, a few waves of the same period as that of a ship would capsize her.

The two most obvious modes of preventing heavy rolling are, therefore, (1) to make the period of rolling of a ship as long as possible, so as to reduce the chances of meeting waves whose period will synchronize with it, and (2) to increase the resistance to rolling. The period of a ship varies directly as her radius of gyration, and inversely as the square root of her metacentric height. Hence the period may be increased by increasing the moment of inertia of the ship, or by decreasing the metacentric height. In armoured war-vessels the moment of inertia is large, on account of the heavy weights of armour on the sides, and the heavy guns that are either placed at the side or high up above the centre of gravity. Ordinary steamers have no such weights concentrated at great distances from the centre of gravity, and their moments of inertia are determined by the distribution of material in the hull that is fixed by structural conditions and by the stowage required for their voyages. Metacentric height cannot be reduced below a certain amount, which is necessary to prevent too easy inclination of the ship, or crankness, in still water. On the whole, we may regard the longest periods that the largest ships are likely to have with advantage to be about those named above, *i.e.* fifteen to eighteen seconds.

Length of period cannot give immunity against occasional heavy rolling; but increase of resistance reduces the angles of roll at all times, and especially when the angular velocity is greatest and the rolling is worst. Such resistance is furnished by the frictional resistance of the bottom of a ship and by the direct resistance of projecting parts of the bottom, such as the keel and the large flat surfaces below at the stem and stern. This resistance can be largely increased by means of bilge keels. The value of bilge keels is recognized in the Royal Navy, and the ships of the Navy have been fitted with them for many years with highly beneficial results. The advantage of bilge keels was proved beyond all doubt many years ago by careful experiments made in this country and in France; and the late Mr. Wm. Froude showed, by the trials he made of H.M.S. *Greyhound* twenty years ago, that bilge keels of excessive size—3 feet 6 inches deep, and 100 feet in length, on a vessel 172 feet long—had only an insignificant effect upon speed throughout great differences of trim.

It is strange that the mercantile marine should not yet have adopted bilge keels, and obtained the undoubted advantage they give in steadiness. The number of ships that have them is comparatively few. There is an almost universal opinion and prejudice against their use, and the largest and finest passenger steamers have no bilge keels. This is in spite of the fact that, in cases where bilge keels have been fitted to try to check heavy rolling—and they have been of suitable size and properly placed—it has been found that the angles of rolling have been reduced by nearly one-half. There is a prevalent belief—which has no foundation in fact—that bilge keels are very detrimental to speed. We have said that Mr. Froude's experiments showed the contrary, even on trials made in still water; but it appears certain that at sea any trifling loss of speed which still-water trials might show would be more than compensated for by gain in speed when the vessel is prevented from rolling through large angles from side to side, and undergoing great changes of underwater form at every roll. Experience with ships that have had bilge keels added after running for some time without them shows that there has been no appreciable difference of speed or increase of coal consumption on their voyages.

Another, and a more heroic, method of stopping or reducing rolling would be to counteract the inclining moment of the ship caused by the ever-changing inclination of the waves by an equal and opposite moment, which would vary as the inclining moment varies. This has been attempted at different times and in various ways. It is essential to any degree of success, however, that the opposing moment brought into operation should be completely under control, so as always to act in the manner and to the extent required. The attempts to obtain a steady platform by freely suspending it, and making it independent of the rolling of the ship, have failed—apart from the practical difficulties of carrying out such an arrangement on a large scale—because the point of suspension oscillates when the ship rolls, and the platform acquires a rolling motion of its own. Weights, made of heavy solid material, which move from one side to the other of a ship subject to the action of gravity and rotation, fail because they cannot be made to act continuously in the manner required.

A degree of success has been achieved by admitting water into a suitably prepared chamber and leaving it free to move from side to side as the ship rolls. This has been done in several ships of the Navy, the case of the *Inflexible* being that which was the most carefully experimented upon. The movement of this internal water follows the inclination of the ship, but it lags behind, and thus tends to reduce the inclination. Its effect can be regulated by the quantity of water admitted into the chamber and by its depth. The *Inflexible* Committee state in their report that comparatively small changes in depth increase or diminish largely the extinctive power of the water. For various reasons—one of which is that while such a chamber is very effective in a moderate sea it fails in a rough sea when the rolling of the ship is greatest—and perhaps partly on account of the destructive and disturbing effect of 100 tons or more of water rushing from side to side of a ship over 60 feet wide—these water-chambers appear to have gone out of use in the Navy, and they have been given up in the *City of New York* and *City of Paris*, which vessels were said to be fitted with them when first built and placed upon the Atlantic.

Mr. Thornycroft has devised a means of checking rolling by moving a weight, under strict control, from side to side of a vessel so as to continuously balance, or subtract from, the heeling moment of the wave slope. It consists of a large mass of iron in the form of a quadrant of a circle, which is placed horizontal, with the centre on the middle line of the vessel, and there connected with a vertical shaft. The shaft is turned by an hydraulic engine, which is very ingeniously controlled by an automatic arrangement. The heavy iron quadrant is swept round from side to side, revolving about its centre, to the extent that is required to counteract the heeling moment. In a paper read on the 6th instant before the Institution of Naval Architects, Mr. Thornycroft said :—

"The manner in which the controlling gear works will be better understood if we imagine a vessel remaining upright among waves, while near the centre of gravity of the ship we place a short-period pendulum suspended so as to move with little friction ; this will follow the change in the apparent direction of gravity without appreciable loss of time, so that any change in the wave angle and apparent direction of gravity cannot take place without due warning, which will indicate the time and amount of the disturbance. It is therefore only necessary to make the motion of the ballast bear some particular and constant ratio to the motion of this short-period pendulum to keep the balance true. The inertia of a heavy mass will cause some loss of time, as we can only use a limited force for its control ; but it is possible to accelerate the phase of motion and overcome this difficulty so far as to get good results.

"If, now, we imagine the ship to roll in still water, the effect of the combination just described will be to balance the ship's stability for a limited angle ; but this defect is removed by the introduction of a second pendulum of long period, which tends to move the ballast in the opposite direction to the first one, and enables the apparatus to discriminate between the angular motion of the water and that of the vessel.

"I find, however, that the long-period pendulum is rather a delicate instrument, and that its function can be served by a cataract arranged so as to always slowly return the ballast to the centre, and this device has the effect of accelerating the phase of motion, which, in some cases, we also require.

"We are therefore able, by very simple parts, to construct an apparatus which will indicate the direction and amount of motion necessary to be given to the ballast at a particular time so as to resist the wave effort ; this power of indicating may be converted into one of controlling by suitable mechanism. The loss of time due to inertia of the necessary ballast is not always unfavourable when the apparatus has to extinguish rolling motion, the greatest effect being obtained when the ballast crosses the centre line of the ship at a time when it is most inclined to the water surface, and this corresponds to a quarter of the phase behind the motion of the short pendulum."

The apparatus has been working for some time in the steam yacht *Cecile* with very good results. What the objections may be to applying it to the largest passenger steamers remains to be seen. A moving weight of something like 100 or 150 tons would probably be required in such vessels. The power necessary to control the movement of the weight appears to be small, and Mr. Thornycroft's invention seems at any rate to show the way towards obtaining the long-desired boon of substantially reducing, if not checking altogether, the rolling of ships. If it succeed in doing upon a large scale only a portion of what is claimed for it in the way of anticipating and counteracting the heeling effect of waves, without the possibility of acting in an erratic or undesirable way, we may hope to see it adopted some day in passenger steamers.

TRAVELS AMONG THE GREAT ANDES OF THE EQUATOR.[1]

MR. WHYMPER'S expedition to the Great Andes of Ecuador, occupied him from December 1879 to July 1880. The results were briefly indicated in communications to the Royal Geographical Society and the Alpine Club, but the full description has been long in coming. Horace recommended giving literary work nine years to ripen: Mr. Whymper has more than followed his advice. Possibly the delay may be a mistake from a commercial point of view, but it is a gain to the readers when a book of travel in an interesting region is not written in a hurry and rushed through the press, but is rendered complete in every detail with an almost loving care.

The principal object of Mr. Whymper's journey was to observe the effect of greatly diminished atmospheric pressure on the vital powers. There was already very strong cumulative evidence that, at elevations of rather more than 14,000 feet above the sea, serious inconveniences were often felt, such as difficulty of breathing, acute headache, a sense of extreme prostration, and sometimes hæmorrhage. Some of the symptoms, some of the suffering on record, might doubtless be attributed to other causes; still the connection between "mountain-sickness" and diminished air-pressure appeared to be indubitable. The problem had already been investigated, so far as could be done in the laboratory, by M. Paul Bert, and an account of his experiments forms an appendix to Mr. Whymper's book. Balloon ascents also had been made, one with disastrous results; for of three aëronauts who had remained for some time at a height of from 26,000 to 28,000 feet, two had died, and the other had narrowly escaped with his life.

But a balloon ascent is an unfairly severe test, since the atmospheric pressure is so rapidly diminished; so Mr. Whymper determined to encamp for some time at an elevation at which others had begun to suffer, and from that level to "carry exploration and research up to the highest possible limits." The Himalayas were at first selected as the place for these investigations, but, before he could start, the attempt to construct a "scientific frontier" aroused so many jealousies that, in all probability, the experiments and the life of the operator would have been simultaneously cut short. War also forbade travel in the very highest region of the Andes, so that ultimately the mountains of Ecuador were selected as the most lofty accessible district.

Chimborazo being the culminating peak of this group, the ascent of this was the main object of Mr. Whymper's expedition. He determined to encamp on its slopes at gradually increasing heights, with the aim of ultimately reaching the summit. "But as there was no certainty that this could be done, and a possibility, at least, that the results of the investigation might be of a negative character, various other objects were kept in view; chief among them being the determination of the altitudes and relative positions of the principal mountains of Ecuador, the comparison of boiling-point observations and of aneroids with the mercurial barometer, and the collection of specimens, botanical, zoological, and geological, at great heights." Mr. Whymper was accompanied by two Alpine guides—one being the well-known Jean-Antoine Carrel, of Val Tournanche, whose sudden death on the Matterhorn in 1890 was so generally regretted among mountaineers; the other, his cousin Louis. Of their services and willing help at all times, he speaks in the highest terms. Chimborazo had been attempted without success by Humboldt and by Boussingault; Cotopaxi had been ascended, but very few of the other high peaks in Ecuador, though many measurements of altitudes had been made by Drs. Reiss and Stübel in 1871–73, who kindly placed their results at Mr. Whymper's disposal.

FIG. 1.—Crossing the Great Arenal.

Mr. Whymper spent 212 days in the upland or mountain district of Ecuador. During 204 nights of this period the barometer never gave a reading higher than 22·51 inches, or the observers were over 8000 feet above sea-level; during 90 of these it ranged from 21·72 to 21·11 inches (9000 to 10,000 feet); during 36 it was 18 inches or less (above 14,000 feet); during 19 it stood between 16 and 17 inches (15,801 to 17,285 feet); and on one night the reading was 14·75 inches, corresponding with a height of 19,500 feet. He landed at Guayaquil on December 9, and reached Guaranda (nearly 9000 feet above the sea) after crossing the Pacific range of the Andes, of which Chimborazo is the culminating point, by a pass about 10,400 feet above the sea. In preliminary explorations on that mountain Mr. Whymper ascended to a height of about 12,900 feet, and his guides, on another occasion, to about 16,500; and his party left Guaranda to attempt the ascent on December 26. They passed the first night at a height of 14,375 feet, on the great sandy plain known as the Arenal, without feeling the slightest inconvenience

[1] "Travels among the Great Andes of the Equator." By Edward Whymper. With Maps and Illustrations. (London: John Murray, Albemarle Street, 1892.)

ished pressure, and next day pitched the second camp at a height of 16,664 feet (pressure 16·5 inches). This was reached without inconvenience, but the mules during the last six or seven hundred feet of the ascent had shown marked and unusual signs of exhaustion. Mules and drivers were sent back, and the explorers remained in excellent health and spirits, but about a couple of hours afterwards all three were suddenly and almost simultaneously prostrated; their respiration became laboured, "accompanied by spasmodic gasps or gulps," they suffered from acute headache, with feverish symptoms, and an "indescribable feeling of illness pervading almost the whole body. . . . The attack seemed to arrive at a maximum quickly, to remain equally intense for several hours, and then it died away imperceptibly." In about 36 hours the Carrels got better, and felt well enough, on the 29th, to set off for a preliminary exploration; they reached a height of about 19,300 feet, but were much exhausted when they returned in the evening. Mr. Whymper recovered rather more slowly, but during the whole time Mr. Perring, a native of the country, who remained with them at the camp, was unaffected. On January 2 they moved on to a height of 17,285 feet, and after an attempt next day, frustrated by bad weather, which appears to be almost chronic in the mountains of Ecuador, reached the summit (20,498 feet) on January 4. The weather was still unfavourable, and the work laborious, but they progressed more slowly than they would have done under similar circumstances in the Alps. They remained at the camp till January 10—for Mr. Whymper contemplated another visit to the summit under more favourable conditions—but were then obliged to return to Guaranda, as Louis Carrel was suffering severely from the effects of frost-bite.

