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FRESHWATER ALGÆ.

Introduction to Freshwater Algæ, with an Enumeration of all the British Species. By M. C. Cooke, M.A., LL.D., A.L.S. With 13 Plates. (London: Kegan Paul, Trench, Trübner, and Co., Limited, 1890.)

DR. COOKE is justified in saying, in his preface, that no apology is needed for the production of this volume, the latest addition to the "International Scientific Series." Notwithstanding the increased attention which has been paid of recent years in this country to this interesting and beautiful class of plants, we have had hitherto no popular hand-book devoted to their structure and their classification; the only existing works on British freshwater Algæ, by Hassall, and by Dr. Cooke himself, having been published at a price which places them out of the reach of the great majority of collectors of Algæ.

More than one-half of the present volume is occupied by a general account of freshwater Algæ, the main points connected with their structure and modes of multiplication, and useful instructions as to their collection and preservation. The greater part of this introductory portion is very good, and will serve admirably to interest and to instruct those who are turning their attention to the collection and determination of the plant-denizens of our streams and pools. In the chapters headed "Polymorphism," "Spontaneous Movements," and "Notable Phenomena," a large mass of interesting information is brought together, and the views of the leading authorities well and clearly presented. In the chapter on "Conjugation," although the present writer naturally dissents from Dr. Cooke's conclusion as to the nature of the process in the Zygnemaceæ, no objection can be taken (except on one minor point) to the way in which both sides of the controversy are presented.

The last two chapters of the Introduction, "The Dual Hypothesis," and "Classification," are much less satisfactory. By the "dual hypothesis" is meant the theory that Lichens are compound organisms made up of a fungal and an algal constituent. Dr. Cooke is, of course, perfectly at liberty to come to a different conclusion on this subject from that of nearly all biologists who have investigated it experimentally; but, at least, if the hypothesis is discussed, the arguments on both sides should be fairly stated. The synthetical construction of a Lichen out of its constituent elements has been affirmed by authorities so worthy of respect as Stahl and Bonnier—a fact which, if established, settles the question in a sense opposite to that accepted by Dr. Cooke; and yet these observations are not even alluded to, much less controverted, by him.[1]

The chapter on Classification is chiefly occupied by animadversions on a system different from that adopted by the author, which has been proposed by other writers on the same subject, "the most pretentious of philosophical systems," which he treats with a certain amount of unphilosophical scorn. Any attempt to classify according to their genetic affinities a class of plants about which so much still remains to be learnt as our freshwater Algæ, must necessarily be to a large extent tentative; but we do not think that practical algologists will be grateful to Dr. Cooke for perpetuating, as the basis of his classification, the obsolete system of Rabenhorst's "Flora Europæa Algarum aquæ dulcis et submarinæ," published in 1864, placing together, for example, *Palmella* and *Apiocystis* in one family, *Protococcus* and *Pediastrum* in another family, and retaining, as a primary group, the "Nematophyceæ." From the sentence on p. 187, the reader would suppose that the separation of the Protophyta as a distinct class was a fad of the "constructors of paper systems," for whom he expresses so great a contempt, instead of having the sanction of such authorities as Luerssen and Sachs long before these "paper systems" were published.

The latter and smaller part of the work is occupied by a description of the families and genera, and of all the known British species, of freshwater Algæ. Though not so stated on the title-page, the two largest families, the Desmids and Diatoms, are not included; but this was inevitable, to bring the work within moderate compass. The Characeæ, which also form a part of Hassall's "Freshwater Algæ," are likewise, and, as we think, rightly, excluded. The plates include a drawing of one species of each genus; they are copied from the plates in the author's "British Freshwater Algæ," and are not improved in the process. It is no fault of Dr. Cooke's that with Algæ, even more than with flowering plants, it is often almost impossible to distinguish the species from verbal descriptions only; those given here are mostly taken from the best writers, and could, on the whole, scarcely be improved. Small inexactnesses in spelling or in expression occur with irritating frequency—such as "immovable" for "motionless" in describing the spores of *Chantransia*, "Kutzing" (and Kutz.) throughout for "Kützing," "*Bulbochoete*" for "*Bulbochaete*," "*Glaeocystis*" for "*Gloeocystis*," "cytioderm" for "cytoderm," &c.; but of more serious inaccuracies we have noticed very few. We must, however, enter a word of protest against the Glossary, taken, apparently, almost *verbatim* from the author's "British Freshwater Algæ." A good glossary is an excellent thing; a bad glossary is useless, or worse. What are we to make of such definitions as the following: "ANTHERIDIA, certain reproductive organs supposed (*sic*) to be analogous to anthers, or fecundative"; "CARPOSPORE, spores produced by conjugation (*sic*) in a sporocarpium"? Under the Chroococcaceæ we find a constant reference to a mucous, gelatinous, or crustaceous "thallus"; turning to the glossary, we find a thallus to be "an expansion somewhat resembling a leaf"! "Trichogonia" are "the female reproductive organs in Batrachosperms"; under the Batrachospermeæ we find no reference to any sexual organs of reproduction.

The work, as it stands, will be in the hands of every collector and lover of Algæ. If, in preparing a second edition, Dr. Cooke will consent, in deference to the views of other algologists, to re-write the two chapters in his "Introduction" to which we have called attention,

[1] Martelli has quite recently recorded a complementary process in the dissociation of a lichen (*Lecanora subfusca*) into its algal and fungal elements.

and will bring his "Glossary" into harmony with the present condition of science, his "Freshwater Algæ" will have a still higher claim to a permanent place in botanical literature. ALFRED W. BENNETT.

APHASIA, OR LOSS OF SPEECH.

On Aphasia, or Loss of Speech, and the Localization of the Faculty of Articulate Language. By Frederic Bateman, M.D., F.R.C.P., Senior Physician to the Norfolk and Norwich Hospital, &c. Second Edition, greatly enlarged. (London: J. and A. Churchill, 1890.)

THE subject of aphasia has always been, and still is, not only of the greatest interest, but also of the greatest difficulty. Its interest is, of course, largely due to the fact that a study of partial or total loss of language may not only help in an analysis of language itself, but also may throw light on the exact anatomical situation of that function which has been said to set up an insurmountable barrier between man and the lower animals. Its difficulty is greatly increased by the fact that each investigator seems to define it in a different way. For instance, in the book whose title is given above, which is a second and greatly enlarged edition of Dr. Bateman's "Aphasia," first published twenty years ago, two entirely different definitions are accepted as correct. In the opening chapter aphasia is defined as "the term which has recently been given to the loss of faculty of language, and of the power of giving expression to thought, the organs of phonation and of articulation, as well as the intelligence, being unimpaired." On p. 154, however, Dr. Bateman states that he will "employ the term as a title for the whole group of disorders of speech, thus embracing not only the loss, but all the various degrees of impairment, of that faculty." This latter definition will, of course, denote an enormous number of affections, such as all the losses or alterations of speech due to gross cerebral lesions, to insanity, diseases of the medulla, cretinism, deaf-mutism, chorea, and so forth, many of which have hardly been touched upon in this work. The former definition also, in spite of its greater connotation, would include such diseases as deaf-mutism, which is hardly a form of true aphasia.

It is, perhaps, better to limit the term aphasia much more than either of the above definitions would allow. As Ross has so well shown in his small but highly philosophical work, "Aphasia," the mechanisms of speech must include (*a*) the "receptive organs"—that is, the eye, the ear, and the touch (as in reading from raised letters); (*b*) the apperceptive centres in the brain, where the various sensory phenomena are appreciated as language—that is, the angular gyrus and supra-marginal convolutions for written language, and the first temporo-sphenoidal convolution for spoken language; (*c*) the emissive motor centres in the brain at the posterior end of the third left portal convolution (Broca's convolution), from which discharges are sent through the internal capsule to the various organs of phonation; and (*d*) the executive organs, including the nerve nuclei in the medulla, the peripheral nerves from these, and the various muscles of the larynx, pharynx, and tongue. Now of these four sets of organs the first and last should not be included in considering true aphasia so that we should not include as aphasia such disorders of speech as arise from deafness, blindness, bulbar paralysis, or paralysis or other diseases of the larynx or tongue. The two remaining groups, (*b*) and (*c*), alone remain, and the organs of both are situated entirely in the brain, so that we can shortly define aphasia as a disorder of speech due to cerebral disease, the intellect being unaffected. It can, moreover, be seen to be roughly of two kinds—sensory when the apperceptive organs are affected, and motor when the emissive organs are affected. Now on these points Dr. Bateman has not been sufficiently explicit, with the result that some subjects have been included in his work which might well have been left out.

Aphasia may be divided, moreover, as regards causation, into organic where there is a distinct gross lesion, and functional where no known lesion is present. Of the functional causes, hysteria is by far the most common, and is generally the cause of those apparently anomalous cases where speech suddenly vanishes, only to return in as sudden a manner.

Nearly the first hundred pages of the book contain a most excellent account of the history of aphasia from the earliest times; but we regret to notice that while great stress is laid on cases reported more than fifty years ago, when nervous diseases were so little understood and when the examination of aphasic patients was most incomplete, yet the later and most thorough accounts of aphasia are noticed very slightly or not at all. Thus, although we find some slight references to Kussmaul's classical work, and also a slighter account of the works of Ross and Broadbent, Wernicke and Lichtheim are altogether neglected. And be it remembered that these names stand out pre-eminently as writers on this difficult subject.

All through this work there is an undercurrent of disbelief in any possibility of localizing the cerebral situation for speech, and after considering all the various views of localization, from that of Schroeder van der Kolk, who localized it in the corpora olivaria of the medulla oblongata, to that of Broca, with his localization in the posterior part of the third left frontal convolution, the author finally agrees with Kussmaul in saying that "a simple centre of language or seat of speech does not exist in the brain, any more than a seat of the soul exists in a single centre." Indeed, as the author's cases (to which I shall refer immediately) show, he seems to take extraordinary pains to satisfy his readers that Broca's convolution is not the seat of language, as in many cases of aphasia it is entirely unaffected. Nowadays, however, a neurologist does not attempt to fix on Broca's convolution alone as the seat of language, but says that either the supra-marginal or angular gyri, or the first temporo-sphenoidal convolution (all on the left side), or their connections with the motor region, are affected, as a rule, in sensory aphasia; or Broca's convolution, or its connections through the internal capsule with the medulla, are affected in motor aphasia. We know now sufficiently well that a lesion at the front of the anterior lobes, or in the motor area proper, would not be accompanied by aphasia, just as we know that a lesion in the other regions mentioned would almost certainly be accompanied by aphasia.

The author's own cases are ten in number, and are of much interest. Cases I. and IV., however, seem to us to have probably been general paralysis of the insane, and therefore not true aphasia, no typical lesion being found in the brain. There is no mention as to whether the pia mater was adherent to the cortex, which would have been probably the case in both instances. Case V. is given as one of disease of the spinal cord producing paraplegia with aphasia, but as no *post-mortem* examination was held, it is impossible to say that there was not a lesion on each side of the brain which would explain the symptoms more simply. In Case VIII., again, no *post-mortem* examination was made, and it appears to us to be a disease of the medulla or pons and not of the brain proper. Cases VI. and X. are evidently both hysterical aphasia, one occurring in a woman at the climacteric period, the other in a man. In the latter case, Dr. Bateman does not consider that it was hysterical, but the whole history of the man appears to us to prove conclusively that it was a typical case of hystero-epilepsy, which is much commoner, even in England, than is supposed. In Cases III. and VII. we have motor aphasia, but without lesion of the anterior lobes, but, inasmuch as the disease was found in the internal capsule, the fibres from Broca's convolution would, of course, be easily affected. Case VII. is again one of motor aphasia, but is rare, as it is accompanied by left hemiplegia instead of the usual right hemiplegia. This, however, is a coincidence which has occasionally been observed, and in which the speech centres seem to be localized on the right side of the brain instead of the left. There appears to have been no *post-mortem* examination in this case. It is much to be regretted that Dr. Bateman has not given better examples from his own experience of the various classes of aphasia, particularly of the sensory variety.

In mentioning the various kinds of aphasia Dr. Bateman describes fifteen different classes. On analyzing these, however, it can be seen that many of these are mere degrees of a larger class, and it would have been much better to have made fewer varieties. Perhaps the most useful division is as follows:—Motor aphasia, including agraphia and aphemia. Sensory aphasia, including word blindness, or inability to understand written language, and word deafness, or inability to understand spoken language. Finally, rather as a result of sensory aphasia, and, as it were, merely a symptom of it, verbal amnesia, in which a patient either constantly uses wrong words, as in paraphasia, or cannot remember the names of things, as in the aphasia of recollection.

Perhaps these cases of verbal aphasia are the most difficult of all to fathom, and they have been the cause of various neurologists assuming that in the brain there is a a definite centre for the understanding and remembrance of nouns, and another for the understanding of propositions. Ross, however, has pointed out that such an assumption is altogether unnecessary, and shows, by a careful analysis of the evolution of language, that in a lesion of any of the various auditory or visual centres such a dissolution of language would occur as would exactly cause inability of understanding propositions or nouns; and, moreover, that highly abstract nouns, such as *virtue*, would disappear first, and, if the injury were greater, then an inability to understand even concrete nouns would occur. In fact, the way in which Ross looks upon all forms of aphasia as mere paralyses, either sensory or motor, is to us the most satisfactory view yet mooted. These highly philosophical explanations have been entirely unnoticed by Dr. Bateman.