How the investigation was continued may be read in the book. In addition to excursions to lower points, Mr. Whymper, with one or both of his guides, ascended the following mountains: Corazon (15,871 feet), Cotopaxi (19,613 feet), where they encamped for the night, close to the brink of the crater, Pichincha (15,918 feet), Sincholagua (16,365 feet), Antisana (19,335 feet), Cayambe (19,186 feet), Sara-urcu (15,502 feet), Cotocachi (16,301 feet), and Carihuairazo (16,515 feet), all but the first three being new ascents. The Carrels also reached the summit of Illiniza (17,405 feet), and on two other occasions Mr. Whymper arrived within a few hundred feet of it. The expedition concluded with a second ascent of Chimborazo, when the travellers were favoured with better weather, and with an exceptionally interesting incident. As they were mounting the slopes, Cotopaxi was full in view, nearly sixty miles away. Suddenly it ejected a column of "inky black smoke" to a height of about 20,000 feet above the lip of the crater. At this elevation the cloud was caught by an easterly wind, and borne at right angles to its former course; then it was taken by a northerly current and carried down upon Chimborazo. When the party reached the summit, at 1.20 p.m., the snow was still perfectly white; but, before long, the dust began to fall thickly, shutting out all view, penetrating into instruments, and adding an unpleasing condiment to their food. It had taken rather more than 7½ hours on its aërial journey. During these excursions, neither Mr. Whymper nor his guides suffered any return of the severe symptoms which they had experienced on the flanks of

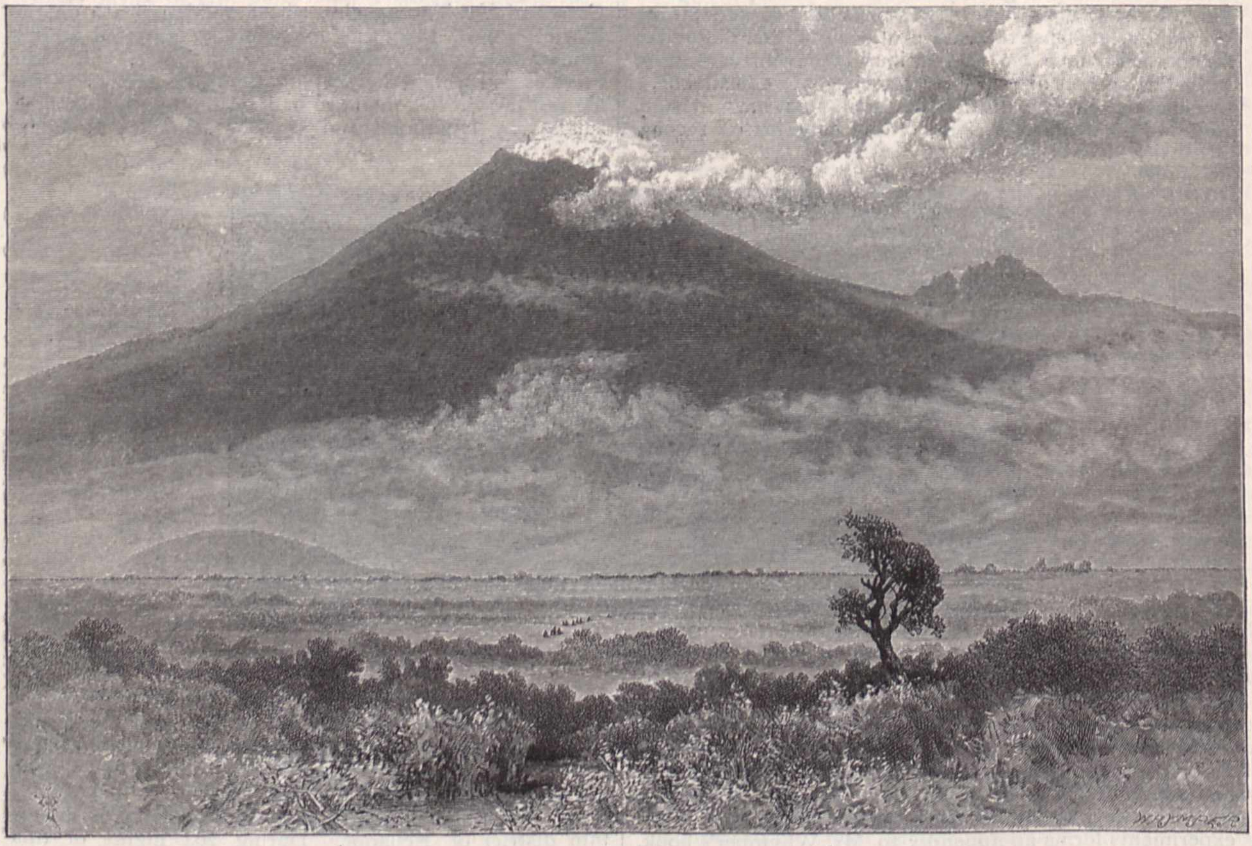

Fig. 2.—Cotopaxi.

Chimborazo; but he proves, by his careful and elaborate observations, that, though they became somewhat habituated to low barometric pressures, their bodily powers were sensibly diminished. In his own case this appeared to begin at a pressure of about 21 inches (roughly, 10,000 feet above the sea). He comes to the conclusion that, after some habituation, life can be sustained, when the body is at rest, at a height of 20,000 feet or more; but "when in motion it becomes difficult to enlarge the breathing capacity to the extent necessary to meet the further demand for air which was the result of muscular exertion."[1]

During these laborious expeditions Mr. Whymper was constantly occupied in carrying out the other objects of his journey. The physical geography of the region was studied, sketch maps were constructed, and many specimens of rocks and volcanic dust were collected, especially from the higher points. The mountains (except Sara-urcu, the rocks of which are crystalline schists and gneisses) all consist of volcanic rocks, varieties of andesite. Cotopaxi and Sangai are still active; in some of the others, even the craters cannot be distinguished. The glaciers were carefully observed, for Mr. Whymper has proved that, contrary to the received statement, glaciers are by no means rare in the Ecuadorian Andes. Botanical and zoological collections were made, especially from the higher localities. Lichens were found as high as 18,400 feet, mosses to about 16,660 feet, grasses nearly as high, with a few Phanerogamous plants; the highest *Lycopodium* found was at 15,871 feet. *Coleoptera*, *Orthoptera*, *Rhynchota*, and *Lepidoptera* were all found at or a little above 16,000 feet, and *Arachnida* nearly as high. *Crustacea*, *Reptilia*, and *Batrachia* are rare; and Mr. Whymper could only obtain one fish (the noted *Cyclopium cyclopum*), which he does not believe to be ejected from Cotopaxi. These have been examined by various specialists, whose reports are summarized in the work, and some of them are collected in a supplementary volume, which will receive a separate notice. Mr. Whymper also made an interesting collection of stone implements and of ancient pottery, of which many specimens are figured. In one of the appendices he discusses the results of observations of mercurial and aneroid barometers. These, though of much interest, we must pass over.

FIG. 3.—The contents of a grave.

FIG. 4.—"This is very old, Señor."

In the space at our disposal it has been impossible to do justice to the varied topics of this volume. It must suffice to remark that Mr. Whymper has more than maintained the reputation which he won in his well-known "Scrambles among the Alps." The present work is admirably written, clear and terse in style, and often enlivened with a spice of dry humour. Of the illustrations it is almost needless to speak; they are even better than those in the former book. Some are delightful renderings of comic incidents; others represent stone implements, pottery, insects, and various examples of the Ecuadorian zoology; others are pictures of the mountain scenery, including the upper part of Chimborazo and the summit crater of Cotopaxi. The book, in short, is not only a record of pluck and endurance (for the hardships, lightly as they are treated by Mr. Whymper, were often great), but also a literary success, and a contribution to science of no small value.

T. G. BONNEY.

[1] I have never suffered (when otherwise in good health) from mountain-sickness in the Alps, but have often observed that I got "out of breath" more quickly in ascending peaks above 10,000 or 11,000 feet. This was especially noticed in an ascent of the Matterhorn, when, owing to threatening weather, I went as fast as possible up the last thousand feet or so.

SCIENCE AT THE ROYAL MILITARY ACADEMY.

MANY of our readers will have seen that on Thursday last Sir Henry Roscoe asked the Secretary of State for War whether the military authorities were aware that at present it is possible for a cadet at the Royal Military Academy to pass through the course of work required of him successfully, and even to win admission to the Royal Engineers, without gaining a fair elementary knowledge of any branch of experimental science, and whether Mr. Stanhope would investigate and remedy this evil.

We understand that this step has been taken by Sir Henry Roscoe because the disadvantageous position of cadets who have entered the Royal Military Academy with a knowledge of science as compared with the position of those who have offered a second modern language at the entrance competition,[1] makes it increasingly difficult to maintain science studies in the Army sides of public schools. It may also be expected before long to have the effect of seriously diminishing the proportion of officers in the scientific branches of the Army who have had the advantage of such a prolonged study of experimental science as was admitted to be desirable when this subject was discussed a few years ago.

The answer made by Mr. Stanhope was partly of a satisfactory character and partly not so. He undertook to investigate the subject to which his attention was

[1] Usually, we believe, the second selection is German.

called. But, on the other hand, his reply reveals the fact that the educational authorities of the War Office still fail to see that science studies, like all other studies, must, in the case of the young, be somewhat prolonged in order to properly develop their value and render their effects permanent; especially if only a moderate portion of time can be devoted to them. For he stated that so far no cadet has gained admission to the Engineers without a fair knowledge of chemistry and physics. Now, as a good many of the cadets enter upon their work at Woolwich with little or no knowledge of these branches of science, as ten subjects are studied at the Royal Military Academy, and as the whole course of work only covers two years, it seems clear that the elementary knowledge in question must often be of a very elementary character indeed, however excellent the teaching may be, especially when it is remembered that some of the cadets doubtless have but little taste for such studies, and that the scientific faculties of these will have become more or less weakened by disuse during their previous course of training, which frequently has included no experimental science subject for several years.

The following are the circumstances of the case. The course of instruction at Woolwich occupies two years, which are divided into four terms. At the end of the second term, the choice of joining the Engineer Division is offered to the candidates in order of merit as indicated by the marks obtained in the first two terms. But no cadet can be posted to the Engineer Division who does not obtain 50 per cent. in fortification.

The marks for the obligatory subjects are:—

Mathematics[1]	3000
Fortification	2000
Military Topography	2000
French *or* German	1000
Chemistry and Physics	1000
Model Drawing	300

In addition, each cadet may take up a second modern language as a *voluntary subject* (in practice this is usually German), marks 1000—50 per cent. being the counting minimum; and landscape drawing is also a voluntary subject, marks 700, and counting minimum 50 per cent.

To count marks in any of the obligatory subjects, at least 25 per cent. of the total must be obtained.

For class promotion at the end of the first and second terms, candidates are required to obtain 50 per cent. of the marks in mathematics, and in at least three out of five obligatory subjects, and 50 per cent. of the aggregate.

Thus it appears that a candidate who had learnt no science at school might gain admission to the Royal Engineers in spite of failing in science at Woolwich.

Experience of this system as it works at the Royal Military Academy shows that in consequence of the very low minimum counting mark of science, even a beginner must be very dull or very idle to prevent him from counting the subject, especially as the teaching is suitable for beginners. Consequently, though chemistry and physics are nominally compulsory, anything beyond a very slight degree of proficiency is really a voluntary matter, especially as the effect of low marks in them can be compensated by marks obtained for a voluntary modern language by those who have offered two modern languages at entrance. The converse of this is not possible. For the voluntary modern language, in consequence of its high counting minimum mark, and in the absence of any really elementary teaching of the subject at the Royal Military Academy, cannot be made to count, as a rule, in the very limited time available, by those who have not taken it as one of their subjects at the entrance examination.

The result is that at the end of the second term those cadets who have taken two modern languages at the entrance competition may not only score a high mark for a voluntary language, but can also easily gain a helpful mark in science; whilst those who have taken up one modern language, and a branch of science, can only as a rule count marks in one subject at the later stage. As the competition for Engineers is very keen, the latter class are at a serious disadvantage. In short, the taking up of a second modern language at the entrance examination is made almost compulsory by the present system, much to the loss of those candidates whose abilities are greater in other subjects.

The state of things which we have endeavoured to make clear in a few words has only lately been realized by schoolmasters and parents, through the reports of former pupils and others who are familiar with the matter. The result has been that there is now often great pressure upon teachers to send up candidates with two modern languages, and no science for the entrance examination, even when they believe that to take up one modern language, and a branch of science would give the boy an equally good or better chance of gaining admission into Woolwich, and would be of far greater professional value to him afterwards. It is therefore certain that, unless it be shown that these views are wrong, or the conditions are amended, there will soon be a distinct diminution in the proportion of candidates offering science from the public schools.

The present situation is unfair to candidates whose abilities lie in the direction of science. It tends to keep out of the scientific branch of the Army the specially scientific candidates. It will tend, also, to keep boys from public schools out of the Army, and replace them by those who have resorted to Continental tutors. And finally, by discouraging the teaching of science in Army classes, it must make it increasingly difficult to maintain a high level of science work at schools generally. We therefore hope that those who are with us in this matter will take any steps they may be able, to secure that the opportunity created by Sir Henry Roscoe shall not be lost.

THE LATE SIR WILLIAM BOWMAN.

TO many of the readers of NATURE the distinguished man of science whose life was so unexpectedly brought to an end a little more than a fortnight ago, was best known as a great ophthalmic surgeon who for a long period of years occupied the first rank in his own line of professional work. But to those of us who are old enough to remember what physiology and anatomy were forty years ago, the name of Bowman has very different associations. It recalls to us a series of splendid anatomical discoveries communicated to the Royal Society between 1840 and 1850, of which the chief results were afterwards brought together in the great work which Bowman subsequently published in association with Dr. Todd on the "Physiological Anatomy of Man." In the following paragraphs I have endeavoured to give a sketch of the most important of these discoveries, in the hope that the many scientific friends to whom his memory is dear may find it, however imperfect, yet acceptable for his sake.

The three most important subjects of Bowman's researches were: (1) the structure of muscular fibre, (2) the structure of the kidney, and (3) that of the mucous membrane of the alimentary canal.

(1) *The Structure of the Fasciculus of Striated Muscle* (Phil. Trans., 1840).—It had been recognized that the fasciculus of striped muscle is made up of what Fontana designated as "*fils charnus primitifs*"; and much more recently

[1] 800 additional marks for higher mathematics, but cadets cannot count these papers if they do not obtain at least 40 per cent. of the marks.

Schwann had shown that the muscular substance is inclosed in a sheath of structureless membrane, which he described as produced by coalescence of the cylindrical cells from which it had originated. Bowman was the first to observe that the "sarcous substance," as he called it, *i.e.* the organized content of this tubular sheath, is capable of being split, not only longitudinally into fibrils, but also into disks, and founded on this observation a new view of its structure—namely, that the sarcous substance consists of *cylindrical parts* ("sarcous elements"), each of which is a segment of a fibril. Bowman's observations were confirmed by Kölliker in the admirable account of the structure of muscle given in the first edition of the "Gewebelehre," published in 1850. He, however, still regarded the existence of "sarcous elements" as open to question. A few years later they acquired a new title to recognition when Brücke, in his researches on the structure of muscle with the aid of polarized light, discovered that the sarcous substance, as observed by this method, behaves as if it were made up of "a system of cylindrical bodies, each having the properties of uniaxial crystals with their axes parallel to that of the fasciculus." Brücke did not pledge himself to the identity of these cylindrical bodies (which he called "disdiaklasts") with Bowman's "elements," but rather regarded each such element as a system of disdiaklasts. It would occupy too much space to enter on this subject further. It must suffice to say that the relation between the optical properties of sarcous substance and its microscopical characters was soon fully recognized, and that Bowman's sarcous elements still hold their own in every discussion on the structure of muscle.

(2) *The Structure of the Mucous Membranes of the Alimentary Tract.*—On this subject Bowman's investigations were fundamental. If anyone were disposed to doubt their claim to have been the starting-point of the long series of researches by which our present knowledge of the subject has been attained, he might at once satisfy himself by comparing the clear account of the subject contained in Bowman's article in the "Cyclopædia of Anatomy" (1843) with the vague statements which are to be found in the best work on "General Anatomy" then in existence, Henle's "Allgemeine Anatomie," published immediately before. The contrast is striking. Within the compass of a very few years Bowman had succeeded in unravelling the structure of mucous membrane, and arriving at new conceptions of the relations between its constituent parts, which have survived to the present day, notwithstanding the infinite amount of work which has been done since, in the same field of inquiry—an achievement which appears the more worthy of admiration when it is remembered that Bowman began as it were from nothing, and had to rely on his own ingenuity for devising his methods, and on his own dexterity for carrying them out. For at that time and for many years after, the methods of preparing tissues so as to display their structure, which are now in everyone's hands, were practically unknown.

The Structure of the Kidneys.—The great discovery which was announced in Bowman's paper on the structure and use of the Malpighian bodies of the kidneys (Phil. Trans., 1842) was that of the connection between the Müllerian capsule and the uriniferous tubes. The anatomists of the time were unanimous in denying the existence of any such communication, and Müller himself—who, in his great work on the intimate structure of the secreting glands, published in 1830, gave the first account of the capsule—characterized the suggestion that it might be connected with the ends of the uriniferous tubes as a "*falsissima opinio.*" In the edition of the "Handbuch der Physiologie," however, which immediately followed the appearance of Bowman's paper, the great physiologist frankly admitted his error.

The result next in importance of Bowman's research was the explanation it enabled him to give of the renal circulation. The knowledge which existed was extremely defective. For, although it was known that there was a communication between the capillaries of the glomeruli and those of the convoluted tubes, the belief that the capsules were closed sacs rendered it impossible to understand their relation to the renal function. They were indeed regarded merely as *retia mirabilia*, intended to check the impetuous blood-stream in its course towards the tubes. Müller had, two years before the publication of Bowman's paper, recognized that the renal tufts of *Myxine* are contained in the urinary utriculi, but the identity of these structures with the glomeruli of the higher Vertebrates was overlooked by him until Bowman's description served to explain his own observations on the renal organs of the lower.

The theory of the function of the kidney which sprang out of Bowman's anatomical investigations was shortly as follows:—The epithelium which lines the convoluted tubes is the mechanism by which the characteristic constituents of the urine are excreted. The water of the urine is discharged by the Malpighian tufts by a process partly physical, partly vital. These organs thereby serve as an apparatus for the regulation of the water-content of the blood, and thereby of the whole body. The grounds for the theory were (1) the distribution of the capillary blood-vessels on the external surface of the tubes; (2) the analogy of the renal epithelium with that of other secreting glands; (3) the absence of any such epithelium on the surface of the tufts; and (4) the consideration that, by the arrangement of their capillaries, the blood-stream through the tufts is retarded—a circumstance favourable to filtration. The theory was in so far "vitalistic" that it assumed for the secreting epithelium a special power or endowment, of which its structure afforded no physical explanation. It was soon met by another which regarded the whole process mechanically. Only two years after Bowman's second paper, Ludwig's article in Wagner's "Handwörterbuch" appeared, in which it was maintained that not only water but the salts and other soluble constituents of the urine are discharged by a process of filtration, and that the function of the convoluted tubes of the cortex is not to secrete the solids of the urine, but to reabsorb the water, and thereby concentrate the product. Without entering into details, it may be sufficient to say that the theory of Ludwig was chiefly based on experimental evidence relating to the immediate influence of purely mechanical conditions in determining the rate of secretion, which showed that the renal flow is instantly increased by augmentation and diminished by decline of the difference between the arterial and venous pressures, and consequently varies with the rapidity of the renal blood-stream. For twenty years this theory was tacitly accepted, until in 1875 Heidenhain published the first of those researches on the process of renal secretion which form the basis of our present knowledge, and which resulted in the reinstatement of the doctrine of Bowman that in the kidney, as in other glands, secretion depends on the active function of special secreting cells. The most material *difference* between the doctrine now taught as the outcome of the anatomical and experimental researches of the last two decades, is connected with a fact which remained unknown for many years after the completion of Bowman's work—that the glomeruli or Malpighian tufts are provided with epithelium, and that their function is not, as Bowman thought, merely filtration. The essential point of *agreement* is that the living epithelial cell contains in itself the essential mechanism for secretion, and that it is on it that the influence of all external conditions is primarily exercised.

In the fifty years which have elapsed since Bowman arrived at a true conception of the function of the kidneys, an enormous and wholly unprecedented progress has been made in anatomical and physiological knowledge. The inferences to which he was chiefly guided by anatomical considerations have thus been placed on a wider basis, at the same time that they have been brought into complete harmony with the more certain evidence of experiment.

The above ragmentary account of Sir William Bowman's scientific work may suffice to show how much his early achievements aided the advancement of knowledge, and how materially they influenced the work of the other great anatomists and physiologists of that stirring time. Who can say how much more a man of such power would have contributed to the building up of the great science which in the vigour of youth he cultivated with such extraordinary success, had not external circumstances withdrawn him—too early—from its service?

J. Burdon Sanderson.

NOTES.

The new London County Council seems to have rather more enlightened ideas as to the need for the promotion of technical education than its predecessor. On Tuesday, when it was moved that the recommendation of the Finance Committee with regard to the Council's receipts and expenses for the year ending March 31, 1893, should be adopted, Mr. Quintin Hogg proposed as an amendment that the following words be added to the motion:—"Provided that £30,000, being part of the amount receivable by the Council for the financial year ending March 31, 1893, under the Local Taxation (Customs and Excise Duties) Act, 1890, be carried over to a suspense account, instead of being applied in reduction of rate, and that such £30,000, when carried over, be dealt with on or before October 1 next by the Council for any purpose authorized by the above Act; and that a special committee be appointed to consider what action the Council should take under the Technical Education Acts, 1889–91, and the Local Taxation (Customs and Excise Duties) Act, 1890, with power to draw up a scheme or schemes for the consideration of the Council." This was seconded by Mr. Baum, and warmly supported by Sir John Lubbock and other speakers. The amendment was adopted by a large majority, only three voting against it.

Dr. Scott having accepted the charge of the Jodrell Laboratory at Kew, the Assistant-Professorship in Botany at the Royal College of Science at South Kensington will be vacant at the end of the present session. The appointment rests with the Lord President of the Council, and candidates for the post should send their applications to the Secretary, Science and Art Department, accompanied by testimonials. The salary is £400 per annum.

Sir Andrew Clark, F.R.S., has been elected for the fifth time President of the Royal College of Physicians of London.

Mr. Francis Darwin, F.R.S., author of "The Life and Letters of Charles Darwin," has been elected a member of the Athenæum Club, under the terms of the rule which provides for "the annual introduction of a certain number of persons of distinguished eminence in science, literature, or the arts, or for public services."

The Trustees of the British Museum have appointed Mr. Arthur Smith Woodward to the Assistant-Keepership of the Department of Geology in succession to Mr. Etheridge, who has been retired by the operation of the Order in Council of August 1890. A junior assistantship which thus becomes vacant will shortly be filled by competition among the candidates nominated by the principal Trustees.

Mr. F. J. M. Page has been appointed to the Chair of Chemistry and Physics at the London Hospital rendered vacant by the death of Dr. Tidy.

Dr. Hugh Robert Mill has been appointed to succeed Mr. J. S. Keltie as Librarian to the Royal Geographica Society.

We have already announced that the Royal Medals of the Royal Geographical Society have been awarded to Mr. A. R. Wallace and Mr. E. Whymper. The Murchison grant has been awarded to Mr. Swan (who accompanied Mr. Theodore Bent in his expedition to Mashonaland); the Back grant to the Rev. James Sibree for his many years' work on the geography and bibliography of Madagascar; the Cuthbert Peck grant to Mr. Campbell for his important journeys in Korea; and the Gill Memorial to Mr. Garrett for his geographical work during the past fifteen years in Sierra Leone.

At the meeting of the Royal Geographical Society, on Monday, Mr. Ernest Gedge read a paper on a recent Expedition under Captain F. G. Dundas, R.N., up the River Tana to Mount Kenia, in East Africa. He said that his account of the expedition had been compiled from the notes and jonrnals of the European members thereof. In appearance the Tana might be likened to a miniature Nile for the whole of its navigable length, a distance of some 360 miles by river, flowing through a vast plain, and generally confined between low banks. The surrounding districts were flooded during the rise of the river in the rainy season. In fact, the whole country from Charra across to the Ozi River might be described as one vast swamp choked with rank vegetation. Only a small fraction of this area was cultivated at present. Above Hameyé, the river was a succession of rapids and falls; the channel was choked with boulders, and quite unnavigable. In fact, it had the general appearance of a mountain torrent of large dimensions. With regard to the geological structure on the upper reaches, this appeared to consist principally of gneissic formations above Hameyé, which, on nearing Mount Kenia, gradually changed to indurated hornblendic schists, till on the mountain itself it again changed to basaltic rocks and volcanic ash.

Dr. Henry Hicks, F.R.S., has announced in the *Times* that during some recent excavations in Endsleigh Street, N.W., in connection with the deepening of the main sewer, the workmen came upon the remains of a mammoth and other prehistoric animals at a depth of about 22 feet from the surface. In the central excavation, near the north end of the street, two large tusks of a mammoth were met with lying near together along with other bones belonging to the same animal. A portion of one of these tusks was brought to the surface, and it was found to measure at its thickest part nearly 2 feet in circumference. The length of the complete tusks would probably be at least 9 feet or 10 feet. In another excavation on the west side of the street, at a distance of about 15 feet from the above-mentioned, the lower jaw and other bones of a younger mammoth were discovered at about the same depth from the surface. The dark loamy soil in which the remains were embedded has yielded on examination many seeds of contemporary plants; and Mr. Clement Reid, of the Geological Survey, to whom samples of the loam were submitted, has been able to determine the presence in it of about twenty species. These show that the land at the time was of a marshy nature. Deposits usually classed with the high-level gravel and brick earth of the Thames Valley were found overlying the animal remains; hence the geological age during which the animals lived, in Dr. Hicks's opinion, must be included in what is known as the Glacial period.

A bust of Gustav Nachtigal has been set up in the Berlin Museum für Völkerkunde, beside the collections formed in the course of his travels. At the unveiling of the monument interesting speeches were delivered by Freiherr von Richthofen, Dr. Bastian, and others.

THE sixth summer meeting connected with the University extension scheme at Edinburgh will take place in August, and promises to be of great interest. The arrangements include "a geographical and technical survey of Edinburgh and district." There will also be a course on the teaching of physiology and hygiene, with a series of evening lectures by prominent specialists on the problems of technical education. A course on sociology will be given by Prof. Geddes; on anthropology, by Prof. Haddon; on general biology and zoology, by Mr. A. Thomson; on physiology, by Prof. Haycraft; and on botany, by Messrs. Turnbull and Herbertson. Occasional lectures will be given by a number of gentlemen, among whom will be several representatives of foreign Universities.

THE Geologists' Association are to devote the Easter holidays to an excursion to Devizes, Swindon, and Faringdon.

THE Geographical Section of the London Geological Field Class will take their first excursion, under the personal direction of Prof. H. G. Seeley, F.R.S., on the afternoon of Saturday, April 23, when they will visit Reigate. Full particulars can be obtained from the general secretary, R. H. Bentley, 31 Adolphus Road, Brownswood Park, N.

BOTANISTS have long been accustomed to publish sets of "Exsiccati," especially of micro-fungi, which have been widely distributed among specialists in the groups dealt with. Sets of Coccidæ prepared by Mr. T. D. A. Cockerell, the Curator of the Museum at Kingston, Jamaica, are to be issued by the Institute of Jamaica on much the same plan, and it is hoped that they will be of service not only to students, but also to horticulturists and those interested in agriculture in tropical countries, who often have to contend with scale insects, which they rarely have the means of identifying. The first set, including ten species, all from Kingston, has already been issued.