A most useful part of this work is a chapter on the medical jurisprudence of aphasia. This is a subject which we believe has not been touched upon in any previous English text-book, and it is of the greatest importance. Undoubtedly in former times many pure aphasics have been considered insane, and so incapacitated for various legal functions. Now, however, the distinction between insanity and aphasia is clear, and although certain cases of aphasia could not be made to understand legal documents, still other cases would have slight difficulty in this respect, and each case would have to be decided on its merits.

The treatment of aphasia is intensely interesting, for, although apparently it is a hopeless task to attempt to form, as it were, new speech centres in the brain, yet it is really wonderful how much may be done in this way by systematic and painstaking efforts.

To summarize briefly, we may say that Dr. Bateman's work is one that should be read by everyone interested in the faculty of language, or in diseases of the nervous system. It contains an enormous amount of valuable material, which has been put together by great labour, and is written by one who has devoted many long years to his subject. ERNEST S. REYNOLDS.

CHEMICAL CRYSTALLOGRAPHY.

Einleitung in die chemische Krystallographie. Von Dr. A. Fock. (Leipzig: Verlag von Wilhelm Engelmann, 1888.)

IN contradistinction to works on systematic and physical crystallography, this little volume is devoted to crystallography in its far more fascinating relations to chemical constitution. It has been a most noticeable fact that while pure crystallography in its geometrical and physical aspects has been brought to a state of great perfection, our knowledge of the essentially intimate connection between crystallographic form and chemical constitution has until recently been almost at a standstill, and our information upon this branch of the subject is confined to a few isolated facts, many of which even are greatly in need of more complete investigation. As to whether chemists will ever be able to predict with tolerable certainty the crystalline form of a new substance of given composition, opinions among crystallographers are divided, and it may with reason be advanced that, in view of the meagre collection of facts before us, opinions cannot claim to have any real value at all. Since crystallography has commenced to be studied a little more from the side of the chemist, almost every number of the crystallographer's journal, the *Zeitschrift für Krystallographie*, edited by Prof. Groth, contains contributions to our knowledge of such relations. And whether it be ever possible or not to attain the great generalization, if chemists will only more generally tackle the study of crystallography, the subject will at least be raised from its present position of doubt and uncertainty. British chemists in particular are somewhat behind in this respect, for the dearth of crystallographers in this country, the home of Miller, one of the greatest names in crystallography, is a subject of general remark among Continental workers in this domain of science. What is required is, first, that chemists shall make practical crystallography, the difficulty of becoming skilled in which has been greatly overestimated, one of the essential accessories of their main subject; and secondly, that special care be taken never to permit a series of well-crystallizing bodies, differing chemically from each other in an ascertained manner, to escape being thoroughly investigated crystallographically, with the object of discovering what geometrical differences accompany the constitutional ones.

To those who take up the subject from this standpoint, Dr. Fock's work will be of great assistance in placing before them in a succinct, concise, and very complete manner, the present state of our knowledge. The earlier chapters deal with the history of the growth of the views now entertained as to the nature of the architecture of crystals. Then follow a series of chapters upon the modes of formation of crystals, by resolidification of the fused substance, sublimation and separation from saturated solutions; upon the complicated influence of water of crystallization upon the geometrical form, and the various theories that have been put forward as to the condition of the water in crystals containing it. The nature of double salts, and the evidence of thermochemistry as to the mode of union of the simple salts in the double molecule, are very fully discussed, and form a most interesting chapter. Then follow a series of chapters upon the ultimate structure of crystals, as evidenced by the mode of formation of crystallites, and the order of growth in larger crystals.

By far, however, the most interesting portion of the book is that which deals with the relations between the crystalline form and chemical composition of crystals. The development of the theory of isomorphism is very clearly traced from the first observation of De l'Isle, in 1772, that the sulphates of copper and iron separated in mixed crystals from a solution of the two, to the latest definition of the theory given by Sohncke with reference to his 65 systems of points. The subject of mixed crystals, and the rules which govern their formation, are entered into at length, and their relations to true isomorphism clearly defined. A very suggestive term, that of "physical isomerism," is given to polymorphism, reminding one forcibly of the similarity between the various forms of the same compound or allotropic forms of elementary substances on the one hand, and the isomerism so characteristic of many of the compounds of carbon on the other. The last few chapters of the book are devoted to a *résumé* of all the more important researches upon isogonism or morphotropy—that is, partial or particular-zone isomorphism. The researches of Groth upon the crystallographical relations between the derivatives of benzene naturally take a prominent place in such a description, being, as they were, the first which were instituted in a systematic manner. And here, in spite of many additions which have recently been made in other branches of organic chemistry to our knowledge of such morphotropic relationships, the subject must perforce end for the present, until more facts have been accumulated and observations multiplied. It is not, however, the mere accumulation of records of measurements of isolated compounds which is so much needed, it is the systematic crystallographical investigation of series of compounds whose chemical relationships are indubitably established that will be calculated to throw most light upon the subject. To this end it is earnestly to be desired that British chemists will not merely content themselves, in describing well-crystallizing new compounds, with attaching to them the meaningless terms "prisms" or "tables," but will have their crystallographical characters thoroughly investigated, and their relationships to other compounds of the same or related series definitely made out.

A. E. TUTTON.

OUR BOOK SHELF.

British Rainfall, 1889. By G. J. Symons, F.R.S. (London: Edward Stanford, 1890.)

THIS work deals with the distribution of rain over the British Isles during the year 1889, as observed at nearly 3000 stations in Great Britain and Ireland. The author begins with his usual report for the year, in which he points out rather particularly, the list only dealing with the years 1884–88, that heavy falls of 3, 4 or 5 inches per diem may occur in all parts of the country. Then follows an interesting article on the amount of evaporation, including illustrations of evaporators and numerous tables.

Under the heading "Staff of Observers" the volume contains returns from 299 stations which sent no perfect record in 1888, the losses being 181, resulting in a net gain of 118. The author informs us that this is the largest increase since the year 1882; and we are glad to see that Scotland, which has been retrograding ever since 1883, has at last improved considerably.

Coming now to the rainfall and meteorology of the year 1889, we have, first, notes of some of the principal phenomena, amongst which we may mention the following:—January 6, at Nottingham, an extraordinary thickness (an inch at least) of rime on all the trees, &c.; June 6, at Cambridge Observatory, severest thunderstorm ever remembered.

The observers' notes for the months and for the year contain some interesting information:—In July, at Finchely, Etchingham Park, there were 22 days of absolute drought followed by 15 wet out of the 20 following days; in the same month the traffic for a distance of ten miles was suspended on the upper level of the Caledonian Canal owing to the scarcity of water.

Of the heavy rains in short periods recorded, the highest was that of 3·37 inches per hour, lasting for 12½ minutes, at Petersfield, Compton; but following this, in Warwickshire, 3·64 inches fell in 1 hour 5 minutes—a quantity unequalled at any station in the British Isles for at least ten years. Of the extremes of rainfall for the year, the largest fell at Stye, in Cumberland (152·85 inches), the least at Dingwall, East Ross (14·51 inches).

Among the absolute and partial droughts, of the former the longest was at Cargen in Kirkcudbright, where no rain fell between June 8 and July 9, or for 30 clear days; and of the latter the longest lasted for 45 days from June 3, at Portland, Co. Waterford. The definitions of these two kinds of drought are respectively:—Periods of more than 14 consecutive days absolutely without rain; periods of more than 28 consecutive days, the aggregate rainfall of which does not exceed 0·01 inch per diem.

With regard to the relation of the total rainfall in 1889 to the average, we find that it is 8 per cent. below the true average as well as 13 per cent. below that of 1870–79.

The general tables of the total rainfall for the year are given, with an explanation of their arrangement.

The result of this systematic and laborious task of gathering all these records and observations reflects great credit on the editor, who seems to have spared no pains to insure the accuracy of the information recorded.

Photogravure. By W. T. Wilkinson. (London: Iliffe and Son, 1890.)

THE aim of photographers has long been to produce prints, permanent and artistic in effect, with the delicacy and truthfulness of a photograph from nature. The process of photogravure seems to fulfil these requirements, and for purposes of book illustration should form a most important factor from the commercial point of view. The process is both simple and interesting, and requires little apparatus or material which is not already found even in most amateur's photographic dark rooms.

Mr. Wilkinson describes in this little book a method employed in obtaining a finished plate, the process being divided into six stages. The first is the production of a transparency upon a special (transparency) carbon tissue from the negative; in the second, from the transparency a negative in ordinary carbon tissue is made; the third consists in laying the etching ground upon a polished copper plate; in the fourth the carbon image (second stage) is mounted and developed upon the prepared copper plate; the fifth stage deals with the protection of the margin, and etching and burnishing; and the sixth and last stage gives us the print from the plate, done in much the same manner as copper-plate etchings and mezzotint engravings. The frontispiece, by W. L. Colls, affords a good illustration of a result of this process.

Elements of Euclid. Book I. By Horace Deighton, M.A. New Edition, Revised. (London: George Bell and Sons, 1890.)

THE present edition of Mr. Deighton's book is a great improvement on many of the works on this subject. In addition to the ordinary propositions, the solutions of a large number of important propositions are incorporated in the text with riders attached to them, which will be found useful, since in examinations nowadays more is required than is contained in Euclid.

Abbreviations and other symbols are used throughout, with the exception of the first fifteen propositions, and great clearness is obtained in the propositions and problems by making the construction lines thin, and also by printing the letters referring to the figures in a larger and more conspicuous type.

At the end of Book I. a series of examples is given on the propositions in it, and a short chapter on plane loci is added. This book will be especially instructive to beginners, the author having smoothed the path for those who wish to acquire facility in solving geometrical questions.

Camping Voyages on German Rivers. By Arthur A. Macdonell. (London: Edward Stanford, 1890.)

IN this book Mr. Macdonell gives an account of boating expeditions on German rivers. Some of the streams he describes have already been dealt with in English books, but he may fairly claim that no previous work of the kind is so nearly complete as his own. Every German river—with the exception of the Lahn—which an Englishman would care to see, he has navigated; and his experiences with regard to each are carefully recorded. We need scarcely say that for young and vigorous travellers there is no more delightful way of visiting a beautiful country. It not only provides them with healthy physical exercise, but takes them into the midst of enchanting scenery, and gives them opportunities of becoming intimately acquainted with interesting towns and villages. Mr. Macdonell has thoroughly appreciated the happiness which has thus come in his way; and in this book he contrives to communicate to his readers a good deal of the pleasure with which he recalls his adventures, and depicts what he has seen. The work is based on notes taken down each day in the course of the various voyages, and to some extent this no doubt accounts for the brightness and freshness of the narative. The value of the book is much increased by good maps, of which no fewer than twenty are given.

Epping Forest. By E. N. Buxton. Third Edition. (London: Edward Stanford, 1890.)

WE are glad to welcome a new edition of this excellent little Guide. Mr. Buxton says the idea of writing it occurred to him when he observed how small a percentage of the summer visitors to Epping Forest ever ventured far from the point at which they were set down by train or vehicle. No one to whom this Guide is known will be content to go to Epping Forest without trying to see as much of it as can be conveniently visited. Mr. Buxton has lived all his life in one or other of the Forest parishes, and knows exactly what parts of the subject are most worthy of being fully dealt with. He knows also how to express concisely and clearly all that he wishes to say. For visitors who are interested in natural history he has added some chapters on "the different forms of life which they may expect to find in the course of their rambles."

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.*]

The "Barking Sands" of the Hawaiian Islands.

ABOUT a year ago NATURE printed my letter from Cairo giving a condensed account of an examination of the Mountain of the Bell (*Jebel Nagous*) on the Gulf of Suez, and of the acoustic phenomenon from which it is named. In continuation of my researches on sonorous sand, which are conducted jointly with Dr. Alexis A. Julien, of New York, I have now visited the so-called "barking sands" on the island of Kauai. These are mentioned in the works of several travellers (Bates, Frink, Bird, Nordhoff, and others), and have a world-wide fame as a natural curiosity; but the printed accounts are rather meagre in details and show their authors to have been unacquainted with similar phenomena elsewhere.

On the south coast of Kauai, in the district of Mana, sand-dunes attaining a height of over one hundred feet extend for a mile or more nearly parallel to the sea, and cover hundreds of acres with the water-worn and wind-blown fragments of shells and coral. The dunes are terminated on the west by bold cliffs (*Pali*) whose base is washed by the sea; at the east end the range terminates in a dune more symmetrical in shape than the majority, having on the land side the appearance of a broadened truncated cone. The sands on the top and on the landward slope of this dune (being about 100 yards from the sea) possess remarkable acoustic properties, likened to the bark of a dog. The dune has a maximum height of 108 feet, but the slope of sonorous sand is only 60 feet above the level field on which it is encroaching. At its steepest part, the angle being quite uniformly 31°, the sand has a notable mobility when perfectly dry, and on disturbing its equilibrium, it rolls in wavelets down the incline, emitting at the same time a deep bass note of a tremulous character. My companion thought the sound resembled the hum of a buzz saw in a planing mill. A vibration is sometimes perceived in the hands or feet of the person moving the sand. The magnitude of the sound is dependent upon the quantity of sand moved, and probably to a certain extent upon the temperature. The drier the sand the greater the amount possessing mobility, and the louder the sound. At the time of my visit the sand was dry to the depth of four or five inches; its temperature three inches beneath the surface was 87° F., that of the air being 83° in the shade (4.30 p.m.).

When a large mass of sand was moved downward I heard the sound at a distance of 105 feet from the base, a light wind blowing at right angles to the direction. On one occasion horses standing close to the base were disturbed by the rumbling sound. When the sand is clapped between the hands a slight hoot-like sound is heard; but a louder sound is produced by confining it in a bag, dividing the contents into two parts and bringing them together violently. This I had found to be the best way of testing sea-shore sand as to its sonorousness. The sand on the top of the dune is wind-furrowed, and generally coarser than that of the slope of 31°, but this also yielded a sound of unmistakable character when so tested. A bag full of sand will preserve its power for some time, especially if not too frequently manipulated. A creeping vine with a blue or purple blossom (*kolokolo*) thrives on these dunes, and interrupts the sounding slope. I found the main slope 120 feet long at its base; but the places not covered by this vine gave sounds at intervals 160 paces westward. At 94 paces further the sand was non-sonorous.

The native Hawaiians call this place *Nohili*, a word of no specific meaning, and attribute the sound caused by the sand to the spirits of the dead, *uhane*, who grumble at being disturbed; sand-dunes being commonly used for burial-places, especially in early times, as bleached skeletons and well-preserved skulls at several places abundantly show.

Sand of similar properties is reported to occur at *Haula*, about three miles east of Koloa, Kauai; this I did not visit, but, prompted by information communicated by the Hon. Vladimar Knudsen, of Waiawa, I crossed the channel to the little-visited island of Niihau. On the western coast of this islet, at a place called *Kaluakahua*, sonorous sand occurs on the land side of a dune about 100 feet high, and at several points for 600 to 800 feet along the coast. On the chief slope, 36 feet high, the sand has the same mobility, lies at the same angle, and gives when disturbed the same note as the sand of Kauai, but less strong, the slope being so much lower. This locality has been known to the residents of the island for many years, but has never been before announced in print. This range of dunes, driven before the high winds, is advancing southward, and has already covered the road formerly skirting the coast.

The observations made at these places are of especial interest, because they confirm views already advanced by Dr. Julien and myself with regard to the identity of the phenomena on sea-beaches and on hill-sides in arid regions (*Jebel Nagous*, *Rig-i-Rawan*, &c.). The sand of the Hawaiian Islands possesses the acoustic properties of both classes of places; it gives out the same note as that of Jebel Nagous when rolling down the slope, and it yields a peculiar hoot-like sound when struck together in a bag, like the sands of Eigg, of Manchester (Mass.), and other sea-beaches—a property that the sand of Jebel Nagous does not possess. These Hawaiian sands also show how completely independent of material is the acoustic quality, for they are wholly carbonate of lime, whereas sonorous sands of all other localities known to us (now over one hundred in number) are siliceous, being either pure silex or a mixture of the same with silicates, as feldspar.

The theory proposed by Dr. Julien and myself to explain the sonorousness has been editorially noticed in NATURE, but may properly be briefly stated in this connection. We believe the sonorousness in sands of sea-beaches and of deserts to be connected with thin pellicles or films of air, or of gases thence derived, deposited and condensed upon the surface of the sand grains during gradual evaporation after wetting by the seas, lakes, or rains. By virtue of these films the sand grains become separated by elastic cushions of condensed gases, capable of considerable vibration, and whose thickness we have approximately determined. The extent of the vibrations, and the volume and pitch of the sounds thereby produced after any quick disturbance of the sand, we also find to be largely dependent upon the forms, structures, and surfaces of the sand grains, and especially upon their purity, or freedom from fine silt or dust (Proceedings Am. Assoc. Adv. Sci., 38, 1889).

I should be lacking in courtesy if I closed this letter without expressing my great obligations to Mr. H. P. Faye, of Mana, and to Mr. Geo. S. Gay, of Niihau, for both a generous hospitality and a sympathetic assistance in carrying out my investigations. H. CARRINGTON BOLTON.

Honolulu, H.I., May 26.

Relative Growth of Boys and Girls.

A "NOTE" in NATURE of August 14 (p. 376) referring to some measurements made by Herren Geisler and Ulitzsch on school children at Freiberg (Saxon), speaks of the fact that between the ages of 11 and 16 years girls are taller than boys as if it had not been previously observed and recorded. The fact has been well known for many years, and was first observed by Dr. Bowditch, of Harvard. In a private letter to me dated March 13, 1876, Dr. Bowditch wrote:—"A comparison of the rates of growth of boys and girls shows that in this community girls about 13 years of age are taller and heavier than boys of the same age, and I wish to see how far this is the case in other countries. Quetelet's observations seem to show that it is not the case in Belgium, but some English observations quoted by him indicate that among certain classes of the population in England the same thing is found." Again, on June 10, 1876, he wrote:—"I am exceedingly obliged to you for your letter of April 27, and for the statistics which it contains. It is very interesting to get a confirmation of my observation on the difference between the two sexes about 13 years of age. I shall endeavour to verify your conjecture as to the cause of it. . . . You refer to Quetelet's measurements as being based on only ten observations for each age. Do you understand that the elaborate tables given in his 'Anthropometrie,' p. 417, rest entirely on this small number of observations?" In his paper on "The Growth of Children," published the following year (1877), Prof. Bowditch demonstrated the fact by both tables and diagrams; and in my "Manual of Anthropometry" (1878), and in the Reports of the Anthropometric Committee of the British Association (1880–83), I have given similar evidence of the difference of the sexes in this country. The English tables published by Quetelet mentioned by Dr. Bowditch refer to factory children, and were collected by Stanway, and published in a Report of the Factory Commission so long ago as 1833. Quetelet makes his curves of growth of boys and girls meet at the age of 12 years, but at all other ages the girls are shorter than the boys, but his ten observations (on selected individuals?) at each age were not sufficient to bring out the true difference. The only novelty in the German observations is that the boys do not "catch up" the girls quite so early as they do in England and America. This point, however, can only be decided by a comparison of the actual measurements of the German with those of the English and American children.

Curzon Street, Mayfair, August 16. CHARLES ROBERTS.

The Perseid Meteors.

As I merely expressed a wish that the Perseid shower should be closely watched on the present occasion, in order to ascertain whether the apparent shifting of the radiant was not really due to other causes, I do not think I need enter into any controversy with Mr. Denning on the subject. I will therefore only say that I think his "Catalogue of Radiants," recently published by the Royal Astronomical Society (the most valuable catalogue I think which has yet appeared), seems to me susceptible (as regards the Perseids) of a different interpretation from that which he places on it in his preliminary remarks.

Dublin, August 8. W. H. S. MONCK.

IN reply to Mr. Monck I need only say that I desired no controversy on this subject, but simply to uphold one of the most conclusive facts of my meteoric observations. I arranged my radiants with the utmost care, and on the basis of a practical acquaintance with the facts; and if Mr. Monck considers my results in regard to the Perseids will bear another interpretation, I must be content to wait for the corroboration which future observers will certainly give.

It is singular that so important a feature as the shifting radiant of the Perseids (which I first announced in NATURE, vol. xvi. p. 362) has not yet been adequately investigated. Mr. D. Booth, of Leeds, has, however, effected some observations in recent years (and especially in August 1887), and his results confirm my own. W. F. DENNING.

Bristol.

The Eclipse of Thales.

MR. PAGE, the author of a work entitled "New Light from Old Eclipses," which was noticed in NATURE last April, has forwarded the following communication on the subject of the eclipse of Thales. The views which Mr. Page entertains on the subject of these ancient eclipses are not those generally accepted; but he believes a crucial test of the superiority of his system is afforded by this particular eclipse;

and the author of the notice referred to is therefore invited to furnish a parallel calculation, based upon the theories which have hitherto received general support. This invitation the writer must decline, simply because two far abler hands than his have already investigated this problem on the lines which he would have pursued; and he could add nothing to the authority that accompanies the utterances of Dr. J. R. Hind, the Superintendent of the English "Nautical Almanac," and Prof. Simon Newcomb, the Superintendent of the American.

The following is Mr. Page's communication:—

"Herodotus speaks of the eclipse of Thales as follows:—'A war commenced between the Lydians and the Medes, . . . which continued five years; and it is remarkable that one of their engagements took place in the night. In the sixth year, when they were carrying on the war with nearly equal success, on the occasion of an engagement, it happened that in the heat of battle day was suddenly turned into night' (Herodotus, b. i., s. 74).

"This battle was fought on the morning of the (Julian) July 8, or 9 days after the solstice; consequently in the time of longest days and hottest weather. It would seem from the above account that it commenced in the night, and was not ended until the time of the eclipse, or 5.24 a.m.; when the armies ceased fighting on account of their fears.

"From Ptolemy's canon we learn that Cyaxares, King of Media, began to reign B.C. 634, and reigned 40 years, during 28 of which the Scythians ruled over Asia. In B.C. 606 the Scythian power was broken, and the Medes and Babylonians conquered Assyria. Soon afterwards (*i.e.* in B.C. 603) that war broke out between Lydia and Media which was terminated by mutual fears of this eclipse. As the King of Media reigned 40 years from B.C. 634, he must have died B.C. 594, which is the latest date that can be fixed for the eclipse; and as he was 28 years subject to the Scythians, he must have reigned 12 years after the defeat of the Scythians in B.C. 606; and as his war with the Lydians could not have taken place for several years after this, and as the eclipse was in the sixth year of the war, the date of the eclipse cannot possibly be placed earlier than B.C. 600: consequently we are compelled to look for it some time between B.C. 600 and B.C. 594."

Appended to this communication is a calculation by Mr. Page of the time of new moon in B.C. 597. This calculation is founded upon Ferguson's tables, to which some corrections have been applied by the computer. The calculation cannot be given here in detail; but the result to which Mr. Page is led is July 8, 5h. 24m. 11s., as that at which the so-called eclipse of Thales occurred. This date differs some twelve years from that which has been assigned by the two authorities just mentioned, viz. B.C. 585—a date, too, which accords with that mentioned by Pliny, reckoned by Olympiads. But those who find Mr. Page's arguments sufficient will agree with him; my regret is rather that he has chosen to build his theory on absolute tables, and to ignore all that the ablest astronomers and mathematicians have recently been able to accomplish in this direction.

WILLIAM E. PLUMMER.

The Rotation of Mercury.

IN your issue for January 16 (xli. p. 257), Schiaparelli's observations on the planet Mercury are stated to lead that astronomer to the conclusion that "Mercury revolves around the sun in the same manner that the moon revolves round the earth, always presenting to it the same hemisphere."

Permit me to recall the fact that, as a matter of deductive reasoning, I recorded this opinion in 1883: "The powerful tidal action experienced by Mercury has greatly retarded its primitive axial motion, and increased its distance from the sun. No surprise would be occasioned by the proof that the planet has already attained to synchronistic motions" ("World-Life," p. 425). This opinion was accompanied by calculations of the solar tidal efficiency on Mercury.

ALEXANDER WINCHELL.

Ann Arbor, Michigan, U.S.A., August 4.

Wet and Dry Bulb Thermometers.

IT may, perhaps, interest you to know that on Friday last the difference between the wet and dry bulb thermometers, on board this ship in Grimsby roads, amounted to 12½°; the dry bulb showing 66°, and the wet bulb 53°·5. Wind west; force, 7 to 8 by Beaufort's scale. This is the greatest difference I have recorded in this country for ten years.

T. H. TIZARD.

H.M.S. *Triton*, Grimsby, August 17.

Experiment in Subjective Colours.

THE following experiment does not seem to be widely known: it is not easy to make a clear explanation of the lenses.

Take a number of the *Graphic* and a piece of thin paper, which, if put upon the ordinary print, allows it to be seen through, as black. Now put the paper over some of the large black letters on the apple-green outer cover: seen through the paper, they appear as bright red.

W. B. CROFT.

Winchester College, August 18.

THE SCIENCE AND ART MUSEUM, DUBLIN, AND THE NATIONAL LIBRARY OF IRELAND.

IN the year 1877 the Natural History Museum and the Library of the Royal Dublin Society, which, though mainly supported for many years by Parliamentary grants, had been directly managed by the Society, were, by Act of Parliament, transferred to the Science and Art Department, a large sum of money having been at the same time paid by Government to the Society for ceding its rights and property.

Soon afterwards steps were taken by the Science and Art Department for providing suitable accommodation for an art and industrial addition to the Museum. Into a consideration of the various causes which delayed the carrying out of this project we need not enter here; they will be found described in the Reports of the Science and Art Department.

At length, in 1884, a final competition between rival architects' designs for the new buildings was arrived at, and those by Messrs. Deane and Son, of Dublin, were chosen by the representative committee, which was specially appointed for the purpose of selection.

The sites for these buildings, which were adopted after much discussion, are at right angles to Leinster House on its Kildare Street or western side. The *façades* of both buildings, which face one another, are about 200 feet long, and are similar, consisting of two rotundas with colonnades, and pavilions at the sides. In the centre of the Museum building is a large court about 125 feet by 75 feet. Opening from it there are in all 24 galleries or rooms, which are devoted to exhibiting purposes.

The foundations were laid by His Royal Highness the Prince of Wales on April 10, 1885, the ceremony connected therewith being the most important presided over by His Royal Highness during his last visit to Ireland.