AT the twenty-third annual meeting of the Norfolk and Norwich Naturalists' Society, held on March 29, Mr. H. B. Woodward, F.G.S., was elected President for the coming session. Dr. F. D. Wheeler, the President, read the annual address, in the course of which he stated that during the past year the Society had lost by death six members, to one of whom—the Rev. H. P. Marsham—it was indebted not only for the register of the "Indications of Spring," begun by his great-grandfather, R. Marsham, F.R.S., of Stratton Strawless, in 1736, and continued with only one break to the present time, but also for the letters of Gilbert White to that gentleman, printed in the Transactions for 1874-75. Dealing with the subject of the gradual extinction of many of the species of Lepidoptera that once inhabited the fens, Dr. Wheeler said he thought the direct action of man might in most cases be wholly disregarded. Indirectly, by draining the fens, man was no doubt responsible for the extinction of many of their peculiar denizens, but even this cannot account for all, since some insects disappeared or became very rare without any striking change in the locality they inhabited. He considered that such cases were generally due to climatic causes, the insects being possibly on the extreme limit of their geographical area. In some cases the gradual drying of the fen might, by affecting the food-plant, prove fatal in the end to the larvæ feeding on it.

AT the meeting of the Linnean Society of New South Wales on February 24, Mr. J. H. Maiden read a paper on *Panax* gum. Resinous exudations have been mentioned for many years as occurring in non-Australian Araliaceæ, but no details of composition, much less of analyses, are, it is believed, in existence. A true gum has been recorded as occurring in a New Zealand *Panax*. The author now describes true gums from *P. sambucifolius* var. *angusta*, *P. Murrayi*, and *P. elegans*. They closely resemble certain Acacia gums, but may be distinguished in practice by slight odours of a peculiar character.

THE Meteorological Council have recently issued, in the form of a preface to the Daily Weather Reports for July to December 1891, a series of tables giving the monthly means for pressure, temperature, and rainfall at twenty-eight stations. The values are for twenty years, 1871-1890, and in the case of rainfall, for twenty-five years, 1866-90, and they will be very useful for reference in various climatological questions. The tables show that the mean pressure is uniformly higher over the southern portion of the British Islands than over the northern, but the difference is less in summer than in winter; in April the means are more uniform than in any other month. The temperature tables give the means of the dry-bulb and wet-bulb, and the mean maximum and minimum values, together with the means of the latter. Taking the mean of the minimum and maximum values for January and July, as representing the coldest and hottest periods of the year, we find that Cambridge is the coldest place, while both Loughborough and York are colder than some of the Scotch stations. The hottest station is London, 72°·4, and Loughborough is 71°·5. The wettest station is Valentia Island, the total fall for the year being 56·6 inches; the next wettest place is Roche's Point, where the annual fall is 47·8 inches. The driest station is Spurn Head, where the total yearly fall is only 20·9 inches. The average yearly fall in London for a quarter of a century is 24·99 inches.

SPANIARDS are making a good many preparations for the celebration of the four hundredth anniversary of the discovery of the New World. In the autumn of the present year there will be several Exhibitions, in one of which will be shown objects relating to the continent of America before the advent of Europeans, while another will illustrate the state of civilization in the colonizing countries of the Old World at the time when the new continent was discovered. In October the Congress of Americanists will meet at Huelva, and will discuss a variety of subjects relating to the continent of America, and its inhabitants 400 years ago. In the same month, at Madrid, a Spanish-Portuguese-American Geographical Congress will meet for the discussion of such questions as relate more particularly to the "Iberian-American" races, their aptitude for colonization, and the future of the Spanish language.

IT is expected that the diamond industry of South Africa will be well represented at the Chicago Exhibition. The collection from Cape Colony will include 10,000 carats of uncut stones, a large quantity of very fine cut and polished ones, together with all that is necessary to show the process of mining and washing. For this it will be necessary to transport to Chicago 100 tons of pulverized blue earth, 50 tons of unpulverized earth, and a complete washing machine, which will be "operated" by natives.

THE first number of the *Irish Naturalist* has been issued, and will doubtless receive a cordial welcome in Ireland, where no other journal of the kind exists. It is a monthly periodical, and for the present each issue will consist of only sixteen pages. The paper starts with the support of all the Irish Natural History Societies.

THE burial mounds of sand in Florida are rapidly disappearing in consequence of the way in which they are disturbed by treasure-seeking natives and relic-hunting tourists. Mr. C. B. Moore has therefore done good service by giving in the February number of the *American Naturalist* an account of a somewhat remarkable burial mound previously unopened. It stands on Tick Island, Volusia County, Florida, and is conical in shape, except towards the east, where from the summit a gradual slope extends into a winding causeway or breastwork. The height of the mound is 17 feet; its circumference, 478 feet. Its base is composed of shells, apparently brought from the neighbouring shell fields to serve as a foundation in the marshy soil. Across the centre of this layer of shells from north to south runs a ridge of pure white sand, above which is a stratum of dark sandy loam mingled with shells, while the sides of the ridge are rounded out with sandy loam in which shells are wanting, thus forming a symmetrical mound. During the excavations over a hundred skeletons were exhumed, and Mr. Moore does not doubt that many hundreds still remain. Although careful searchers examined every spadeful of sand, not a bead of glass nor a particle of metal was discovered, so that the mound had probably ceased to be used for burial purposes when Florida began to be occupied by white men. Many fragments of pottery were found, and various ornaments and stone weapons.

The Pittsburgh Electric Club, according to an account of it given by the American journal *Electricity*, seems likely to be a successful institution. It was organized nearly a year ago, and is a corporation of the State of Pennsylvania. Its aim is primarily to aid in the progress of electrical and mechanical science, and incidentally to promote social intercourse among those interested in this main object. By the time it completes its first year of existence it will have 200 members. Every electric company in the United States is represented in its membership. The Club has already provided itself with "a large and luxurious home," several of the rooms of which are effectively represented among our contemporary's illustrations.

An interesting paper on the manufacture and use of aluminium, from an engineering stand-point, by Mr. Alfred E. Hunt, President of the Pittsburgh Reduction Company, is printed in the current number of the Journal of the Franklin Institute. Mr. Hunt is strongly of opinion that financially the most successful solution of the aluminium problems of the future will be in the way of utilizing the metal in the arts rather than in devising more economical methods of manufacture. He gives a very good account of the uses to which aluminium has already been applied. We may note that it has been successfully used instead of lithographic stone. Powdered aluminium mixed with chlorate of potash is used to give a photographic flash-light, which produces much less smoke than the magnesium compounds used. An aluminium has been produced for the coating of iron, and Mr. Hunt thinks that this will undoubtedly be considerably used in the future.

According to the *National Druggist*, the sunflower is found to be of great service in Southern Russia, where it has for some time been extensively cultivated. It is grown principally for the bright yellow, colourless, and tasteless oil yielded by its seeds. That oil is said to be superseding olive oils throughout Southern Russia for domestic purposes. The pressed seeds and the boiled leaves (the latter mixed with clay) serve as cattle food, the stalks as fuel. Like the eucalyptus, the sunflower possesses the property of drying marshy soil, and counteracts the development of malaria germs.

A valuable paper on photography applied to the detection of crime, by Dr. Paul Jeserich, was read at a recent meeting of the Photographic Society of Great Britain, and has now been printed in the Society's Journal and Transactions. Among the subjects with which the author deals is the application of photography to the detection of the falsification of handwriting. In such cases photography can be of great service, as in an enlarged photographic picture erasures and alterations can be more clearly seen than in the original. But, above all, photography can be used to demonstrate in the resulting picture differences in inks which cannot be perceived by the eye. Dr. Jeserich claims that by his method, the outcome of many years' experience, it is possible to demonstrate differences in the colours of the inks which cannot be seen, the one ink appearing light and the other dark. This process depends on the following considerations:—As is well known, the tints of the inks that are called black are either brown, red, green, or blue in shade. Such tones have but little effect on the eye, as it is chiefly sensitive to the yellow and red rays, but the chief sensitiveness of photographic plates, on the other hand, lies in the blue, violet, and ultra-violet. As, with ordinary sensitive plates, yellow and green subjects are rendered dark, and blue ones light, the same will follow in photographing inks of various tones. This difference can be considerably intensified by the use of suitably coloured light, and colour-sensitive plates. In this manner marked differences in the various inks can be clearly and distinctly demonstrated. After the reading of the paper, Captain Abney, the Chairman, said he once examined an engraving which was reputed to be of value, and by means of photography he was able to bring out the original signature under a spurious one, which had been added. The picture turned out to be worthless.

Some correspondence has been going on in the New York *Nation* about the present position of the study of psychology as a science in the United States. Mr. E. W. Scripture is very far from being satisfied with it. One or two pioneers in the use of scientific methods have, indeed, achieved some success; but this, says Mr. Scripture, "ought not to blind us to the fact that by far the large majority of our so-called Universities teach a psychology which would call a blush of shame to the face of old Aristotle, the father of the science, for the degeneration of his offspring in the last two thousand years. To attempt to console ourselves by pointing out the entire lack of psychological facilities in England (except in the Cavendish Physiological Laboratory), is like trying to persuade the New Yorkers of the charms of bossism because the Czar of Russia is worse than Hill."

Perhaps the most noticeable contribution to the new number of the Journal of the Royal Agricultural Society of England is a paper by Mr. Carruthers, explanatory of a series of eight diagrams, illustrating "The Life of the Wheat Plant from Seed to Seed," which the Society has recently published. These notes will be very useful, and, judging from the woodcuts in the Journal, the diagrams themselves are likely to prove of considerable value to agricultural lecturers and teachers. Amongst the reports, that from the Royal Veterinary College is interesting; it deals mainly with the subject of foot-rot in sheep, and furnishes very strong evidence of the contagious nature of the disease; further investigations are in progress with the bacteria found in pus from the diseased surfaces. Mr. R. E. Prothero contributes an interesting historical sketch of farming in England, under the title of "Landmarks in British Farming."

Himmel und Erde for April contains some interesting notes on the nature of Jupiter's surface; the observations which Christopher Scheiner made with his instrument about the year 1625, with two illustrations, one showing a perspective view of the instrument itself, the other being a representation of the solar surface, on which are situated several spots that were visible on the sun from April 18 to May 1, 1625; an article by Dr. A. Fock on a "Problem of Chemical Mechanics"; and a paper by Dr. Leize on the "End of the Age of Alchemy, and the beginning of the Iatrochemical Period."

Part 13 of the "Universal Atlas" that is being published by Messrs. Cassell and Company contains maps of the British Empire, The Caucasus, and Greece. In the first of these all the well-known currents are charted, and in addition, the commercial routes of the world, which form such a network of lines, especially in the Atlantic Ocean, are inserted. Three smaller maps on a larger scale show in greater detail these steamship lines in the neighbourhood of Western Europe, the West Indies, and the Mediterranean.

THE anhydrous sulphates of zinc, copper, nickel, and cobalt have been obtained in well-developed crystals by M. Klobb, who describes his experiments in the current number of the *Comptes rendus*. It was first observed that when a small quantity of the ordinary hydrated sulphate of cobalt was allowed to fall into fused sulphate of ammonia it immediately dissolved, imparting a deep blue colour to the liquid, and when the heating was continued in such a manner that the ammonium sulphate slowly volatilized away, the walls of the crucible were found to be covered with small red crystals. Upon analysis these crystals proved to be those of anhydrous cobalt sulphate. Similar experiments with the hydrated sulphates of zinc, copper, and nickel succeeded equally well, and it was found to be immaterial whether the hydrated salts with five, six, or seven molecules of water, or the amorphous anhydrous salts obtained by ignition, were employed. The best mode of operating in order to obtain good crystals is briefly as follows. A quantity of ammonium sulphate is placed in an ordinary porcelain crucible; over this is then laid an intimate mixture of ammonium sulphate with one-third its weight of the metallic sulphate required. The crucible, covered by its lid, is then inclosed together with a packing of sand within a Hessian crucible, which is afterwards placed in a muffle furnace and heated until the sulphate of ammonia has all escaped. The heating should then be at once discontinued in order to prevent decomposition of the metallic sulphate. After cooling, if the heating has been carefully conducted, the residual metallic sulphate is found to be crystalline throughout, and to consist largely of single well-formed crystals. The result is particularly good in the case of zinc sulphate. If quantities of about twenty grams of anhydrous zinc sulphate are employed, colourless octahedrons two and a half millimetres long may be obtained. These crystals only dissolve with extreme slowness in cold water, but are much more rapidly dissolved upon warming. Sulphate of copper treated in a similar manner yields prismatic needles of the anhydrous salt. These crystals present a pale grey appearance, but on being left exposed to the air for a few days they assume first a green tint and subsequently pass over to the ordinary pentahydrated blue salt. Unlike the crystals of anhydrous zinc sulphate, they are rapidly dissolved by cold water, forming the usual blue solution. The crystals of anhydrous sulphate of cobalt prepared in like manner consist of brilliant red octahedrons, which are apparently unaltered by exposure to the air, and which are only slightly attacked by water even when boiling. Still more remarkable are the green crystals of anhydrous nickel sulphate obtained by the above mode of preparation, for these crystals, so unlike the readily soluble hydrated sulphate, are practically insoluble both in cold and boiling water. This last instance affords a striking example of the influence of water of crystallization upon the solubility of a salt.