The tender for the erection of the buildings by Messrs. Beckett Brothers, of Dublin, was accepted on November 3, and by the 17th operations had commenced. In four years, or by November 1889, the Museum building was completed, and was handed over to the Science and Art Department, and the transfer to the new galleries of the collections which had accumulated in the temporary premises during twelve years was at once proceeded with.

It was not until June of the present year that the sister building, for the reception of the National Library of Ireland, was completed. During the month of July the transfer of the books, consisting of about 100,000 volumes, from the old Library in Leinster House, has been satisfactorily accomplished.

Both institutions are about to be opened on the 29th of the present month by His Excellency the Lord-Lieutenant, after which they will continue to remain open and free to the public.

It may be of interest to add some details as to the principal contents and system of arrangement in the two institutions respectively. In order to describe the Museum effectively, it is necessary to include here an account of the collections in the Natural History Department, which, however, remain in their old quarters—a very suitable building on Leinster Lawn. It has for a pendant a similar building, the National Gallery of Painting, which is, however, under different management. The relative positions of the five buildings may be compared to a capital H, in which the cross bar represents Leinster House, and the other portions of the letter the four buildings which have been referred to, with Leinster Lawn and the courtyard of Leinster House between them. Close by there is another group of buildings, which contains the class-rooms of the Metropolitan School of Art.

Leinster House, which is comparable in a sense to Burlington House, affords accommodation to the officers of the Science and Art Department in administrative charge of the various institutions, and also to the Royal Dublin Society, which, since it has been relieved of its mangement of the several institutions, has considerably developed its various functions in science and agriculture; for the due carrying out of the latter it has provided itself with extensive show yards at Ball's Bridge in the suburbs of Dublin, where the cattle shows, &c., have acquired an importance and success never attained while they continued to be held in the City premises.

The Society is possessed, moreover, of a large private library, and its members enjoy various privileges, such as the use of a general reading-room, free admission to meetings, lectures, &c. The Society has recently entered upon several new lines for the development and encouragement of the arts and industries of Ireland.

Returning to the Museum—the building which contains the natural history collection consists of two large rooms or halls, one on the basement and the other on the first floor, the latter having two galleries. The basement room contains the systematic collections of fish, reptiles, a number of large recent and fossil skeletons, and groups illustrative of the geographical distribution of animals.

In the lobby of the first-floor room there is a special collection of the mammals of Great Britain and Ireland, and in the room itself the main systematic collection of mammals is arranged in a row of large central cases, and the invertebrate collections in table and wall cases at the sides. As in some of the other groups, there are special collections of Irish invertebrates.

The first gallery contains a general collection of stuffed birds, and a special collection of Irish birds. In the second gallery there are general collections of insects, and of birds' nests and eggs. A room off this gallery contains a large collection of birds' skins arranged in glazed drawers, for study. Besides the above, there are considerable collections of invertebrates—especially of insects—in the curators' rooms.

A large annex, which was formerly occupied temporarily by a portion of the art collections, has been made use of for the display of the palæontological collections, which are of some extent and importance. The specimens of plant and animal fossils are for the most part arranged systematically; they include large numbers of fossils from the Sivalik Hills in India, and many well-known casts of generalized types of animals. The special collections, not incorporated, include an extensive one of Irish mammals, Sir Richard Griffith's collection of Irish Carboniferous and Silurian fossils, and several collections of Arctic fossils made by Sir F. Leopold McClintock and others.

From this annex a passage affords access to the new building which is about to be opened. In the first two rooms the collections of fossils, rocks, and minerals, which have been made by the Geological Survey of Ireland, are exhibited. In an adjoining room there is the general Museum collection of minerals, with a small one of meteorites. The next room is devoted to a large relief map of Ireland, coloured geologically. It is on the horizontal scale of one inch to a mile, the vertical scale, as is usual, being considerably exaggerated. In this room there are also a number of photographs representing natural phenomena, including some large transparencies which were presented by the United States Government. The corresponding rooms on the other side of the building are devoted respectively to (1) Greece and Rome; (2) Egypt and Assyria; (3) Ethnography, a very extensive and important collection; (4) Musical instruments; (5) India and Persia.

The Central Court, from which these rooms open off, is devoted mainly to casts of antique and mediæval sculptures, and to a large number of models of statues and busts by the late J. H. Foley. Close by is the rotunda, a hall which has been compared to Napoleon's tomb. It contains casts of antique sculptures, and in the centre a group of three bronze guns, with their carriages, &c., which were taken at Sobraon and Maharajpur, and presented to Lord Gough by the Honourable East India Company.

Ascending to the first floor, we meet in succession rooms devoted to (1) textiles (lace and embroidery); (2) wood carving; (3) glass and ceramics; (4) furniture; (5) casts of ivories and metal-work; and on the opposite side (1) woven materials, models of looms, &c.; (2) industrial models; (3) and (4) rooms intended for the famous collections of Irish antiquities made by the Royal Irish Academy; and (5) arms and armour. The gallery of the Central Court contains a number of casts of Celtic antiquities, a large collection of metal-work, and electrotypes, besides many other objects of considerable interest. In the gallery of the rotunda there are a number of casts of modern sculptures, &c.

On the south side of the building there is a second floor containing four rooms; these have been allotted to the Herbarium and Botanical Museum, the collections included in which are considerable, having been brought together from many different quarters. They have not yet, however, been arranged for public inspection. The various collections of Cryptogams are, perhaps, the most valuable. There are also several well-known collections of Irish plants.

It will be seen from the above sketch that this Museum covers a very wide field. This will be still further apparent from a study of the general "Guide" which is about to be issued.

There are some special features in the arrangement of the specimens which may be touched upon briefly. The objects in the Museum are largely provided with fully descriptive labels and maps. In the mounting of the specimens many novel devices have been made use of, and some ingenious contrivances have been founded upon inventions which, though used in American museums, have not hitherto been adopted in Europe.

The Museum is open free to the public daily, Sunday and two week-day evenings being included. The daily average attendance is about 600, and there is every reason for believing that the institution, which is now about to be fairly launched on its more extended career, will become increasingly popular and increasingly instructive to the people of Ireland.

The National Library is being arranged in its new quarters, upon principles which have been for many years the subject of earnest consideration and study by the librarian, Mr. William Archer, F.R.S.

The principal public reading-room is a very handsome apartment, capable of accommodating 200 readers. With the exception of a few works of reference, such as dictionaries, &c., the books are all arranged in stores, which are close at hand, in one of the wings of the building. These stores are in five stories, which are connected by ordinary (not spiral) stairs of low gradient, and the books are arranged on free standing presses, within easy reach of hand and eye; thus no ladders are required, and no wall presses are used. Although the ultimate potential storage capacity of the building when complete may be extended to 600,000 volumes, at present only about 100,000 have to be provided for.

The arrangement of the books is according to a modification of the decimal system of Mr. Dewey, of the State Library of New York. It is claimed for this system that it brings together on the shelves all works of cognate character, be they general or specific.

Within the space available here it is not possible to fully illustrate this system, but a few lines may be devoted to explaining the general principles of the method. The whole Library must be regarded as being divided into nine libraries, numbered as follows: (1) Philosophy, (2) Religion, &c., (5) Natural Science, and up to (9) History. Each of these is again divisible, *if necessary*, into nine parts.

Thus the number 54 represents the 4th division (Chemistry) of the 5th class (Natural Science); 541 represents Theoretical Chemistry, and 5412 represents the 2nd division (Atomic Theory) of Theoretical Chemistry.

Every book as it is received in the Library will receive a number, which will at the same time indicate its place on the shelves, and be a summary of its contents.

When he receives the *title* from a reader, the attendant will, after a little practice, be able to go directly and without reference to the place marks, to the exact shelf or quarter of the stores by simply translating the title into its corresponding number.

One advantage of the system is that the special works contained in the Library on a given subject can always be seen together at a glance. It is needless to point out that the complex character of many books will furnish complex exceptions to the more simple nomenclature.

The Library, as an all-round, modern, working student's library in science and literature, is a very valuable one, though it is not at present so in the sense that it contains any particular literary treasures.

The administration of these several institutions, together with the Botanic Gardens at Glasnevin, and the Metropolitan School of Art, is carried on by the Science and Art Department, which is represented locally by the Director of the Science and Art Museum, under whom there are heads of the several departments and institutions. Two local bodies were created in 1877 to aid the Department in the supervision of these institutions, one the Board of Visitors of the Museum and Botanic Gardens, and the other the Council of Trustees of the National Library, the functions of the latter including the selection of books for the Library.

The total cost of the several institutions is provided in the annual estimates of the Science and Art Department which are voted by Parliament.

COMPARISON OF THE SPECTRA OF NEBULÆ AND STARS OF GROUPS I. AND II. WITH THOSE OF COMETS AND AURORÆ.[1]

II.

General Comparisons.

IN the preceding article I showed that the spectra of nebulæ, auroræ, bright-line stars, and stars of Group II. are closely related to the spectra of comets. In the table which follows, all the spectra are brought together and compared. It is not sufficient to show that each group resembles comets in some respects, as each one might have some feature which was absent in the other. I therefore give the following table to show how far they resemble each other. In the last column the dark bands which are simply due to absence of radiation, and are not really absorption-bands, are omitted.

[1] Continued from p. 345.

Nebulæ.	Aurora.	Comets.	Bright-line Stars.	Stars with Mixed Flutings.
4101	411	—	4101	—
—	426	[426]	—	—
—	431	431	—	449 (bright space)
434	435	—	434	—
447	—	—	—	—
—	—	—	—	461–451 bright
468–474	474–478	468–474	468–474	472–476 bright
479	482	483	—	—
486	486	486	486	—
4958	—	—	—	4958–486 bright
500	500	500	—	502–4959 dark
509	—	—	507	—
517	517	517	517	516–502 bright
—	519	519	—	—
520	522	521	—	522–516 dark
—	—	—	—	524–527 dark
527	—	[527]	527	—
—	531	—	—	—
—	535	—	—	—
—	539	—	540	—
546	545	546	—	544–551 dark
554	—	—	—	—
559	558	558	558	559–564 dark
—	—	561	—	—
—	—	564	564	—
—	—	568	568	—
—	—	[579]	579	—
—	—	—	—	585–594 dark
5872 (D_3)	—	—	5872	—
—	—	[589]	589	—
—	606	—	—	—
—	620	[615]	—	616–630 dark
—	630	—	635	—

It will be seen that there are three flutings which run through the five columns, namely, 468–474, 517, and 558—these are due to carbon and manganese, and are the familiar cometary bands; four more—hydrogen 486, magnesium 500, magnesium 521, and lead 546—occur in four out of the five columns. Out of the thirty-four lines or flutings given, there are nineteen which occur in less than three columns, but this number is greatly reduced when slight differences of temperature, masking effects, and the exceptional conditions of comets are taken into account.

It is now universally agreed that comets are swarms of meteorites, and the tables which I have given show that nebulæ, bright-line stars, stars with mixed flutings, and the aurora, have spectra closely resembling those of comets, the special features of which are the carbon bands, to which I have recently added the absorption bands of manganese and lead; all are therefore probably meteoritic phenomena.

The following is a list of the bodies which contain either one or both of the carbon flutings near 517 and 468–474, the latter being a group of flutings, which, as I have before shown (Roy. Soc. Proc., vol. 35, p. 167), sometimes has its point of maximum brightness shifted from 474 to 468. The fluting near 564 has been omitted from the table, as it is generally masked, either by continuous spectrum or by the superposition of the fluting of manganese near 558. The wave-lengths given are as measured by the various observers stated.

The spectrum of the aurora is added for the sake of completeness.

It will be seen from the table that the record of the presence of carbon is unbroken from a planetary nebula through stars with bright lines to those resembling *a* Herculis, *i.e.* entirely through Groups I. and II. of my classification.

Name.	Fluting 468–474.	Fluting 517.	Reference.
Planetary nebula	469·4 (Copeland)	— —	Copernicus, vol. 1, p. 2.
Nebula in Orion	470 (Taylor)	— —	Monthly Notices, vol. 49, p. 126.
Nebula, Gen. Cat., No. 4373	— —	518 (Vogel)	Bothk. Beob., Leipzig, Heft 1, 1872, p. 57.
" " " " 4234	— —	518 (Vogel)	" " " "
" " " " 4390	— —	518 (Vogel)	" " " p. 58.
Nebula in Andromeda	468–474 (Fowler)	517 (Fowler)	Roy. Soc. Proc., vol. 45, p. 216.
" "	— —	517 (Taylor)	Monthly Notices, vol. 49, 126.
γ Argûs	468 (Ellery)	— —	Observatory, vol. 2, p. 418.
"	464·6 (Copeland)	— —	Copernicus, vol. 3, p. 205.
Arg.-Oeltzen, 17681	461–470 (Vogel)	— —	Astro-Phys. Obs. zu Potsdam, vol. 4, No. 14, p. 16.
" "	473 (Pickering)	— —	Astr. Nachr., No. 2376.
Lalande, 13412	469 (Vogel)	— —	Astro-Phys. Obs. zu Potsdam, vol. 4, No. 14, p. 17.
1st Cygnus	470 (Wolf and Rayet)	— —	Comptes rendus, vol. 65, p. 292.
"	465–470 (Vogel)	— —	Astro-Phys. Obs. zu Potsdam, vol. 4, No. 14, p. 17.
"	468–474 (Fowler)	517 (Fowler)	New observations.
2nd Cygnus	470 (Wolf and Rayet)	— —	Comptes rendus, vol. 65 (1867), p. 292.
"	464 (Vogel) middle of band	— —	Astro-Phys. Obs. zu Potsdam, vol. 4, No. 14, p. 17.
"	468–474 (Fowler)	517 (Fowler)	New observations.
3rd Cygnus	470 (Wolf and Rayet)	— —	Comptes rendus, vol. 65 (1867), p. 292.
"	461–468 (Vogel)	517 (Vogel)	Astro-Phys. Obs. zu Potsdam, vol. 4, No. 14, p. 17.
"	468–474 (Fowler)	517 (Fowler)	New observations.
γ Cassiopeiæ	— —	517 (Sherman)	Astr. Nachr., No. 2691.
"	468–474 (Fowler)	517 (Fowler)	New observations.
o Ceti	468–474 (Fowler)	517 (Lockyer and Fowler)	New observations.
α Herculis	468–474 (Fowler)	517 (Lockyer and Fowler)	New observations.
α Orionis	— —	517 (Lockyer and Fowler)	New observations.
Aurora	474–478 (Vogel)	— —	Bothk. Beob., Leipzig, Heft 1, 1872, p. 43.
"	— —	517 (Backhouse)	Nature, vol. 7, p. 463.