THE additions to the Zoological Society's Gardens during the past week include an Entellus Monkey (*Semnopithecus entellus* ♂) from India, presented by Dr. Wm. Eames and Dr. Earle, R.N.; a —— Owl (*Pseudoscops grammicus*) from Jamaica, presented by the Trustees of the Jamaica Institute; a Green Conure (*Conurus pavua*) from Trinidad, presented by Mrs. Hill; two Sharp-nosed Crocodiles (*Crocodilus acutus*) from Central America, presented by Sir Henry Arthur Blake, K.C.M.G.; two Common Vipers (*Vipera berus*), British, presented by Mr. A. Cotton, F.Z.S; an Orange-winged Amazon (*Chrysotis amazonica*); two Mississippi Alligators (*Alligator mississippiensis*) from South America, a Mantchurian Crossoptilon (*Crossoptilon mantchuricum*) from Northern China, four Spiny-tailed Mastigures (*Uromastix acanthinurus*) from North Africa, deposited; a Slow Loris (*Nycticebus tardigradus*) from Borneo, two Bar-breasted Finches (*Munia nisoria*) from Java, two Mute Swans (*Cygnus olor*), European, purchased; an Angora Goat (*Capra hircus* var.), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

OBSERVATIONS OF THE SPECTRUM OF NOVA AURIGÆ.—Dr. Henry Crew, in *Astronomy and Astro-Physics* for March, gives a general description of the visible spectrum of Nova Aurigæ on February 10 and 11, observed by him with a spectroscope attached to the 36-inch of the Lick Observatory. The positions of the following lines were determined by direct comparison with the lunar spectrum and the spark spectra of hydrogen and magnesium:—

No. of line.	Wave-length.	Description.
1	6565·8	Probably C; very broad and bright in prism; not seen in grating.
2	6321	Faint, broad, diffuse.
3	6209	Not quite so bright as 2, but broader; both 2 and 3 may be bright only in comparison with neighbouring absorption bands.
4	5898	Yellow line, just below D.
5	5265	Three very faint lines; difficult to say whether they are really bright lines or simply bright regions bounded by dark spaces.
6	5254	
7	5216	
8	5167·1	Much more brilliant than any of the preceding; quite broad; much sharper on the upper side than the lower; nearly coincides with b_4. The most brilliant part of the continuous spectrum is terminated abruptly by this line.
9	5009	Of about the same brilliancy as 8, and, like it, sharper on the upper side.
10	4920	About half as bright as 9.
11	4861·6	Probably F; not less than 6 tenth-metres in width.
12	4352	Hγ? Wide and difficult to see.

A curve, showing the intensities of the lines as seen with a prism, accompanies this description. Prof. Young has determined the positions of twelve bright lines in the Nova spectrum (*Astronomical Journal*, No. 258). The wave-lengths are as follow: 4340 (Hγ), 449, 4861 (F), 4922, 5015, 5165, 5260, 5304, 559, 590 (D?), 632, 6563 (C). A faint line was also glimpsed below C, and another—probably *h*—above G. The lines at 4922 and 5015 are believed not to be nebular lines. Those at 559 and 632 are possibly coincident with the two principal lines in the aurora spectrum.

DENNING'S COMET (*b* 1892).—*Edinburgh Circular* No. 25 contains the following elements and ephemeris of Denning's comet, computed by Dr. R. Schorr:—

Elements.

T = 1892 May 6·13922 Berlin M.T.

$$\pi - \Omega = 126^\circ\ 39'\ 17''{\cdot}7$$
$$\Omega = 252\ 55\ 13{\cdot}8$$
$$i = 89\ 49\ 45{\cdot}1$$
$$\log q = 0{\cdot}298920$$

Ephemeris for Berlin Midnight.

1892.	R.A. h. m. s.	Decl. ° ′	Log *r*.	Log Δ.	Brightness.
April 15	1 29 2	+59 47·0	0·3024	0·3989	0·95
,, 19	1 49 52	59 11·4	0·3012	0·4041	0·93
,, 23	2 9 26	58 29·1	0·3002	0·4095	0·91
,, 27	2 27 43	57 41·4	0·2995	0·4149	0·89
May 1	2 44 45	56 49·5	0·2991	0·4204	0·87
,, 5	3 0 37	55 54·2	0·2989	0·4258	0·85
,, 9	3 15 23	54 56·6	0·2990	0·4311	0·83
,, 13	3 29 7	53 57·3	0·2994	0·4362	0·81
,, 17	3 41 55	52 56·7	0·3000	0·4411	0·79
,, 21	3 53 52	51 55·4	0·3008	0·4458	0·77
,, 25	4 5 3	50 53·8	0·3020	0·4502	0·75
,, 29	4 15 32	+49 52·0	0·3034	0·4543	0·72

The brightness at the time of discovery is taken as unity.

The comet passed about half a degree north of γ Cassiopeiæ on April 8, and is moving towards Perseus.

COMET SWIFT, 1892.—The following are places for this week for 12h. Berlin mean time:—

1892.	R.A. h. m. s.	Decl. ° ′
April 16	21 44 50	+8 21·2
„ 17	21 48 13	9 16·5
„ 18	21 51 35	10 11·1
„ 19	21 54 55	11 4·9
„ 20	21 58 13	11 57·8
„ 21	22 1 30	12 49·9
„ 22	22 4 45	13 41·2
„ 23	22 7 59	14 31·6

Displacement of Radiant Points.—The late Dr. J. Kleiber left behind him a paper "On the Displacement of the Apparent Radiant Points of Meteor Showers due to the Attraction, Rotation, and Orbital Motion of the Earth." The paper appears in the March number of *Monthly Notices of the R.A.S.* The three principal causes of displacement mentioned in the title are treated separately, and the theory is illustrated by a consideration of the Perseid and Andromedid radiants. More than twenty years ago Schiaparelli developed formulæ for determining the amount of displacement of a radiant point due to the attraction of the earth. The effect of the attraction is to diminish the zenith-distance of every radiant and leave its azimuth unchanged. The corrections to be applied to the co-ordinates of the Perseid and Andromedid radiants on account of this disturbing cause were computed by Dr. Kleiber, and are given in his paper. It is shown that the latter swarm affords a good example of the displacement of a radiant due to the attraction of our planet. The rotation of the earth produces a small aberration of radiants, never amounting to more than 1° in the latitude of Greenwich. With regard to the earth's orbital motion, Dr. Kleiber found that it is sufficient to explain the displacement of 57° in right ascension, and 10° in declination, observed by Mr. Denning in the case of the Perseid swarm. And, after the proper corrections have been applied, it appears that of the forty-nine radiants catalogued by Mr. Denning as belonging to the Perseid shower, "forty-six lie within a circle described about the cometary radiant with a radius of 2°." This important result settles definitely the question as to the reality of the shift of radiant points.

Two New Variables in Cepheus.—Mr. Paul S. Yendell, in the *Astronomical Journal*, No. 258, communicates the discovery of two variables of long period in Cepheus. One of them, D.M. 50° 2769, has a range of variation of a full magnitude (5·8 mag. to 6·8 mag.) in about a year. An interesting point is that "the star is apparently subject, especially near its maxima, to sudden and considerable fluctuations in light, often amounting to several steps from one night to the next." The star No. 8594 of Chandler's "List of Stars probably Variable" has been proved to be variable. The period is about 348 days, and the light-range about 0·7 mag., from 6·2 mag. to 6·9 mag.

On the Variation in Latitude.—At the Paris Academy on March 28, M. Faye said:—"The question of the variability of latitudes has lately occupied the minds of astronomers and geodetists to a large extent. The Academy will hear with interest that this question appears to be settled in the affirmative by some observations that the Geodetical Association has recently had made at Honolulu. Whilst at Berlin, Prague, and Strasburg, the latitude increased 0″·04 from June to September, and afterwards decreased 0″·1 or 0″·2 to December, and then diminished 0″·13 to January, at Honolulu it varied in the opposite direction—that is, it fell about 0″·3 from June to September, and increased 0″·13 from December to January."

THE INSTITUTION OF NAVAL ARCHITECTS.

THE annual spring meeting of the Institution of Naval Architects was held on Wednesday, Thursday, and Friday of last week, the President, the Earl of Ravensworth, occupying the chair during the whole of the sittings excepting that of Thursday evening, when Admiral Sir John Hay presided. The programme was not quite so long as usual, the Council of the Institution having come to the conclusion—wisely, we think—that it would be more desirable to have fewer papers and devote more time to their respective consideration. As it is now settled that the Institution is always to hold two meetings in the year, there is a chance of relief to what was always a congested programme when the business of the whole year was crowded into a single session. Where the summer meeting is to be held this year is not yet settled, but it is to be hoped that some place in the provinces will be selected, as it is right that the great shipbuilding centres of the Kingdom, of which London is not one, should be visited by the leading shipbuilding institution.

The following is a list of the papers read, in the order in which they were taken:—On divisional water-tight bulkheads as applied to steamers and sailing-vessels, by B. Martell, Chief Surveyor Lloyd's Register of Shipping; on steadying vessels at sea, by J. I. Thornycroft; notes on some recent experiences with H.M. ships, by W. H. White, C.B., F.R.S.; a ram vessel and the importance of rams in war, by Commander E. B. Boyle, R.N.; whale-back steamers, by F. C. Goodall; on an approximate rule for the vertical position of the centre of buoyancy, by S. W. F. Morrish; on balancing marine engines and the vibration of vessels, by A. F. Yarrow; some notes on the strength of steamers, by A. Denny; on the transverse stability of ships, and a rapid method of determining it, by W. Hök; notes on experiments with inflammable and explosive atmospheres of petroleum vapour, by J. H. Heck; on the theoretical effect of the race rotation on screw propeller efficiency, by R. E. Froude; performance of three sets of engines belonging to the second-class cruisers recently added to H.M. Navy, as calculated from the full-power steam trials, by Mr. J. G. Liversidge, R.N.

It is evident that the space at our command will not permit us to give anything approaching a full description of a meeting that occupied five sittings, some of them of over four hours' duration; and we will therefore concentrate our attention upon those points more especially within our scope. Mr. Martell's paper was one of great value, but it was treated from a purely constructive point of view. There are, it may be remarked in passing, some very nice mathematical and physical considerations involved in the study of the theory of bulkheads. This was pointed out by Dr. Elgar during the discussion, but up to the present we are not aware that the matter has been approached in a philosophic spirit. Before that can be done, certain experimental data must be obtained, and it will then remain for the mathematician to apply the canons of his science to the elucidation of the problems involved.

Mr. Thornycroft's paper on the steadying of vessels at sea was an account of some investigations and experiments carried out by one of our most scientific and careful mechanical engineers. Mr. Thornycroft has a steam-yacht, the *Cecile*, of 230 tons displacement. With this vessel he proceeded to make experiments with a view to reducing the rolling motion in a sea-way. The *Cecile*, it should be stated, is a bad roller, or, rather, a difficult vessel to prevent from rolling, as she has large metacentric height and a flat floor; in other words, she has considerable stability. In this vessel Mr. Thornycroft fitted, under the cabin floor, a shaft, which was free to turn completely round its axis, and to this was keyed a mass of ballast weighing 8 tons. The shaft had a crank, which was actuated by an hydraulic motor. In this way the ballast could be moved out from the centre line of the ship, so as to counteract the rolling motion. The movement of the weight had naturally to be provided for by some automatic arrangement, and this was supplied by a short-period pendulum placed near the centre of gravity of the ship, and actuating the valves of the motor. So far, all is simple enough, but here the difficulties commence. The inertia of the heavy mass of ballast will cause some loss of time, as only a limited force could be used for its control, and Mr. Thornycroft sets himself the task of overcoming this difficulty. He therefore introduced a second pendulum, of long period, which tends to move the ballast in an opposite direction to the first pendulum, and this enables the apparatus to discriminate between the angular motion of the water and that of the vessel. Mr. Thornycroft found, however, that the long-period pendulum is rather a delicate instrument, and its function can best be served by a cataract arranged to always slowly return the ballast to the centre. This device has the effect of accelerating the phase of motion, which in some cases is required. Unfortunately, at this point Mr. Thornycroft's description breaks off. The mechanism by which the motion of the pendulum is made to govern the movement of the weight was described by Mr. Beauchamp Tower, who has seen it in operation, as "the greatest intellectual treat to all who appreciated the niceties of mechanical design." This intellectual treat was denied to the members of the Institution, for the mechanism was not described further than that it was an electrical device. Those, however, who have attempted to work with pendulums on board ship will be sure that Mr. Tower did not exaggerate the ingenuity of its inventor; and we hope some day to have the details made public, more especially as the Director of Naval Construction—who was another of the favoured few who had seen the apparatus at work—stated that he felt sure it would have a wide application for other purposes than that for which it was originally devised. As a result, in a heavy sea in the Channel, the apparatus reduced a roll of 18° each way to one of 9° each way.

Mr. W. H. White's paper on recent experiences with H.M.'s ships had of course been looked forward to with considerable expectation and interest. The Director of Naval Construction has the art by which he can render interesting almost any subject upon which he writes. Probably, however, the paper was disappointing to many engineers, who were misled by the title into the belief that the great forced-draught and leaky-tube question was going to be fought out. As a matter of fact, Mr. White only referred to the boiler problem in order to inform his audience that he was going to say nothing about it; and the chief point to which he turned his attention was the influence of shallow water upon the trial trip speeds of modern vessels. In past times when speeds were more moderate, the Stokes Bay measured mile did well enough, but now that vessels have to be tried to 20 knots and over, the depth of water is wholly insufficient. Most of the measured miles on which ships are tried have an insufficient depth of water, the notable exception being the Skelmorlie course on the Clyde, which appears to be everything that can be desired, the water being both sheltered and deep. The Humber course is apparently the worst, as it is shallow in depth and very much exposed. In connection with this matter, an amusing incident arose during the discussion on Mr. White's paper. A patriotic Scots shipbuilder had been exulting in the superiority of the Scottish mile over all those on the English coast. He was followed by a Hull constructor, who acknowledged the excellence of the Skelmorlie trial ground, "which," he said, "doubtless largely accounted for the very excellent results attained by Clyde-built vessels." To return, however, to Mr. White's paper; he gives an instance of two sister vessels tried on the Maplin mile at different states of the tide. The variation in depth of water was 9 feet on 42 feet, and with the same power indicated there was a difference of half a knot in speed. The cruiser *Edgar*, in Stokes Bay, with 12 fathoms of water, required 13,260 horse-power to attain 20½ knots; whilst in water 30 fathoms deep she reached 21 knots with 12,550 horse-power. In running from the Nore to Portsmouth, the first-class cruiser *Blenheim* made 20 knots with 15,750 indicated horse-power in water 9 fathoms deep. On the same trip, when the vessel got into water of 22 to 36 fathoms, the speed rose to 21½ knots with practically the same horse-power. In this instance the estimated loss due to the shallower water was 3000 horse-power. Other examples were given by the author, and by other naval architects during the discussion, the most notable perhaps being that narrated by Mr. Philip Watts, the chief of the Elswick Ship Yard, who gave his experience with the Italian cruiser *Pimonte*, the results being very similar to those of the *Blenheim*. It is evident that depth of water has a far greater influence on speed trials than has hitherto been generally supposed, and it should be remembered that the smaller vessels, such as torpedo-boats, suffer almost as much as the larger craft. A vessel travelling at a given speed has to carry a wave of dimensions corresponding to the speed, whether the vessel be large or small, so that the size of the vessel does not affect the depth of water required, except in the important detail that a big vessel's keel is nearer the bottom than that of a small one. Vibration was another subject upon which Mr. White treated, but this question was so much more fully dealt with by Mr. Yarrow in the evening, that we may pass on to the paper of the latter contributor; skipping the three intervening, which were of less general interest.