We have now to inquire into the previous work on this subject.

Carbon in Stellar Spectra.

Secchi, in 1869, was the first to call attention to the possible existence of indications of carbon in stellar spectra in connection with stars of his types III. and IV.[1] He even compared the spectrum of 152 Schjellerup with the carbon spectrum obtained from benzene. His micrometric measures of the distances of the principal bands in the two spectra from the sodium line D gave great weight to his statement.[2]

But although Secchi observed the coincidence of the edges of two dark bands in his types III. and IV., and remarked that the light-curve in one case faded towards the red, and in the other towards the violet end of the spectrum, he did not recognize that we were dealing with radiation in one case and absorption in the other.

Indeed, Secchi regarded type IV. as presenting chiefly radiation phenomena, for later,[3] when writing with respect to stars of this type he states :—

" Quelques-unes des raies noires et les plus importantes, coincident à très-peu-près avec celles du troisième type ; cependant le spectre, dans son ensemble, *se présente comme un spectre direct appartenant à un corps gazeux*, plutôt que comme un spectre d'absorption. Si on le considère comme un spectre d'absorption, on trouve qu'il présente le caractère des composés du charbon, tels qu'on les obtient en produisant une série d'étincelles électriques dans un mélange de vapeur de benzine et d'air atmosphérique et dans l'arc voltaique entres les charbons."

From the foregoing, it is evident that Secchi had observed the coincidence of the flutings of carbon with the dark flutings in stars in his fourth type, but missed the significance of it altogether.

[1] *Atti dell' Acad. de' Nuovi Lincei*, xxv., 1872.

[2] These and other comparisons led Secchi to note :—" La conclusione è che nelle stelle di 4° tipo vi é certo il carbonio in una combinazione di debole tensione coll' idrogeno, é che questa combinazione esiste nello stesso stato, o in altro prossimo anche in quello di 3° tipo."

[3] " Le Soleil," vol. ii. p. 458.

Dr. Huggins, however, in a footnote to the first edition of Schellen's " Spectrum Analysis," edited by him, gave an observation of his of the spectrum of 152 Schj., and a diagram of the spectrum of this star, which combated Secchi's work. In his words :—

" He compared the spectrum of the star, using a narrow slit, with the bright lines of sodium and carbon. The line marked D he found to be coincident with that of sodium. The less refrangible boundary of the first of the three principal bright bands in the spectrum of carbon is nearly coincident with the beginning of the first group of dark lines ; the second of the carbon bands is less refrangible than the second group in the star ; the third band of the carbon spectrum falls on the bright space between the second and third group of dark lines in the spectrum of the star. The absorption bands are therefore not due to carbon."

Vogel, in 1884, showed that Dr. Huggins's observations were inaccurate ; that the bands really did coincide with the carbon bands ; and that Secchi's statement was perfectly correct with regard to this star (152 Schjellerup).[1]

[1] " Neben dem Spectrum des Natriums erschienen noch ganz schwach zwei Banden des Alkohol-spectrums, die vollkommen mit den dunklen Banden des Sternspectrums zu coincidiren schienen. Der Anfang der ersten Bande des Alkoholspectrums wurde zu + 14′ 37″ gemessen. Auf den Anfang der zweiten Bande wurde wiederholt der Faden gestellt, und coincidirte jedesmal der Faden so vollkommen als möglich mit der Bande im Sternspectrum. Auch directe Vergleichungen zwischen Alkoholspectrum und Sternspectrum konnten gemacht werden, da das Sternspectrum hell genug war und sich ganz gut von den das ganze Gesichtsfeld durchsetzenden mattleuchtenden Banden des Alkoholspectrums abhob." Following some measures made on June 1, it is noted :—" Bei den Vergleichungen mit dem Natrium- und Alkoholspectrum wurde wiederholt die Ueberzeugung gewonnen, dass eine Coincidenz mit den Natrium-Linien, sowie mit den beiden stärksten Banden des Kohlenwasserstoffspectrums im Spectrum der Flammen und des Sternes stattfand. Ich setzte an diesem Abend, da der Himmel besonders gunstig war, noch das stark zerstreuende Rutherfurd'sche Prisma ein und konnte damit wenigstens die beiden stärksten Banden im Sternspectrum messen und wiederum durch directe Vergleichung die absolute Coincidenz der hellsten Bande des Kohlenwasserstoffspectrums mit einer Bande des Sternspectrums beobachten." In summing up the observations of the spectrum of this star Prof. Vogel remarked, " Vergleicht man diese Beobachtungen mit den Seite 14 angeführten des Kohlenwasserstoffes, so ergiebt sich zweifellos das Vorhandensein von Kohlenwasserstoff in der Atmosphäre des Sternes."—" Astrophysikalischen Observatoriums zu Potsdam," No. 14, p. 23, 1884.

Similar comparisons of the carbon spectrum with the spectra of other stars of the same type were made, and the coincidences led Vogel to the following final conclusion :—

"Die charakteristischen Banden dieser Sternspectra scheinen durch die Absorption von Kohlenwasserstoffen, die in der Atmosphäre der betreffenden Sterne vorhanden sind, hervorgebracht zu werden."

Quite recently, Mr. Maunder, in commenting upon the Rev. T. E. Espin's admirable revision of Birmingham's "Red Star Catalogue," wrote :[1] "In the note on No. 364 [152 Schjellerup], it should surely have been made clear that the difference between Secchi's and Huggins's account of its spectrum was due to the one having compared it with the spectrum of a hydrocarbon, and the other with that of carbonic oxide, and that the perfect accuracy of Huggins's description has been abundantly confirmed, though, for the reason just given, he missed the recognition of the absorption bands of the stellar spectrum as those of carbon."

Mr. Maunder here refers—I presume with authority—to a statement made by Dr. Huggins which I have not been able to trace. In the note already quoted, Dr. Huggins refers to the spectrum of carbon without giving any idea of the actual compound used for making the comparison, and I have not been able to find any subsequent statement which justifies Mr. Maunder's remarks. Further, it is not sufficient to simply state the compound used, as the spectrum obtained depends upon the conditions of experiment. It does not follow, therefore, that, even if carbonic oxide were employed, the spectrum obtained was not the so-called "hydrocarbon" spectrum. I fancy that now most workers are agreed that the band at 517 is a true carbon band, and obtainable, therefore, from any carbon compound.

Dunér, in 1884, discussed the evidence as to carbon absorption in stars of type IV.[2] The mean wave-lengths. given by him for the bands in this group are compared with those found by Vogel in the following table :—

Number of Dunér's band.	Wave-length. μμ		Vogel's measures. μμ
		Spectrum begins	660
		Band	656
2	621	Band	622
3	604·8	Band	606·5
4	589·8	Line in a band	589·3
		End of the band	584·8
5	576·0	Line	575·7
6 (beginning)..	563·3	Line, beginning of a band	563·1
7	551	Line	552
6 (end)	545	Line	544
8	528·3	Group of lines	528
9 (beginning)..	516·3	Line, beginning of a band	515·9
		Line	513·2
9 (end)	496		
10 (beginning)..	472·7	Beginning of a band ...	472·9
10 (end)	463		
End of spectrum	437	Band	437
		Spectrum ends	430

Dunér compared Vogel's measures and his own with the following wave-lengths of the hydrocarbon bands said to be given by Hasselberg :—[3]

		μμ.
Beginning of band	1	618·7
End „ „		594
Beginning of band	2	563·4
End „ „		543
Beginning of band	3	516·4
End „ „		507
Beginning of band	4	473·7
End „ „		467
Maximum ...	5	436·7
Beginning of band	6	431·9
End „ „		423

[1] *Observatory*, No. 164, July 1890.
[2] "Sur les Étoiles à Spectres de la Troisième Classe," Stockholm, 1884.
[3] "Ueber die Spectra der Cometen," p. 21.

These values differ slightly from those measured by Hasselberg in 1880, and given in the work referred to by Dunér.

From a comparison of the two sets of wave-lengths, those found in the spectrum of a body of type IV. and those given by Hasselberg, Dunér concluded that :—

"Les longueurs d'onde des bandes 6, 9 et 10 dans les spectres III.*b* sont donc à considérer comme identiques à celles des bandes 2, 3, et 4 dans le spectre de l'hydrogène carboné. Mais aussi la longueur d'onde 437 de la bande au violet, où pour mon réfracteur était la fin du spectre, et la longueur d'onde 430 de la fin du spectre visible selon M. Vogel, sont d'accord avec les deux bandes violettes de l'hydrogène carboné. On peut donc régarder comme extrêmement probable que :

"*Les bandes principales dans les spectres III.b sont dues à l'absorption exercée par un composé du carbon qui se trouve dans les atmosphères de ces étoiles.*"[1]

It will be seen from the passage which I have given in a note that most of the discussion had turned on the coincidence between bright carbon bands seen in the laboratory and dark absorption bands seen in stellar spectra (type IV.). It is not a little curious to see Dunér, in the passage I have underlined, holding to a possible similarity between stellar and cometary structure based upon carbon radiating in one case and absorbing in the other.

The next important advance was made by Dr. Copeland, who, in January 1886, in a communication to the Royal Astronomical Society on the spectrum of a new star in Orion, wrote as follows :—[2]

"The spectrum is unmistakably of the third type, of which α Orionis is the brightest member. But in this star the *bright bands* are so strikingly developed that they form the most salient parts of the spectrum. Adopting this view an examination of the preceding numbers and the descriptions of the bands, &c., to which they refer, reveals the startling fact that this spectrum is not so much a continuous one, interrupted by dark lines and dusky bands, as a *not very luminous spectrum upon which a series of bright bands are superposed.* One of the bright bands, that beginning with the 'very bright line,' W.L. 516·2 m.m.m. is most readily identifiable as

[1] Dunér, in his conclusions as to the spectra of stars of Class III., wrote :—

"Si l'on passe ensuite à considérer le développement ultérieur de l'étoile, il est évident qu'à mesure qu'elle se refroidit davantage, elle parvient enfin à une température ou le carbone qui doit se trouver en abondance, soit dans son atmosphère soit sous une forme quelconque dans son photosphère, peut se combiner avec l'élément l'hydrogène ou un autre, qui ensemble avec le carbone donne origine au 'Spectre de Swan.' A partir de cela, le spectre se montre coupé par une large et faible bande à la longueur d'onde 516 mm. et par une autre encore plus pâle à 473 mm., et les parties du spectre au-delà de celle-ci sont très faibles. Mais peu à peu ces deux bandes gagnent en intensité, et en même temps la bande à 563 mm. se fait valoir, d'abord à peine visible, puis de plus en plus forte. A cette époque se développe la bande étroite à 576 mm., et finalement les trois bandes principales sont presque égales entre elles en intensité, et on reconnait, dans le spectre, tous les détails caractéristiques. Ce serait s'engager dans une discussion inutile si l'on voulait seulement exprimer une supposition sur le moment ou les bandes secondaires dans le rouge et dans l'orange font leur apparition, aucun fait n'étant connu qui pût être cité à l'appui.

"Ce qui est sans doute très remarquable c'est que dans les spectres III.*b* on n'aperçoit trace de la bande carbonique à la longueur d'onde 618·7 mm. laquelle est si brillante dans les tubes de Plücker contenant de l'hydrogène carboné. Ceci est au reste en parfaite analogie avec ce qu'on voit dans les spectres des comètes qui doivent leur apparence au même composé carbonique qui les spectres stellaires III.*b*, et il y a des analogies aussi pour les autres bandes. Ainsi la bande à 563 mm. est souvent bien faible même dans de brillantes comètes, et la bande dans le vert est toujours la plus forte, aussi bien dans les comètes que dans les étoiles. La bande dans le bleu est quelquefois assez faible dans les spectres cométaires, tandis que dans les étoiles elle est seulement un peu plus faible que la bande dans le vert ; mais il faut se souvenir qu'elle est située dans une partie déjà très faible dans les spectres des étoiles. Il est donc fort possible qu'un affaiblissement médiocre suffise pour rendre entièrement imperceptible la lumière restante. *Il n'y a donc peut-être pas à voir dans cela une diversité entre les comètes et ces étoiles.* Quant aux bandes violettes, elles sont très faibles dans les tubes de Plücker mais fortes dans le spectre de la flamme de l'alcool. On en a vu une trace dans les spectres des comètes les plus brillantes. Dans les étoiles III.*b* très brillantes et pas trop rouges, on a aussi une zone violette laquelle se termine, comme les mesures montrent, à la longueur d'onde 430 mm. donc à la position de la seconde de ces bandes, et à la position de la première il y a, dans les spectres de ces étoiles, une bande."