Mr. Yarrow's paper on balancing marine engines and the vibration of vessels was undoubtedly the great feature of the meeting, as was his paper last year on the construction of marine boilers. Unfortunately it is impossible to give a good idea of Mr. Yarrow's lecture—for it was more than a paper—without the aid of the views by which it was illustrated. These were thrown, by means of the lantern and electric light, on a large screen erected for the purpose. As everyone knows who has been present on the trial trip of a torpedo-boat, the vibration in these little craft is excessive. The enormous power exerted by the engines, the rapidity of their reciprocations, and the slight and elastic nature of the hull construction, all combine to render the deck of a torpedo-boat, travelling at her best speed, a most unpleasant position; especially when the spray is driven in sheets across the deck, and the white-hot cokes are at intervals emitted from the chimney. It is natural, therefore, that the question of vibration should be attacked, and to a great extent solved, by one of our two great torpedo-boat builders. Mr. Yarrow, some time ago, came to the conclusion that it was the reciprocating weights of the engines that caused vibration. There was long a general belief that the propeller was the origin of nearly all vibration in screw vessels, and the belief still largely exists; but those best acquainted with the subject have for some time known it to be erroneous. If the blades of a screw be properly balanced, and in other respects if the propeller is as well made as the screws of torpedo-boats have to be, there will be little difference in the amount of vibration whether the screw be in position or taken off, provided the engines are running at the same speed in both cases. Mr. Yarrow has proved these facts most conclusively by an elaborate series of trials made with working models and also with an actual torpedo-boat. The principal model represented to scale a three-crank tri-compound engine. This was hung in a frame by means of spiral springs. The weights of their pistons and other moving parts were as ordinarily arranged in a torpedo-boat's engines. The model was caused to work by means of a thin and flexible steel wire, so that no motion other than a rotary movement, could be conveyed to the apparatus. When the model was caused to work, at a given speed, the movement was excessive. In this way was very clearly brought out the fact, already known to engineers, that the vibration of a boat is at its maximum when the revolutions of the engine synchronize with the natural period of vibration of the boat. It will be seen that a boat or ship, like any other elastic structure, say a girder or a tuning-fork, will have a period of vibration natural to it. The reciprocations of the engine pistons cause a certain number of impulses to be communicated to the hull, and if the number of vibrations and the impulses are either one a multiple of the other, then the vibration will be excessive. This has been thoroughly proved by experience, and it has been the aim of builders of high-power vessels of light scantling to fit screws so designed that at maximum speeds the vibrations and revolutions of the engine will not synchronize. In Mr. Yarrow's model the elasticity of the hull was represented by the stiff spiral springs by which the model engine was suspended. Having shown the way in which the reciprocating weights of the engines acted so detrimentally, Mr. Yarrow next proceeded to explain the manner in which he overcame the difficulty. Attached to the model were weights, which he termed bob-weights. These were so placed as to balance the natural reciprocating parts of the engine. They were actuated by eccentrics, and could be put in and out of gear as required. With the bob-weight in operation, the effect was most marked, the model being perfectly steady at any rate of movement. The bob-weights have, of course, to be of the proper weight, and must be accurately placed in the longitudinal plane of the engine, otherwise the balance would be destroyed. This was shown by Mr. Yarrow with the model. He had first thought that a good effect might be obtained by making all three pistons of equal weight—the low-pressure piston is naturally far heavier than the others—but little benefit was obtained in this way. One of the most interesting parts of the lecture was the photographic pictures of torpedo-boats thrown on the screen by the magic lantern. These pictures were among the best of the kind we have ever seen. The boat was moored in the West India Docks so as to get still water, and a calm day was chosen. The propeller was removed so that the engines ran free. The first photograph was taken with the engine in its ordinary condition, no bob-weights being attached. By previous experiment the number of revolutions that caused the most vibration had been ascertained; we believe 240 per minute was the number, and the engines were run at that speed. The boat was therefore caused to vibrate excessively, and the effect was clearly shown by the waves or ripples thrown off from the side. These were beautifully marked in the photograph, the pattern caused by the intervening wave-series being very curious. Many pictures were given illustrating various wave phenomena due to different combinations, one of the most interesting being that in which vibration was caused by one of Mr. Yarrow's assistants springing on the stern 240 times a minute; an athletic feat of no mean order, and one which required considerable training.

Another series of photographs, taken broadside, very clearly showed, by means of the wave motion, the nodes of vibration due to the period; the straight and the broken water line being well defined. When the bob-weights were attached, this phenomenon was naturally not present, as the vibration was destroyed. Our description has extended so far beyond our proper allotment of space, that we have not been able to describe the "vibrometer" which Mr. Yarrow has devised, and by which he obtains automatic records of the vibrations of a vessel. This instrument, if not absolutely accurate, has been proved quite sufficient for the purpose. On the whole, one can hardly doubt, after hearing Mr. Yarrow's lecture, that he has found a practical solution to the vibration difficulty, which threatened to become one of such serious dimensions, not only in torpedo craft but passenger steamers, in these days of high speed and steel hulls.

The other papers we must pass over very briefly. Mr. Denny's monograph on the strength of steamers consisted virtually of a table with some explanatory notes. It represented a large amount of work, and will prove of great use to naval architects. Mr. Hök's contribution added another to those many "rapid methods" which from time to time are brought forward, but none of which have, so far as we are aware, yet superseded the older methods of calculating stability. Mr. Heck's paper was a useful contribution, explaining some simple methods he had devised for arriving at the state of the atmosphere in petroleum steamers.

On Friday the first paper taken was that of Mr. Froude, who may be safely described as our first living authority on the screw propeller in its scientific aspect. It will be remembered that the author has of late read a series of papers on this subject before the Institution. During the discussion on his contribution of last year Mr. Thornycroft suggested that some of the conclusions arrived at might be modified by the rotation of the race, and it was in order to elucidate this point that the investigation was undertaken. The present paper is the outcome of this. It would be useless to attempt to abstract, ever so briefly, a paper on so abstruse a subject as this; in fact, up to the present time we have not been able to give the day's preliminary study which Mr. Froude's papers require before we can fairly get a grasp of their drift. We should perhaps have hardly had the courage to make this admission had not two such past masters of the subject as Mr. Thornycroft and Mr. Macfarlane Gray confessed that they had devoted a day to the study of the paper, and still were not in a position to discuss it. The paper by Mr. Liversidge was the last read, and led to a short discussion, in which no point of special interest arose.

FOURTH ANNUAL REPORT OF THE DELEGATES OF THE OXFORD UNIVERSITY MUSEUM.

THE Delegates of the University Museum have presented their Report to Convocation for the year 1891. This Report consists of two parts: (1) the General Report of the Delegates, properly so called; and (2) the Departmental Reports of the Professors and Lecturers teaching within the Museum precincts.

The Delegates call attention to the improved accommodation provided, or in course of being provided, for the several departments of Comparative Anatomy, Zoology, Geology, and in the Pitt-Rivers Museum. These new and improved buildings will be fully available before the end of 1892. The result will be, in the Comparative Anatomy Department, by altering the old dissecting-room, to utilize it for convenient and well-lighted rooms for laboratory and museum work. The Geological Department, which has long been inadequately accommodated, will be enlarged by a long working-room and a store-room above. Two spacious store-rooms have likewise been provided for the department of Zoology and the housing of the Hope Collection. A Curator's room has also been provided for the Pitt-Rivers Collection, and additional facilities for the arrangement and storage of specimens.

The dissecting-room, lecture-theatre, museum, and assistants' and working rooms required for the department of Human Anatomy are in course of erection. They are expected to be available for use early in 1893.

Among the Professors' Reports, the Regius Professor of Medicine regrets that the University authorities have not seen their way to provide, even on a modest scale, a Bacteriological Laboratory for the use of his department. But under the supervision of Dr. Carl Menge, recommended by Prof. Virchow, a small laboratory has been arranged in the limited space devoted to the department of Medicine. The apparatus was purchased in Berlin, and Dr. Menge, freed from duties abroad, conducted a class during the long vacation in the technique of Bacteriology. This class was not only attended by several gentlemen who had passed the M.B. examination, but interested many of the medical practitioners in Oxford.

Sir H. Acland hoped to investigate the condition of the waters in and about the Isis and Cherwell, in connection with the larger inquiry as to the bacterial condition of the water supplied to London, but for various reasons this investigation is for the present left in abeyance.

The Linacre Professor of Comparative Anatomy divides his report into two subdivisions: (1) the care and development of the collections illustrating the comparative anatomy and classification of animals placed in the court of the Museum, and (2) the administration of the laboratories and lecture-room assigned to his department.

In the first subdivision the Professor remarks that the specimens are rather stored in cases than "exhibited." By the aid of competent assistants, however, he hopes that the more typical specimens may be set out and labelled in a thoroughly demonstrative manner, after that introduced by Prof. Flower at the British Museum. A special case, illustrating the chief treasure of the Oxford Museum, viz. the head and foot of Ashmole's Dodo, is being made ready, and also a series of specimens, casts, and drawings, to exhibit the interest and importance of the six fossil jaws of Mammals from the Stonesfield Slate.

"The task of doing justice to the valuable collections belonging to the University, by adequately exposing, labelling, and arranging, some in exhibition cases, and by carefully recording and storing others, where they shall be readily accessible for the purposes of the student, is no light one. Even with a full staff of assistants it would take several years, and could never be 'finished,' any more than the books of the Bodleian Library could be finally arranged and left so for the admiration of future generations. The Natural History collection of the University requires constant care, special curators, and consequently a considerable annual expenditure, just in the same way as does its collection of books, though the former at present does not require so large a sum for its proper administration as does the latter. I have therefore to report that I have not sufficient funds at my disposal for carrying out the arrangement of the collections under my care with efficiency, or with reasonable promptitude."

The second part of the report shows the number of students attending the laboratory and lecture rooms. The number averages about thirty per term, and in addition to the ordinary lectures, informal meetings are held in which recently published memoirs on embryological and morphological subjects are discussed. Dr. Benham, Mr. Goodrich, Mr. Minchin, and Mr. E. B. Poulton and others have assisted the Professor in these informal classes.

The Curator of the Pitt-Rivers Museum gives a long catalogue of additions to his department, and remarks that the various series of musical instruments have been so far as possible completed, with labels, sketches, maps, &c. The weaving and bark-cloth series has been re-arranged, and similarly the series of masks, primitive boat models, and the fire-making series, which is one of the most typical in the collection.

The Report of the Lecturer on Human Anatomy has reference principally to the construction of the new laboratories referred to in the Delegates' Report. The Lecturer in the course of the summer vacation visited the medical schools of Strassburg, Munich, Freiburg, Vienna, Buda-Pest, and Brussels, in order to observe the most approved methods of teaching and museum arrangement, and also to inspect the recently built anatomical institutes of these various centres of medical education, with the view of using the information so obtained in the fitting up of the new Laboratory.

The remaining reports do not present any points of special interest. They include reports from the Hope Professor of Zoology, the Professor of Experimental Philosophy, the Waynflete Professor of Chemistry (who has had ninety-eight individual students at work under his direction during the year), and the Professors of Geology, Mineralogy, Geometry, Natural Philosophy, and of the Reader in Anthropology.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, March 31.—"The Abductor and Adductor Fibres of the Recurrent Laryngeal Nerve." By J. S. Risien Russell, M.B., M.R.C.P. Communicated by Prof. V. Horsley, F.R.S. (From the Pathological Laboratory of University College, London.)

The first part of the following research consists in the separation and isolation of the different bundles of nerve fibres of which the nerve trunk is composed, electrical excitation of each separate bundle, and observation of the effects produced on the vocal cords by such excitation.

Exposure of the different bundles of nerve fibres, under exactly similar circumstances, to the drying influence of the external air, with observation of the relative duration of vitality possessed by the different bundles, forms the second part of the investigation.

Other methods were next instituted to control the results of the foregoing, and the first of these, constituting the third part of this work, consisted in tracing by *post-mortem* dissections each bundle of nerve fibres separated in the nerve trunk to its termination in the mucous membrane or in a muscle of the larynx.

The next control method consisted in exposing the muscles of the larynx immediately after death, and direct observation of them during excitation of the separate bundles of nerve fibres, this being controlled by occasional excitation of individual muscles themselves. This forms the fourth part of the investigation. The fifth or last part of the research served as a third control method, and consisted in observations of the muscular degenerations which followed division of one or other bundle of nerve fibres in the nerve trunk, three weeks after such division.

The results of these experiments show clearly :—

(1) That the abductor and adductor fibres in the recurrent laryngeal nerve are collected into several bundles, the one distinct from the other, and each preserving an independent course throughout the nerve trunk to its termination in the muscle or muscles which it supplies with motor innervation, a condition of things, the possibility of which was suggested by Dr. Semon more than ten years ago, from the evidence of pathological facts.

(2) That while in the adult animal simultaneous excitation of all the nerve fibres in the recurrent laryngeal nerve results in adduction of the vocal cord on the same side, abduction is the effect produced in a young animal by an exactly similar procedure.

(3) That when the abductor and adductor fibres are exposed to the drying influence of the air under exactly similar circumstances, the abductors lose their power of conducting electrical impulses very much more rapidly than the adductors—in other words, they are more prone to succumb than are the adductors—a fact which has for long been recognized and insisted on by Dr. Semon as being the case in the human subject, and in support of the truth of which that observer has adduced so many powerful arguments.

(4) That, even in the young dog, the abductor nerve fibres, though perserving their vitality much longer than in the case of the adult animal, nevertheless in the end succumb before the adductor fibres.

(5) That this death commences at the point of section of the nerve, and proceeds gradually to its peripheral termination, and does not take place in the whole length of the nerve simultaneously.

(6) That it is possible to trace anatomically the abductor and adductor fibres throughout the whole length of the recurrent laryngeal nerve to their termination in the one or other group of laryngeal muscles, and that these fibres appear to bear a fixed relationship to each other throughout their course, the abductors being situated on the inner side of the nerve or that next to the trachea, while the adductors are on the outer side.

(7) That it is possible to so accurately separate these two sets of fibres in the nerve trunk that excitation of either of them evokes contraction of the abductor or adductor muscles, as the case may be, without evoking any contraction whatever in the muscle or muscles of opposite function

(8) That the bundle of nerve fibres concerned with one function may be divided without injury to that concerned with the opposite function, and that such division is followed by atrophy and degeneration of the muscles related to that function without any such changes being detectable in the muscles related to the opposite function.

Further, it is clear that the theory advanced by Mackenzie, and which has since found favour with many, viz. that possibly the reason why the abductor fibres succumb before the adductor in affections of the nerve is because they are more superficially and circumferentially arranged, while the adductor fibres are situated deep in the substance of the nerve, is shown by these experiments to be entirely erroneous.

One point which is difficult to explain is why there should be so marked a difference between the recurrent laryngeal nerve of a young and that of an adult dog, as regards the respective predominance of abductor or adductor representation in the trunk of the nerve. Possibly the reason why the abductor influence is in the ascendency in the young dog is because the power of phonation is still imperfectly developed, and with it both the muscle and nerve fibres subserving this function are also imperfectly developed, while the function of respiration is from the beginning fully developed, and with it the muscle and nerve fibres connected with that function. That the reverse should be the case in the adult animal may well be due to the fact that phonation is perfectly developed, while respiration has become so automatic that very feeble stimuli are necessary to keep it going.

"Interference with Icterus in Occluded Ductus Choledochus." By Vaughan Harley, M.D.

This paper is one of considerable biological-pathological interest, as it gives an experimental explanation of the strange discovery made by Kufferath, in 1880, that by placing a ligature on the thoracic-duct, the jaundice-producing effects of an occlusion of the common bile-duct could be instantly arrested—which fact Kufferath did not so much as even attempt to explain ; and no other physiologist having either confirmed or negatived the statement, far less offered any explanation of it, there were two problems requiring to be solved when Dr. Vaughan Harley entered upon the investigation :—

(1) Does ligaturing the thoracic duct actually prevent the jaundice which otherwise inevitably occurs after occlusion of the common bile-duct ?

(2) If it does, how can such a remarkable phenomenon be explained ? seeing that the chyle-transmitting thoracic duct has no apparent physiological connection with the ductus choledochus.

Kufferath only kept the animals he operated upon alive from 1 to 2½ hours—a period of time far too short to admit of any important morphological changes occurring, which could yield a clue to the mystery. Hence the first thing was to try and find a means of keeping the animals experimented upon alive for much longer periods of time, after both ducts had been ligatured. This was successfully done by feeding the dogs on fat-free food, containing only small proportions of proteids. It was found that when so fed dogs could not only be kept alive for weeks, but even months ; and, what was stranger still, they even gained in weight.

The non-appearance of jaundice after ligature of the bile-duct when the chyle-duct was also tied, appeared remarkable from the fact that it was by all believed that both bile pigments and bile acids were always absorbed by the blood capillaries from the bile ducts ; whereas it is now shown experimentally, in this paper by Dr. Vaughan Harley, that the blood capillaries have absolutely nothing whatever to do in the matter, and that, contrary to what has been up till now imagined, the pent-up bile is solely absorbed from the bile-ducts by lymphatics, and carried by them into the general circulation by the circuitous route of the thoracic duct.

Dr. Vaughan Harley has further demonstrated experimentally that, if a sufficient length of time is allowed to elapse after ligaturing the thoracic duct, bile pigment and bile acid again appear in the urine just as if the thoracic duct had not been ligatured at all, and that this arises from the fact that collateral lymphatics shoot out from the thoracic duct at a point below the ligature, and convey its contents into the right innominate vein. Hence he says that the three following conclusions may be drawn from the results obtained from his experiments :—

(1) That bile existing in the bile-ducts can only reach the blood through the intervention of the lymphatics.

(2) Seeing that lymphatics surround the liver blood-vessels, one is forced to believe that bile pigment and bile acid cannot pass through the endothelium of the blood capillaries in the liver ; or, perhaps, even throughout the body. The fact that bile reaches the blood when it has escaped into the peritoneal cavity is no argument against this view. For in that case it reaches the blood through the lymphatics of the diaphragm.

(3) After the left thoracic duct of the dog has been ligatured for some time, collateral lymphatics are opened up or developed from it leading into the right innominate vein.

Physical Society, March 25.—Prof. S. P. Thompson, Vice-President, in the chair.—A note on the electromotive forces of gold and platinum cells was read by Prof. E. F. Herroun. Modern text-books put gold before platinum in Volta's electro-positive series, and thus one is led to expect a greater evolution of heat when gold combines with (say) chlorine, than when platinum does so. This, however, is not the case, for Julius Thomsen gives for the heat of formation of platinic chloride a value considerably greater than that for auric chloride. Gold should therefore be electro-negative to platinum. The few experimenters who have tested such cells, arrived at different conclusions, hence the author took up the subject, and examined experimentally the E.M.F.'s of zinc-platinum and zinc-gold cells, the metals being immersed in solutions of their chlorides of equal molecular strength. Instead of platinic chloride a solution of sodio-platinic chloride was employed. From Thomsen's thermo-chemical data, the E.M.F. of such a zinc-platinum cell should be 1·548 volts, whilst experiment gave values between 1·70 and 1·473, according to the previous history of the cell. The average E.M.F. was about 1·525. Allowing the cell to send a current reduced the E.M.F. considerably, but it partly recovered on standing. Renewing the sodio-platinic chloride reproduced the high initial E.M.F. of 1·7 volts. This high value, and the uncertainty of the E.M.F. after sending a current, the author believed due to dissolved oxygen. Zinc-gold cells, the metals being immersed in solutions of their chlorides, gave more constant results, the maximum being 1·855, and the minimum 1·834 volts, whereas from thermo-chemical data the E.M.F. should be 2·044. On replacing a gold plate by a platinum one, the E.M.F. fell to 1·782. Other experiments showed that gold is slightly electro-positive to platinum in water or dilute HCl, but in aqua regia the positions are reversed. Prof. Ayrton said the experimental E.M.F.'s were fairly close to the theoretical values, and thought the differences might arise from occlusion of gases, which, although not taken into account in the thermo-chemical experiments, might have considerable effect on the electrical values. Platinum, especially, had remarkable occluding properties. Mr. Enright pointed out that, if any gases were disengaged by the reactions in the cells, their thermal values must be allowed for. The Chairman (Dr. Thompson) believed that some discrepancy between the calculated and observed values of the E.M.F.'s might be due to the calculations only being carried to the first degree of approximation. The complete expression contained, amongst others, a term depending on the temperature coefficient of the cell. On the subject of variation of the sign of E.M.F. with the strength of solutions, he said he had observed similar effects with cyanide solution. Dr. Herroun, in reply, said care was taken to expel as much of the occluded gas as possible before using the plates, and no gases were formed in the reactions. To Dr. Thompson he pointed out that Clark's cell had an E.M.F. greater than that calculated from thermo-chemical data, hence the temperature coefficient ought to be positive, but, as a matter of fact, it is negative. The discrepancy between the calculated E.M.F. and the observed he believed due to inaccurate determinations of the thermo-chemical constants of mercury salts.—A new instrument for showing the effects of persistence of vision was exhibited and described by Mr. E. Stuart Bruce. The instrument, which the author calls an "aërial graphoscope," consists of a narrow wooden lath mounted on a whirling machine, so as to be rotated rapidly in its own plane. The lath is tinted gray in the centre, and shades off to white at the ends. When rotated rapidly, it presents the appearance of a nearly uniform screen or disk, owing to persistence of impression. Ordinary lantern-slides were projected on this aërial screen with remarkable effect, for the pictures appeared suspended in mid-air. The author explained that the object of darkening the lath near the middle was to give a more uniform illumination to the picture or disk. On covering up the centre portion of the lath with white paper, the middle of a picture projected on it was much more strongly illuminated than the edges. Mr. Blakesley pointed out that the effect produced by darkening the centre of the lath might be attained by painting white sectors on a black lath.—A paper on some electrical instruments was read by Mr. R. W. Paul, and the apparatus exhibited. He first described a new form of standard ohm, the distinguishing feature of which is that the wire is wound in one flat spiral, and contained between two thin brass plates. The whole of the wire is thus practically at the same level in the water-bath, and therefore will be more likely to be at uniform temperature throughout than coils having considerable vertical depth. A thermometer passing down the central tube has its bulb on the same level as the wire; and another thermometer, placed in the water-bath at the same level, serves to check the uniformity of temperature. In order that the width of the coil may not prevent convection currents in the bath, the screws which fix the two brass plates together have large holes through them. Dr. Fleming's suggestion of forming the upper ebonite insulator into an oil cup has also been carried out. A new form of Wheatstone bridge was next shown, possessing all the advantages of the dial pattern combined with great facilities for cleaning. There are four resistances in each proportional arm, and the adjustable arm has four sets of coils—units, tens, hundreds, and thousands—each set consisting of ten equal coils. The ends of each coil are connected to brass sockets, fixed, about an inch apart, on the ebonite top. Successive coils are put in circuit by placing a plug attached to a flexible cord in the required socket. Special contact-bars are provided, whereby two or more coils of any set of ten may be put in parallel arc, so as to get accurate resistances of large carrying capacity. These bars are also useful for obtaining high ratios between two resistances, a point of considerable importance in the testing of large resistances. Amongst the advantages claimed are: better insulation, avoidance of surface leakage by providing ample facilities for cleaning, small block error which is constant and easily measured, and no loose plugs required. Each set of ten coils may be used as separate circuits. By means of two travelling terminals the box may also be used as a potentiometer reading to 1 part in 10,000. A reflecting galvanometer with several improvements was then exhibited and described. The coil is supported on an ebonite pillar fixed to a tripod, below the centre of which controlling magnets on the Siemens principle are pivoted. The pillar gives good insulation from earth, and the adjustment of the control can be made without setting the needle in vibration. The two halves of the coil are wound according to Sir W. Thomson's law, and fixed in ebonite boxes turned to fit them. They are thus kept permanently in shape. The ebonite boxes are interchangeable, so that either high- or low-resistance coils can be used in the same stand. The coils have separate terminals, and can therefore be used in series or parallel or differentially. The mirror is placed in a metal box below the coils. When intended for an astatic instrument, magnets are put behind the mirror, and the metal box serves to damp the vibrations. For ballistic work the mirror has no magnets on it, and the damping may be regulated by sliding in or out a plug which carries the window of the mirror box. Mr. Swinburne inquired whether the plan of using two vertical magnets to form an astatic system had been tried, and with what result. He also asked if dial bridges made with switches instead of plugs would not be advantageous. Dr. Sumpner said vertical needles had been used at the Central Institution, and found satisfactory. Mr. A. P. Trotter wished to know whether there was any very great advantage in designing galvanometers with a minimum amount of wire. A galvanometer was often required for many different purposes, and it did not follow that one with a minimum amount of wire was the best all-round instrument. Mr. C. W. S. Crawley made inquiries as to the magnitude of the block error in the form of Wheatstone bridge shown, for he thought the flexible cords would make it considerable. In reply to Mr. Swinburne, he said he had found the variations in switch bridges greater than in plugs. Prof. S. P. Thompson thought it was not generally known that the best shape of galvanometer coil depended on whether the instrument was to be used as an ammeter or voltmeter. The shape determined by Sir W. Thomson was a voltmeter coil; that for an ammeter was much shorter axially. Mr. Paul, in reply, said he used one or other shape of coil according to the use for which the galvanometer was intended. The block error in the Wheatstone bridge was very small, and quite negligible for most purposes. When very great accuracy was required, the error, being constant, was easily measured and allowed for.