[2] *Monthly Notices R.A.S.*, vol. xlvi., p. 112

the great hydro-carbon band seen in the spectrum of every comet that has been examined under favourable circumstances. This identification is strongly supported by the second bright line, 513·7, which is also found both in hydro-carbon and cometary spectra. It is, however, on bringing the spectra of the star and of the blue flame of a spirit-lamp at the same time into the field of the spectroscope that their exact agreement becomes most evident. For not only do they agree perfectly in wave-length and in beginning with two plainly distinguishable bright lines, but also in the delicate gradations of light by which they similarly fade away towards the violet, thus forcing the extreme probability of a common origin upon the observer.

"But the presence of luminous lines does not rest on this single band, for the second cometary and hydro-carbon band which has its bright edge at W.L. 472·9 (Hasselberg, 'Ueber die Spectra der Cometen') is also found in the new star's spectrum at W.L. 472·2.

"Of the three other luminous bands agreeing with the coal-gas spectrum, which were all measured at Dun Echt in that of comet 1881 III.,[1] two lie beyond the limit to which I have yet traced the spectrum of this star, and the third, falling between W.L. 563 and 534, in a bright and otherwise difficult part of the spectrum, has not made its possible presence evident.

"This leaves the origin of the bright bands beginning at 542·8 and 494·4 an open question; but excepting their general appearance, there is no reason why they should be due to the same substance as the great band at 516·2. On the other hand, the presence of the bright hydro-carbon bands in a spectrum of type III. removes any difficulty there may be in accepting Secchi's conclusion that they appear in a reversed (dark) form in spectra of type IV."

Dr. Copeland also made determinations of the position of the bright bands in Nova Andromedæ,[2] and noted—

"It seems probable that the three 'bright' bands, of wave-lengths 546·8, 514·0, and 489·2, are identical with the three brightest bands afterwards measured with the same apparatus in Mr. Gore's Nova Orionis, of which the brightest parts were at wave-lengths 542·8, 516·2, and 494·4. The trace of a condensation of light at W.L. 471·6, seen on September 20, agrees well with the bright line in Nova Orionis at W.L. 472·2. . . . In conclusion, it seems worthy of remark that the spectrum described above is the same as that given by any ordinary hydro-carbon flame, burning so feebly that the spectrum of the blue base of the flame is just beginning to show through the continuous spectrum afforded by the white part of the flame."

Vogel made some observations of Nova Orionis,[3] and found that the wave-lengths of the absorption bands were the same as those of α Orionis and other stars of that group, the only difference being that the bright spaces were more strongly marked. Dunér also noted[4] very bright parts in the green and blue, which he identified as the bright zones 516·8–503·2 and 495·8–484·3. With respect to these bright parts, he thought they may be partly due to the contrast with the very dark and broad bands.

M. Ch. Trépied observed that the spectrum of Nova Orionis was like α Orionis and β Pegasi. He also remarked:—[5]

"Le 23 décembre, j'ai, pour la première fois, soupçonné l'existence de lignes brillantes dans le vert; mais cette observation est un peu incertaine. On sait combien il est difficile de décider si les apparences de lignes ou de bandes brillantes, dans un spectre faible, sont vraiment celles qui caractérisent l'état d'incandescence d'une matière gazeuse, ou s'il faut les attribuer à un effet de contraste causé par le voisinage des bandes obscures."

[1] *Copernicus*, vol. ii. p. 227.
[2] *Monthly Notices*, vol. xlvii. p. 54.
[3] *Astr. Nachr.*, No. 2704.
[4] *Astr. Nachr.*, No. 2707.
[5] *Comptes rendus*, vol. cii. p. 41, 1886.

M. Thollon observed the same Nova, and recorded—[1]

"Ce qui nous frappa tout d'abord fut l'éclat remarquable du rouge et surtout du vert, tandis que le jaune était relativement sombre. Cette particularité nous suggéra d'abord l'idée que nous nous trouvions en présence d'un spectre de bands brillantes, analogue à celui des comètes, mais bien plus compliqué. Les observations comparatives faites sur α d'Orion nous confirmèrent dans cette idée. Cette étoile, en effet, montre avec une parfaite évidence un spectre continu conservant partout l'éclat qui lui est propre, et coupé par des bandes et raies obscures."

With the exception of Dr. Copeland, however, no observer confronted the spectrum of the Nova with that of carbon, or the identification of the bright spaces with the carbon flutings would have been evident.

A short time after Dr. Copeland had published his observations, Mr. Maunder challenged the assertion[2] that in the Nova "the spectrum is not so much a continuous one, interrupted by dark lines and dusky bands, as *a not very luminous spectrum upon which a series of bright bands are superposed.*" The accuracy of the observations was not, however, doubted, nor was the importance of the view denied.

The main objection urged by Mr. Maunder was that Dr. Copeland's measures of the bright parts in Nova Orionis did not exactly agree with laboratory determinations of the wave-lengths of the hydro-carbon bands. He does not, however, make mention of the fact that there are two perfectly distinct sets of bands seen under different conditions. Nor does he refer to the "laboratory work" which has been relied on to show that they are not hydro-carbon bands at all. The mean of Dr. Copeland's measures of the bright line in the green, beginning a band, is 516·2. The wave-length of the first carbon fluting of one series is given by Thalén as 516·4, which, therefore, gives a difference of 0002 in the two determinations. The line measured by Dr. Copeland at 513·7 is said by Mr. Maunder scarcely to support his view, since the second maximum of the carbon fluting has a wave-length 512·8, and of the blue carbon fluting it is noted, "The third hydro-carbon band, that in the blue with wave-length for its less refrangible edge 473·7, is indeed not far from the bright space Dr. Copeland has observed at λ 472·2, but the correspondence is certainly not very exact." Since this criticism was made, however, it has been shown that at different temperatures the maximum of the blue carbon fluting may shift from 468 to 474, so that Dr. Copeland's measures may represent the exact position of the band in the Nova.

But it is evident that a vast difference must exist between the accuracy attainable in the observatory and in the laboratory. Dr. Copeland's measures appear to give the smallest probable error in the determination of wave-lengths in such an object as Nova Orionis, yet he measured the brightest band once at 517·4 and on the following evening at 515·6, a difference of 0018. The difference of the observations *inter se* exceeds any of the differences between the bright parts measured by Dr. Copeland and the accepted wave-lengths of the carbon bands; nevertheless Mr. Maunder says the observations are "undoubtedly very accurate," hence it cannot reasonably be argued that the bright bands are not carbon because of a want of exact coincidence with those measured in the laboratory.

Mr. Maunder also notes that "the second band in order of brightness in the hydro-carbon spectrum begins at λ 563·4. This is certainly non-existent in spectra of the third type; a broad dark band—No. 4 in Dunér's nomenclature and my own, wave-length 564·2 to 559·2—occupies the very place." This contention, however, is no longer allowable, since the recent researches show that the carbon fluting of one series at 563·4 is masked by the

[1] *Comptes rendus*, vol. cii. p. 356, 1886.
[2] *Monthly Notices R.A.S.*, xlvi. p. 284.

absorption of the first manganese fluting at 557·6, and the same argument might be employed to abolish carbon from many cometary spectra.

My recent work has entirely justified Dr. Copeland's observations, and to him certainly belongs the credit of having established the existence of the carbon bands bright in a new star. J. NORMAN LOCKYER.

ON THE SOARING OF BIRDS.

THE interesting problem of the soaring of birds, though repeatedly discussed, especially in NATURE, has not yet found a satisfactory solution. This is the explanation I propose.

Suppose that a bird soaring horizontally with a certain velocity enters a current of air cutting his own course rectangularly. The bird will be seized and partly borne by the wind. Instead of passing by calm the distance *a* to *b*, he will advance from *a* to *c* in the same space of time (see Fig. 1; the arrow *ef* indicating the direction of

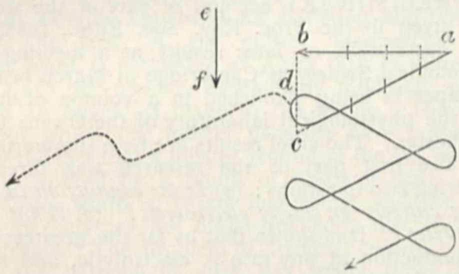

FIG. 1.

the wind, and the cross-lines the length-axis of the wing-area). The way *a* to *c* evidently being longer than *a* to *b*, the bird, on arriving at *c*, has a greater absolute velocity than if he had pursued, in a calm, his course *a* to *b*. It is equally evident that, if the initial velocity of the bird and the velocity of the wind are properly adapted, the velocity of the bird at the point *c* can, in spite of the resistance of the air to his advancing, be greater than at *a*. If arriving at *c* the bird can turn against the wind[1] without considerable loss of velocity, it is clear that he is able to continue his new course for a short space, before his velocity sinks to the initial velocity which he possessed at the point *a*. During this part of his course, the relative velocity of the bird (with relation to the air) is more than twice the absolute velocity of the wind, supposing the initial velocity of the bird equal or superior to that of the wind. Let *d* be the point where the absolute velocity of the bird has sunk to the initial velocity. If the bird turns at *d*, so that his course crosses the direction of the wind at right angles, he is again ready to begin the same course as when starting from *a*. Thus, on the way *a* to *c* the absolute velocity increases, on *c* to *d* it diminishes as much.

Let us now suppose the direction of the wing-plane unchanged: the course of the bird will no longer lie in the horizontal plane, but, from reasons now easily understood, *a* to *c* will gradually drop down to the earth, according as the relative velocity diminishes; on the other hand, *c* to *d* will rise according to the increment of the relative velocity. Which will be the greater, the sinking or the rising, depends on several circumstances, but principally on the force of the wind, the adaptation of the wing-plane, the size and form of the bird and the corresponding proportions between the bearing of the wings and the resistance of the air. This resistance is, of course, in proportion to the weight, less to the advancing of large birds than to the advancing of small birds. This is the reason why large and heavy birds are the best soarers.

It results from this that a bird suitably built for the purpose can not only maintain the same level without working his wings, by a uniform and moderate wind, but also gain in height by adroit movements.

It may perhaps be objected that, according to this scheme, the course of the bird will not be spiral, but run in figures of eights gradually moving in the direction of the wind or in continuous windings on the one or on the other side and partly with the wind (Fig. 1). Indeed it is likely that the movements of the birds will often prove that they profit by this principle in manœuvres the purpose of which has not yet been understood.

The spiral soaring is still to be explained. I think we must suppose that commodiousness is the principal motive thereof. Let us fancy that a bird, having acquired the necessary initial velocity, soars in a calm without working his wings, not in a rectilinear course, but by suitable inclinations and turnings of the wings in circular courses. We know that, in order to perform this manœuvre, the bird drops the interior wing a little and raises the exterior wing just as much, so that the wing-plane, during this motion, forms a conic ring, the top of the cone pointing downwards. If the velocity did not diminish, the bird would be able to continue this course indefinitely, or he would rise or sink in a screw-formed course, according as the velocity should increase or diminish. By greater inclination of the wing-plane to the axis of the cone, the circles would become narrower; by diminishing inclination, they would become wider: both these motions are easily produced by minimal changes of the form of the wing-plane or of the place of the centre of gravity. Let us further suppose that the stratum in which the bird soars is continually moving in a certain direction. From the moment the course of the bird is perpendicular to the direction of the wind (point *a* in Fig. 2) till the moment

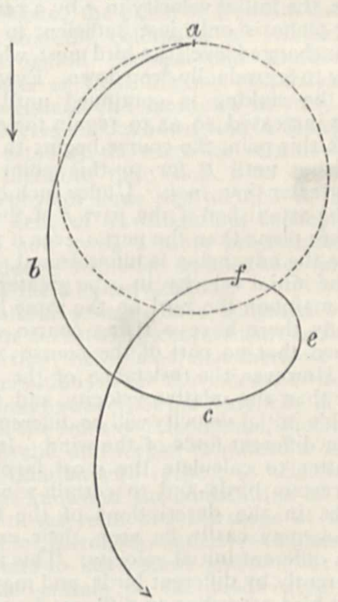

FIG. 2.

it grows parallel with it (*b*), the bird obtains from the wind an addition to his absolute velocity (not considering the loss occasioned by the resistance of the air) and also an increment of velocity from the moment his course deviates from the direction of the wind (*b*) till the moment it grows perpendicular to it (*c*). From this moment again the absolute velocity gradually diminishes, till, at last, at the point *f*, it reaches its minimum. From this point (*f*),

[1] It has long been acknowledged that some birds possess the power of changing their direction without any sensible loss of velocity.

a new circle begins identical with the first one, if the absolute velocity in *f* is the same as that in *a*, which does not imply any impossibility, even including the resistance of the air to the advancing. It is, however, important that the increment of velocity during the course *a–b–c*, is equal to its diminishing during the course *c–e–f*. Certainly the resistance of the air caused by the wind is greater during the latter part of the course than during the former, but the way is shorter in which this greater resistance is working.