Royal Microscopical Society, March 16.—Dr. R. Braithwaite, President, in the chair.—Mr. G. C. Karop exhibited and described Messrs. Swift's new fine adjustment to the substage. Mr. Karop stated that in this substage one complete revolution was equivalent to a vertical movement of the $\frac{1}{150}$th of an inch.—Mr. E. M. Nelson gave a *résumé* of the contents of two papers, the first of which was entitled "Virtual Images and Initial Magnifying Power," and the other "On Penetration in the Microscope."—Dr. W. H. Dallinger said that an important communication had been received from Prof. Czapski, "On the Calculable Limit of Microscopic Vision." Its purpose was to show why it was that great numerical aperture was of such high value in the determination of minute structure, and to inquire whether—seeing that a numerical aperture of 1·60 was so utterly unavailable in the case of living objects, or of such as did not admit of being put into media of sufficiently high refractive index—there was any method of making these high numerical apertures available for such objects? The author had inquired into the value of monochromatic light for such a purpose, and the latter part of his paper was to show that by using the blue rays of such light with large apertures it was possible to increase the aperture so as to obtain the relatively great advantage which would result from a difference between 1·40 and 1·75. Mr. F. Crisp thought it should be pointed out that the broad fact dealt with in this paper was one which had long ago been explained. Dr. Dallinger said he had himself worked it out some time ago, obtaining as a result the difference between 1·40 and 1·70 which came remarkably near to that mentioned in the paper. Mr. Crisp said that the aperture table which was printed with every number of the Journal gave them the difference in resolving power between white light and monochromatic blue light with objectives of various apertures.—Prof. F. Jeffrey Bell gave an outline of the contents of a paper by Mr. H. L. Brevoort, entitled "Observations on the Brownian Movement," and pointed out that, whilst the general conclusion arrived at by the author was that light had some influence in the matter, he did not seem to have taken any precautions as to temperature, an element which was usually considered to be an active agent in this phenomenon.—A letter from the Hon. J. G. P. Vereker was read, replying to some points raised during the recent discussion of his paper "On the Resolution of *Podura* Scales."—Dr. A. C. Mercer read a paper on photomicrography as illustrated by a collection of seventy-three lantern-slides. Among the slides exhibited was a group which threw light on the vexed question of *Podura* scale structure. The author showed conclusively that the so-called featherlets on *Podura* scales are only inflations of the membrane. A number of slides also proved the value of the microscope as a means of detection in cases of forgery, or when alterations were alleged to have been made in promissory notes, the evidence afforded in one important case being very clearly demonstrated. A further group of slides was devoted to the illustration of the apparatus used in photomicrography. The President, in proposing a vote of thanks to Dr. Mercer, said he regarded the exhibition as the finest examples of what could be done by means of photomicrography.

Entomological Society, March 23.—Dr. D. Sharp, F.R.S., Vice-President, in the chair.—The Secretary read a letter from the City of London Entomological and Natural History Society on the subject of a proposed Catalogue of the Fauna of the London District.—Mr. G. C. Champion exhibited a number of new species of Longicornia from Mexico and Central America, recently described by the late Mr. H. W. Bates, in his paper entitled "Additions to the Longicornia of Mexico and Central America, with remarks on some previously recorded Species," read at the last meeting of the Society.—Mr. S. Stevens exhibited three very rare species of *Noctuæ*, viz. *Noctua flammatra*, *Leucania vitellina*, and *Laphygma exigua*, all taken by Mr. H. Rogers at Freshwater, Isle of Wight, in the autumn of 1891.—Mr. F. C. Adams again exhibited the specimen of *Telephorus rusticus*, in which the left mesothoracic leg consisted of three distinct femora, tibiæ, and tarsi, originating from a single coxa, which he had shown at the meeting on the 24th of February last. The specimen was now reversed, to admit of the better examination of the structural peculiarities of the leg, upon which Dr. Sharp, Mr. Champion, and Mr. Jacoby made some remarks.—Mr. Osbert Salvin, F.R.S., exhibited a series of mounted specimens of the clasping organs in the male of several species of *Hesperidæ*.—Dr. Sharp exhibited, for Mr. F. D. Godman, F.R.S., a collection of Orthoptera recently made in the Island of St. Vincent, West Indies, by Mr. H. H. Smith, the naturalist sent to that island by Mr. Godman in connection with the operations of the Committee appointed by the British Association and the Royal Society for the investigation of the Fauna and Flora of the Lesser Antilles. It was stated that the collection had recently been referred to, and reported on by, Herr C. Brunner von Wattenwyl and Prof. J. Redtenbacher.—Mr. J. W. Tutt exhibited and remarked on a series of various forms of *Orrhodia vaccinii* and *O.* (*spadicea*) *ligula*.—Mr. C. G. Barrett exhibited and made remarks on a series of specimens—including some remarkable varieties—of *Bombyx quercus* and *Odonestis potatoria*. A long discussion ensued as to the probable causes of the variation exemplified, in which Mr. Tutt, Mr. E. B. Poulton, F.R.S., Mr. H. Goss, Mr. Jacoby, Mr. Salvin, F.R.S., Mr. Bethune-Baker, Dr. Sharp, and Mr. Distant took part.—Mr. G. A. J. Rothney sent for exhibition a number of specimens of *Camponotus compressus*, *C. micans*, *Œcophila smaragdina*, *Sima rufo-nigra*, *Solenopsis geminata* var. *armata*, and other species of Ants, from Calcutta. He also communicated a short paper on the subject, entitled "Notes on certain species of Calcutta Ants and their habits of life."

PARIS.

Academy of Sciences, April 4.—M. d'Abbadie in the chair.—Notice of the works of the late M. de Caligny, by M. J. Boussinesq.—On certain systems of equations with partial differentials, by M. Emile Picard.—Delivery from circular orifices, and reappearance between their different superficial elements, by M. J. Boussinesq.—On the native iron of Cañon Diablo, Arizona, by M. Mallard. The author has examined some specimens of native iron found in Arizona, the origin of which is doubtful. The iron contains only 3 per cent. of nickel, and when polished shows cavities filled with a black substance supposed to be iron carbide. In this comparatively soft substance a diamond, 0·5 mm. in diameter, was found by Prof. Koenig in 1890. The iron appears to be of meteoric origin, judging from its appearance. Mr. Foote has pointed out that the existence of a singular elevation, called Crater Mountain, near the place where large fragments of the material were found, may have something to do with their occurrence, but he has been unable to find any volcanic rocks in the neighbourhood. So the question of origin remains *sub judice*, and a critical examination of the region will have to be made before it can be settled.—On the spark spectra of gallium, by M. Lecoq de Boisbaudran. The spectrum given when sparks from a large induction coil play upon the surface of gallium chloride consists of two characteristic violet lines, and a wide, nebulous band in the green. If the same coil is used with a condenser and metallic gallium, a much more complex spectrum is obtained, and one from which the band in the green (wave-length = 502·33) is absent. The two lines in the violet (wave-lengths 417·04 and 403·19) are bright under both conditions of sparking. Substituting a small coil for the large one, M. Lecoq de Boisbaudran found that, besides the two violet lines, two others, at the approximate wave-lengths 641·24 and 639·23, were seen when no condenser was employed. On introducing the condenser, the latter line suffers a considerable diminution in intensity. Another line occurs at λ 632·67, and a nebulous line about λ 535·51. The wave-lengths and characters of all the lines observed under the three conditions are stated in detail.—On a method for the determination of the mechanical elements of helical propellers, by M. S. Drzewiecki.—Observations of Swift's comet (a 1892), made at the Paris Observatory with the West Tower equatorial, by M. G. Bigourdan. Observations for position were made on March 29, 30, 31, and April 1, 2, 3, 4.—The two asteroids discovered respectively by Wolf on March 28, and Charlois on April 1, were observed for position by Mdlle. Klumpke, at the Paris Observatory, on March 31 and April 1 and 2.—Observations of Swift's comet (1892, March 6), made at Lyons Observatory, by M. G. Le Cadet. Position observations were made on March 31 and April 1.—On the indices of refraction of saline solutions, by M. Paul Bary.—New unipolar conductivity of gases, by M. Edouard Branly.—On the attraction between two disks separated by a dielectric, by M. Julien Lefèvre. The author has measured the attraction between two electrified disks separated by a dielectric not in intimate contact with them, and finds it to be represented by the following formula:—

$$\frac{F}{F'} = \left(\frac{e + e'}{\frac{e}{k} + e'}\right)^2,$$

where F′ equals the attraction stress between the plates at the distance $e + e'$ in air; F the attraction at the same distance when a lamina whose dielectric constant is k, thickness e, and having parallel faces, is placed between the plates; e' therefore represents the sum of the thickness of air between the lamina and the electrified disks.—On the production, in the dry way, of some anhydrous crystallized sulphates, by M. P. Klobb. (See Notes.)—On a nitroketone derived from camphosulphophenol, by M. P. Cazeneuve.—On the composition of pinnaglobine, a new globulin, by M. A. B. Griffiths.—On the existence of parallel series in the biological cycle of Pemphigiens, by M. Horvath.—The history of the *Garcinia* of the sub-group *Rheediopsis*, by M. J. Vesque.—Researches on the variations in the transpiration of flowers during their development, by M. G. Curtel.—On some diseases of mushrooms, by M. Julien Costantin.—On the *rôle*, distribution, and direction of ocean currents in France during the Upper Cretaceous period, by M. Munier-Chalmas.—The tubercular vaccination of the dog, by MM. J. Héricourt and Ch. Richet. The authors' experiments indicate that, by the inoculation of tuberculosis *aviaire*, dogs can be vaccinated against human tuberculosis.—On a new pathogenic diplobacteria obtained from the blood and urine of influenza patients, by MM. Teissier, Roux, and Pittion.—Measures of the variations in the lengths of the Dauphiny glaciers, by Prince Roland Bonaparte. Of the sixteen glaciers whose movements were studied in 1890, six were found to be advancing, eight retreating, and two stationary. In 1891 the results obtained indicated that six glaciers were advancing, five retreating, and five stationary. The amounts of movement measured are given in the paper.

BERLIN.

Physiological Society, March 4.—Prof. Munk, President, in the chair.—Prof. Zuntz spoke on Dr. Werigo's experiments respecting the influence of oxygen on the elimination of carbon dioxide by the lungs. When an animal breathed pure oxygen into one lung and simultaneously pure hydrogen into the other, Werigo found more carbon dioxide in the alveolar air of the oxygen-lung than in that of the hydrogen-lung, and hence concluded that oxygen furthers the escape of this gas. Prof. Zuntz, however, pointed out that the diffusion of carbon dioxide from the alveolar air into the contents of the cannulæ used for the introduction of the gases must be greater on the side supplied with hydrogen than on the other, and that hence less carbon dioxide must naturally be found in the alveolar air of the former than of the latter. The really important question whether the absorption of oxygen leads to an increased elimination of carbon dioxide has therefore not yet been answered. Werigo's experiments should be repeated, using oxygen and nitrogen.

Meteorological Society, March 8.—Prof. Schwalbe, President, in the chair.—Dr. Lachmann gave an account of a research on the extremes of temperature in Europe. He first assured himself of the trustworthiness of the readings of his maximum and minimum thermometers. He then determined for stations which afford prolonged series of data how many years must be taken into account in order to arrive at a trustworthy mean, and found that in the case, *e g.*, of Brussels, ten years suffice for the determination of its maximum temperature, whereas some forty years must be taken into account when determining its minimum temperature. After comparing the extremes of temperature with the periodic observations, he discussed the maximal and minimal temperatures met with in Europe, and gave an account of their geographical distribution. When those places with equal maxima are joined by lines, curves are obtained which on the whole resemble the July isothermals, and are the same as the latter if 12° be added to them. The curves of equal mean minimal temperatures correspond to the isothermals for January after subtracting 10°–11°.—Dr. Knorre read a letter containing an account of a thunderstorm on January 31, near Jüterbock, accompanied by hail and light phenomena, which must undoubtedly be regarded as a case of St. Elmo's fire.—Prof. Spörer exhibited photographs of the recent large sun-spot group which he observed between February 9 and 16, and which were most probably connected with the magnetic storm of the 13th and 14th of that month.

Physical Society, March 11.—Prof. Kundt, President, in the chair.—Dr. Stapff spoke on the increase in density of the interior of the earth, and deduced a mathematical formula for its determination.—Dr. Arons described experiments on the electrical polarization at the two sides of a metallic plate immersed in an electrolyte at right angles to the currrent. A platinum plate 0·1 mm. thick gave not only an evolution of gas but an increase of resistance, results which were entirely absent when a gold-beater's film was employed, as also with a film of silver. Pores in the metallic films were not the cause of the absence of polarization, since it appeared even when a small hole was bored in the above-mentioned platinum plate. When four gold-beater's films were superposed, they led to a slight increase of resistance and feeble polarization.—Dr. Rubens stated that he had extended his observations on the dispersion of the ultra-red rays from w.l. 5·7 μ to w.l. 8 μ. He found that the curves for the index of refraction do not correspond with Langley's surmises. As far as w.l. 5·3 μ the curves of the two observers coincide, but the rectilinear course which the curve assumes at w.l. 5·0 μ is not persistent with light of greater wave-length; it tends to rise slightly from the line of abscissæ. Hence Langley's interpolations for very long waves are inaccurate.

AMSTERDAM.

Royal Academy of Sciences, February 27.—Prof. van de Sande Bakhuyzen in the chair.—Dr. Moll communicated some results he had obtained on the karyokinesis of Spirogyra. By embedding the threads in collodion and paraffin, and cutting them into series of sections with the microtome, he has observed a special organization in nucleolus and karyoplasma, leading to the formation of the chromatic segments; he has been able to establish with certainty the existence of the phenomenon of heteropoly in Spirogyra; and lastly, he has seen that Tangl's and Strasburger's *Verbindungschlauch* between the daughter-nuclei appears at an earlier stage in the form of some vacuoles, of which a single one finally prevails.—Mr. van der Waals treated of the phenomenon of incomplete mixture of two liquids, in those cases in which the mixture is complete at a higher temperature, and gave a formula founded on his "theory of a mixture of two substances," by which the volumes of a given weight of dissolved matter may be calculated in the same way as the volumes of liquid and vapour of a single substance.—Mr. van Bemmelen treated of the difference of colloid oxides and crystalline hydrates, especially in reference to the oxide of iron. He demonstrated that only Brunck and Graebe have observed the crystalline hydrate of a definite composition. The substance prepared by Rousseau is not a crystalline hydrate, but ferrite of potassium, transformed by the action of water into amorphous hydratic oxide (of indefinite composition), and only pseudo-crystalline, as it has preserved externally the crystalline form of the ferrite.—Mr. Franchimont showed a sample of ethylaldoxime (acetaldoxime), a beautiful crystallized body, melting at 48° C. The ethylaldoxime, discovered in 1882 by V. Meyer, was described by him and by Petraezek as a fluid, boiling at 114°–115° C. The crystallized ethylaldoxime has the same boiling-point, and may be a stereo-isomery.

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