In which plane or in which planes the different parts of the course will pass depends upon the initial velocity and upon the changes of the relative velocity of the bird; naturally also upon the invariable quantities—the weight of the bird, the size and form of the wing plane, so far as the latter has influence upon the resistance of the air to the advancing. Now in *a* and *f* the relative velocity is the same as the absolute or minimal velocity. In *c* the relative velocity is also the same as the absolute velocity, but in *c* they are both greater than in *a* and *f*, as we have shown here above. Thus the relative velocity has increased during the course *a–b–c*. During the course *a* to *b* no increment has occurred, on the contrary; so much the faster has it increased during the course *b* to *c*. During the course *c* to *e* the relative velocity increases continually, and obtains near *e* its maximum; whereas it gradually diminishes during the course *e* to *f*, so as to equal the initial velocity. Suppose then that the relative velocity diminishes somewhat during the course *a* to *b*. This diminution, however, will be over-compensated during the course *b* to *c*, the relative velocity in *c* being greater than that in *a*. During the whole course *c–e–f*, the relative velocity is greater than in *a* and *f*. Surely the supporting power of the current of air on the wings depends upon the relative velocity. It increases with the relative velocity, if we suppose everything else to be unchanged, particularly the angle of inclination of the wing-plane. If, therefore, the initial velocity in *a* by a certain pointing of the wing-plane is only just sufficient to maintain the bird at an unchanged level, the bird must, when describing the course *a* to *b*, gradually drop down. Even on the other side of *b* the sinking is continued until the relative velocity has increased so as to regain the same value as in *a*. From this point the course begins to rise and will continue rising until *f*, for to this point the relative velocity is greater than in *a*. Under such circumstances we cannot be astonished if the part *f* of the course will be in a higher plane than the part *a*, even if the resistance of the air to the advancing is infinitesimal.

Should the initial velocity in *a* be greater than what is required to maintain the bird on the same level, the bird would already there have a rising course, and it might easily happen that no part of the course would be descending. However, the resistance of the air increases much faster than the relative velocity, and therefore the most available initial velocity will be different for different birds and for different force of the wind. It is not as yet an easy matter to calculate the most favourable initial velocity to certain birds and to certain winds. But the discrepancies in the descriptions of the forms of the circles find, as may easily be seen, their explanation in supposing a different initial velocity. This is likely to be chosen differently by different birds, and may be different for the same bird according to different force of wind.

I am convinced that the bird always, even when soaring with the wind, has a greater velocity than the wind, and that thus during this part of the circle his speed is not hastened by the wind, but on the contrary he is here delayed, maybe less than in the other parts of the course. On the other hand, the velocity of the bird is augmented by the wind, as soon as the wind catches the bird from the side or obliquely from behind. This gain of velocity covers the loss caused by the resistance of the air to the advancing, and consequently allows the bird to maintain the necessary average velocity. It is less obvious, but nevertheless very likely, that the soaring bird, having gained the necessary velocity and having pointed his wings suitably, can, without changing the form of his wings, incessantly continue the soaring, as long as the force of the wind is unchanged.

Mr. Peal's[1] explanation no doubt comes nearest the truth, when he compares the soaring bird to a kite. We may consider the bird a kite, but the string which connects him with the earth is not fixed at a point of the surface of the earth, but the point of fastening moves with the wind, though it may be slower than the wind. It is the difference of velocity between the motion of the fastening-point and that of the air which affords the necessary power for the support and the rising of the bird. MAGNUS BLIX.

Lund, Sweden.

[1] NATURE, vol. xxiii. p. 10.

ELECTROLYSIS OF ANIMAL TISSUES.

A PRELIMINARY account of part of the work was given in the Proc. Roy. Soc. Edin., 1888, and a short description of later results at a meeting of the Physiological Society at Cambridge in March last. The full paper is being published in a volume of memoirs from the physiological laboratory of the Owens College, Manchester. The chief results are here summarized.

(1) The first part of the research was directed to answering two questions: (*a*) *Is the conduction in animal tissues entirely or chiefly electrolytic?* (*b*) *What are the electrolytes?* It is shown that by far the greatest part of the conduction at any rate is electrolytic, and that the best conductors by far are the inorganic constituents of the tissues. Next to these, but at a great distance, come some of the nitrogenous metabolites. The proteids are exceedingly bad conductors.

(2) *The changes produced in simple proteid solutions* were next investigated. It is shown that the proteids are affected not by primary electrolysis, but by the products of electrolysis of the salts.

The effects vary to some extent with the current density. In solutions of coagulable proteids alkali-albumin is formed at the cathode, and acid-albumin at the anode, some of the proteid being coagulated at the latter.

(3) *The effects of electrolysis on isolated tissues and on some of the liquids of the animal body.*

Striped Muscle.—Great changes were found in the microscopic appearance of the fibres. The nuclei became very prominent in those near the anode, with apparent coagulation of the sarcous substance, suggesting the action of a dilute acid. At the cathode the fibres were more homogeneous than before. The striation was impaired. Chemically, the same changes in the proteids were found as in simple proteid solutions, and a distinct effect on the distribution of the salts was made out, by estimating the ash in different parts of the muscle.

Blood.—Entire defibrinated blood, blood serum, and pure hæmoglobin solutions were used. There was no indication that hæmoglobin, or any derivative of it, acts the part of an ion. At the anode the reaction becomes acid, and acid-hæmatin is formed, which remains partly in solution and is partly thrown down, the solution becoming less deeply coloured. When the current is strong or long continued the hæmatin suffers further change and is decolorized, apparently by the oxygen or chlorine set free. If a reducing agent is present at the anode, the hæmoglobin there is not affected by the electrolysis. At the cathode alkali-hæmatin is ultimately formed, although its less definite spectrum does not show itself so soon as that of acid-hæmatin at the anode. The proteids of the serum and corpuscles are partly coagulated at the positive pole. At the cathode they are partly changed into alkali-albumin.

Bile and urine were taken as further examples of animal liquids.

(4) *The effect of electrolysis in the living body.*

Pithed frogs and anæsthetized rabbits were used. This part of the work is still incomplete.

G. N. STEWART.

LOBSTER CULTURE IN THE ISLE OF MULL.

WE have been favoured with a circular, issued by Mr. George Brook, Lecturer on Embryology in the University of Edinburgh, and Mr. W. L. Calderwood, late of the scientific staff of the Fishery Board for Scotland, expressive of an intentention to establish at Lochbuie a small marine laboratory. The promoters have set themselves to restore our shell fisheries to their former condition; and a leading item in their programme is the proposal to construct a lobster pond, with suitable apparatus for hatching and rearing lobsters. The cost of the entire laboratory, with pond and plant, is estimated at £400, that of maintenance at £150 per annum—exceedingly moderate sums, for which an appeal is made to the public. The condition into which our lobster fisheries have lapsed is shown by the fact that a lobster ground in the far west of Ireland is worked by a South of England boat. Our import lobster trade is yearly increasing, and the fact that our markets are not home-stocked is discreditable in the extreme. The problem of artificial culture necessary for the purpose in view has many times been attacked by British naturalists. Saville Kent had it constantly in mind while officiating at our several aquaria; he made it a primary object in his schemes for the establishment of marine stations in Jersey and at Brighton, and he meanwhile attempted to raise interest in it in a paper read at the International Fisheries Exhibition held at South Kensington. All this notwithstanding, the matter has, with us, not yet passed beyond the experimental stage, and we are behind in the international race. At Lochbuie the conditions should be favourable; and as Mr. Brook, in the preparation of his *Challenger* Report, has shown himself capable of performing a difficult task under exceptional conditions, we have full confidence in his ability to carry out his project. The promoters of this scheme propose in other respects to pursue a course of scientific study of the marine fauna of the west coast of Scotland, but their chief aims are unmistakably economic. We sincerely hope that they will confine their attention to the one or the other branch, for nothing can be plainer than that the extraordinary successes which have placed the fishery work of our American cousins foremost in that of the world, have been largely, if not wholly, due to their having kept pure science and economics scrupulously apart. The Lochbuie scheme is a modest though an ambitious one, and Messrs. Brook and Calderwood signify their intention of giving their services as superintendents. Recent proceedings in Parliament have shown that there is disaffection on the Scottish Fishery Board; and it would be an interesting circumstance should private enterprise, which has done so much for science in Britain, solve the difficulty in hand, while the State-aided body fritters away a handsome endowment.

THE FRENCH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

THE nineteenth meeting of the French Association for the Advancement of Science opened at Limoges on the 7th inst.

After some remarks on the learned societies of Limoges, and some references to Gay-Lussac, the inauguration of whose statue took place on the 11th inst., Prof. A. Cornu, the President of the Association for the year, delivered a discourse on the part played by physics in the progress of the sciences. It is impossible in the space at our disposal to do justice to this interesting address, but the following will give an idea of its character.

Beginning with chemistry, Prof. Cornu pointed out that the introduction and use of the chemical balance by Richter, Wenzel, Dalton, and Lavoisier led to the substitution of the laws of multiple and equivalent proportions, and the indestructibility of matter, for the vague hypotheses held by the alchemists.

Two other physical instruments introduced into chemical methods are the calorimeter and barometer. By means of the first, Dulong and Petit's law, that the same quantity of heat is required to heat an atom of all simple bodies to the same extent, was discovered; and but for the second, Gay-Lussac could not have made his researches on vapour density, which, with the work of Ampère and Avogadro, led to the determination of the numerical relation between the temperature density and pressure of a gas and the notion of atomic volume.

Another common physical instrument, the thermometer, has furnished organic chemistry with the means of discovering important laws of organic series; and recently, with the calorimeter, it has enabled M. Rault to determine molecular weights by the freezing of dissolvents, and has furnished Thomson, Berthelot, Sarrau, Vielle, and other workers in thermo-chemistry with the means of arriving at the new mechanics of the affinity of atoms according to their size, like the universal law of gravitation.

The introduction of the spectroscope into the chemical laboratory for purposes of analysis, by Bunsen and Kirchoff, marks an important epoch in the history of chemistry. This instrument has been entirely created by the labours of physicists; the prism of Newton, the telescope of Fraunhofer, and the collimator of Babinet marking stages in its evolution Bunsen and Kirchoff demonstrated the power of their method of analysis by the discovery of rubidium and cæsium; in fact, it is only necessary to observe an unknown line in the spectrum of a substance to establish the existence of a new element.

It appears therefore that each time chemistry has borrowed from physics some new method it has entered into a prolific field of investigation, conceptions have been extended and given a more precise meaning, and chemical knowledge advanced in a manner proportional to the power of the adopted methods.

The other natural sciences have benefited in the same way. Up to the seventeenth century astronomers had no means of assisting their vision, and therefore they could only make observations of the movements of the heavenly bodies. In spite, however, of the simplicity of the means of observation, the work of Hipparchus, Ptolemy, Copernicus, Tycho-Brahé, and Kepler contained a considerable amount of information with respect to celestial motions, but nothing was known of the constitution of the bodies observed. With the refracting telescope of Galileo and Newton's reflector, astronomy underwent a transformation: the sun was found to have spots and faculæ; the plains, mountains, and craters of the moon were observed: Venus was shown to go through phases in the same manner as our satellite; Jupiter's belts and satellites were seen; and the beauty of Saturn and his rings revealed.

Later, Herschel's large mirrors, worked by his own hands, enabled him to discover double and multiple star systems; to prove that many stars are suns like our own, inasmuch as they have other bodies revolving round them.

Such was the revolution produced in astronomy by the employment of the first optical instruments. The introduction of the spectroscope considerably extended the limits of investigation. The chemical constitution of the stars was determined in spite of their immense distances; the sun was shown to contain sodium, iron, magnesium, calcium, hydrogen, in a state of vapour at its surface—that is, the same elements as those which make up the earth's crust; it also contains nickel, an important constituent of meteorites, those nomadic bodies which fill interplanetary space. The sun and the bodies revolving round it are therefore composed of the same elements.

By means of the spectroscope it has been proved that the moon and the planets shine by reflected light, and that the stars, like the sun, are self-luminous, and made up of the same elements, thus demonstrating the unity of the chemical composition of the whole universe.

But the spectroscope has not only revealed the substance of the stellar world, it affords a means of investigating a component of stellar motion. The principle enunciated by Doppler, viz. that light-waves, like those of sound, vary in length with the relative velocity of the source producing it, remained unapplied for some time because there was, of course, no means of determining the proper colour of a star in repose and comparing it with that received, the variation being produced by motion in the line of sight. Fizeau showed, however, that by substituting lines in the spectrum for the idea of colour the conditions necessary for the application of the principle were met; all that was required being a line common to a star and some terrestrial element, and the measurement of the displacement of this line. This method was proposed by Fizeau in 1859, and has been considerably developed; numerous lines in stellar spectra are coincident with those of terrestrial substances. If they are all shifted towards the red the star is receding from the earth; if towards the violet the star is approaching us. The displacement of the line is measured with a micrometer, and a simple calculation gives the velocity with which the star is moving, whatever may be its distance.

It has been shown that for the application of the Doppler-Fizeau principle it is necessary to find in the spectrum of the star the lines of a terrestrial element. This common element is most often hydrogen—the simple body *par excellence*, the elementary substance of those who hold in the unity of matter.

Among all the methods of rendering impurities manifest, the simplest and most delicate is that of spectrum analysis. With the spectrum of hydrogen observed in the laboratory feeble lines of other substances are always present, and to decide upon the true hydrogen spectrum becomes therefore a difficult matter. But it was an astronomer and not a chemist who first described the pure hydrogen spectrum; the lines photographed by Dr. Huggins in the spectra of the white stars having since been shown to be reproduced in the laboratory when the spectrum of approximately pure hydrogen is observed.

In physics, the centre of natural philosophy, many branches have made rapid and definite advances. The results of the development of electrical science is seen on all sides, yet no science has had a more humble beginning. The first electrical experiment was made six centuries before our era: this was the attraction of light bodies by rubbed amber. The knowledge remained in this stage for more than twenty centuries; then the two electrical states were gradually recognized, and conductors and non-conductors were separated. In the establishment of the identity of atmospheric electricity with that obtained by electrical machines the death of Richmann at St. Petersburg should be noticed, and the discovery of the lightning conductor by the illustrious Franklin.

Everyone knows the story of the convulsive movements of a frog's leg in contact with a bimetallic arc observed by Galvani, an Italian physiologist. Volta saw in this circumstance that electricity might be developed by the contact of different substances; he discovered the law which permitted the energy to be multiplied; and in 1794 summed up all his works in an imperishable monument—the voltaic pile.

All the sciences benefited by the discovery, but chemistry gained the most. Carlisle and Nicholson decomposed water; Davy, with the great pile belonging to the Royal Institution of London, decomposed the alkalies and alkaline earths, formerly supposed elementary bodies. Later, Davy performed an experiment which eclipsed everything accomplished with the invention of Volta. By joining two carbon poles to his colossal pile, he produced a dazzling and continuous light, and discovered the electric arc now so commonly seen.

In 1820, Oersted discovered that the wire joining the poles of a pile exercised an influence on a magnetic needle. Ampère discovered the mutual action of electric currents, the mathematical law governing it, and, finally, the production of magnetism by the sole action of the voltaic current.

The discovery of the electro-magnet was a great event, not only in the history of science, but in that of humanity. In telegraphy it is the electro-magnet which transmits messages from one end of the world to the other with the velocity of light; in the telephone, the word itself; in the powerful machines derived from the memorable discoveries of Faraday, it is that which causes the transformation of energy.

Great advancements have also been made on the purely theoretical side. Ampère, Poisson, Fourier, Ohm, Gauss, Helmholtz, Thomson, and Maxwell have done much to connect electricity with mechanical laws. Again, electro-magnetic and optical phenomena obey the same elementary laws, and appear to be two manifestations of the movement of the same medium—the ether; thus optical problems may be settled with the equations of electro-magnetism. From an experimental point of view, results full of promise have already been obtained; the velocity of light, found by optical methods, has also been determined by measures purely electrical; and recently M. Hertz has accomplished experimentally the identification of electrical discharges with light-waves.

All these facts show that as our knowledge increases the distinctions between different branches of science vanish; the limits which have been traced between them are shown to be artificial, and only testify to ignorance of natural laws; but the efforts of successive generations have not been in vain, and we look forward to the time when these limits will be effaced, and all the branches of natural philosophy be united in one harmonious whole.

Prof. Cornu's discourse, of which the foregoing is but a sketch, was received with much applause.

After an address by the Mayor of Limoges, the Secretary of the Association, M. A. Gobin, read the report for 1889-90, and gave an account of the meeting in Paris last year. The financial statement by M. Gallante shows that the Association is in a prosperous condition, and increasing its number of members.

Many interesting and important communications were made in the different sections. The series of excursions included one of three days' duration, and visits were made to all places of interest in or near Limoges. The Congress will be remembered as a very successful one by all who were fortunate enough to be present.

C. H. F. PETERS.

By the death of Prof. C. H. F. Peters, Director of the Litchfield Observatory, Hamilton College, Clinton, N.Y., astronomy has lost an assiduous observer. An interesting sketch of his career is given in the *Astronomische Nachrichten*, from which the following details are taken.

He was born at Coldenbüttel, in Schleswig, on Sept. 19, 1813, and educated at the Gymnasium of Flensburg and the University of Berlin, where he studied mathematics and astronomy. Having taken his degree in 1836, he tried to obtain an appointment at the Observatory of Copenhagen, but his application was not successful. He then went to Göttingen, to carry on his studies under Gauss. Afterwards he was induced to undertake some scientific investigations relating to Mount Etna.

Having accomplished the task entrusted to him, he was made Director of the Trigonometrical Survey of Sicily. Of this appointment he was deprived in 1848, when he gave great offence to the authorities by expressing sympathy with the revolutionary party. He escaped on board an English vessel to Malta, but soon returned to Sicily, and joined the Sicilian army under Mieroslawski, acting first as a captain, then as a major, in the engineering branch of the service. It was under his direction that Catania and Messina were fortified. When Palermo fell into the hands of the Neapolitans, in May 1849, he fled to France, but soon changed his residence to Constantinople, where he proposed to devote himself in peace to scientific research. Here he secured many friends, and it was intended that a scientific expedition, under the guidance of Peters, should be sent to Syria and Palestine. Various obstacles, however, stood in the way; and the scheme had to be given up after the outbreak of the Crimean War.

He now turned his attention to the United States; and, with recommendations from Alexander von Humboldt, he went in 1854 to Cambridge, Mass., and from thence to Washington, where he obtained an appointment on the Coast Survey. After working for some time in this position, and establishing an observatory at Utica, he accepted, in 1858, the offices of Director of the observatory at Clinton, N.Y. (now known as the Litchfield Observatory), and Professor of Astronomy at the Hamilton College. The duties of these offices he continued to discharge until his death, which took place on the morning of July 19. He was found dead on the road between the observatory and his house, and seems to have died of heart-disease when returning from his work.

In 1874 Peters acted as chief of the North-American Expedition to New Zealand for the observation of the transit of Venus. He discovered no fewer than 48 minor planets and several comets, and much important work was done at Hamilton College under his supervision, his celestial charts and star catalogue being of considerable value. Few astronomers leave a better record behind them, and his death is much regretted.

NOTES.

THE annual excursion of the Belgian Royal Malacological Society took place under the guidance of MM. X. Stainier and J. S. Gardner. The Eocenes from the Thanets to the Lower Bagshots were examined at Herne Bay and Sheppey, where Mr. Shrubsole assisted, and the Gault and Chalk at Dover and Folkestone. The Eocenes seen were pronounced to be in all respects identical with beds of corresponding age in Belgium. The Society proposes to revisit England next year.

AMONG the excursions which have been arranged by the Local Committee of the British Association is one to Malham in Craven. This is to take place on Thursday, September 11, under the guidance of the officers of the Yorkshire Naturalists' Union. The district to be investigated is the plateau of Malham and the escarpment which it forms along the South Craven fault. It includes the only lake in the West Riding, and the remarkably picturesque scenery of Malham and Yoredale. In addition to these attractions, every branch of natural history can be successfully pursued in this locality. This advantage arises chiefly from the diversified character of the geological formations, which include Silurian rocks, mountain limestone, Yoredale shales, and millstone grits. We believe that this will be a popular excursion among members of Field Naturalists' Clubs, who will have an opportunity of observing the methods of work adopted by the Yorkshire Naturalists' Union, and it is hoped that as this will be an essentially working excursion, any field naturalists and geologists who may take part in the Leeds meeting of the British Association will attend the Malham excursion.

WE learn that the French physicians who went to the International Medical Congress at Berlin were much gratified by the cordiality with which they were received.

IN a letter to the *Times* the other day, Mr. John Cordeaux referred to a unique collection of migrating birds formed at Heligoland by Herr Gätke as the result of work carried on during 40 years. This collection, he added, was to be brought to England, "having been secured to the nation by the munificence of a single individual." With reference to this statement, Prof. W. H. Flower writes from the British Museum (Natural History), Cromwell Road, to the *Times* as follows:—"May I supplement the letter of Mr. Cordeaux by saying that the individual by whose liberality Herr Gätke's collection has been secured for the nation is Mr. Henry Seebohm, and that arrangements are being made by which, when the collection arrives, it will be permanently exhibited in this Museum?"

A WORK on "The Birds of the Japanese Empire," by Mr. Henry Seebohm, is nearly ready for publication. It is illustrated with numerous woodcuts. Mr. R. H. Porter is the publisher. The same publisher has in the press "The Birds of Sussex," by Mr. William Borrer. This work is supplied with a map of Sussex, and with six coloured plates by J. G. Keulemans.

MESSRS. MACMILLAN AND CO. announce for publication this week an English translation of Prof. Ostwald's "Grundriss der allgemeinen Chemie" by Dr. J. Walker, of Edinburgh University. This work covers the same ground as the author's classical "Lehrbuch," but the treatment throughout is elementary, and, as far as possible, non-mathematical. The new modes of molecular-weight determination, van 't Hoff's theory of osmotic pressure, Arrhenius's hypothesis of electrolytic dissociation, and the interesting applications of these to purely chemical problems—all receive special attention at the hands of the author. The appearance of the book is particularly well-timed, as we learn that Profs. Ostwald, Raoult, van 't Hoff, and Dr. Arrhenius have intimated their acceptance of the invitation issued to them by the British Association, and will be present at the coming meeting in Leeds.

THE first volume of a work by Prof. A. de Mortillet, on the origin of hunting, fishing, and agricultural pursuits among primitive races, has just been published. It contains many interesting representations of prehistoric implements in the Saint Germain Museum.

ATTENTION has been called in various quarters (England, Belgium, France, and Germany) to the remarkably cold weather prevailing of late years, since 1885, in Central and Western Europe; the yearly averages being constantly under the normal. It now appears from an Algerian record, that these years have been warmer than usual in Algeria. It is also shown that there has been no change in the frequency of north and south winds, while in Europe the north-east winds have been increasing in frequency.

IN the new number of the Journal of the Anthropological Institute the most elaborate paper is one on the Dieri and other kindred tribes of Central Australia, by Mr. A. W. Howitt. There are also papers on characteristic survivals of the Celts in Hampshire, by Mr. T. W. Shore; skulls dredged from the Thames in the neighbourhood of Kew, by Dr. J. G. Garson; and a new spirometer, by Mr. W. F. Stanley. In the paper on Celtic survivals in Hampshire, Mr. Shore refers to the feeling with which the May-day sunrise was regarded by the ancient Celts. "This May-day sunrise," he says, "was certainly reverenced in mediæval Christian time as well as in pagan Celtic time, for the line of about 20° north of east is the line of orientation of a large number of the oldest churches in Hampshire, and of many in other counties. It is a common orientation among the oldest churches of Hampshire, in which county there are as many as seventy examples of it. I cannot explain this on any other ground than the survival of a reverence for the May-day sunrise from Celtic pagan time to Saxon Christian time, and under a modification to a later date. It appears to me that, as there is evidence of the survival of part of the Celtic people, it is not surprising to find that traces of their May-day customs have survived also. It is of course possible that in this common line of orientation of many old churches we may see all that remains of one of the customs of the old British Christianity which existed before the coming of the Saxons."

ACCORDING to the *Journal de la Chambre de Commerce de Constantinople*, quoted by the *Board of Trade Journal*, the silk section of the Agricultural Society of Moscow has offered a prize of 500 roubles for the best work on the anatomy and embryology of the silkworm. Works on this question must be sent not later than January 1, 1892.

THE Rio Negro Salt Company seems to have had an interesting stall at the Rural Exhibition recently held at Palermo, near Buenos Ayres city. The Buenos Ayres *Standard*, in an article quoted by the *Board of Trade Journal*, thus calls attention to the subject:—"Here, in an unpretending but exhaustive manner, are displayed the products of those vast *salinas* or salt lakes which lie some few miles north of the town of Patagones, and which this company has recently commenced to work. There are large blocks composed of big crystals taken in the rough from the *salinas*; barrels of natural brine; compressed cakes for cattle; coarse salt for hides and meat curing; ground salt for kitchen use; and refined salt, dazzling as snow, and in every way equal to the English bottled salt, for use at the domestic table; in short, salt in every form that can be desired either for practical wants or the dainty demands of luxury. Pamphlets are distributed containing analyses by eminent men of science, which demonstrate the excellence and purity of its quality, and its adaptability for all known purposes. As regards quantity, we were informed that a calculation had been made that in a given year it would be possible to take from the Rio Negro lakes, occupying an extension of about nine square leagues, upwards of two millions of tons, and that, in the ensuing season an equal quantity of salt would be found, owing to the fact that every winter the lakes became filled with a brine of a density of from 25° to 32°, which in due time becomes a solid cake of salt."

A *Zeitschrift für Psychologie und Physiologie der Sinnesorgane* (*i.e.* organs of sense), has been recently started in Germany (April), under the editorship of Herren Ebbinghaus and König, the former of whom is known for some remarkable researches on the memory, and the latter for his studies in physiological optics. Among the contributors are Herren Aubert, Exner, Helmholtz, Hering, and other eminent men of science. The following are some of the subjects that have been dealt with: disturbance of the perception of very small differences of brightness by the proper light of the retina: simultaneous contrast; disappearance of after-images in eye-movements; memory of regularly successive and equal sound-impressions.

IN the *Victorian Naturalist* for June, Mr. G. Lyell, Jun., of South Melbourne, notes that while walking along the edge of a mountain stream in Gippsland last January he observed a peculiar habit of the Victorian butterfly, *Papilio macleayanus*. One of these butterflies was seen to alight close to the water, into which it backed till the whole of the body and the lower part of the hind wings were submerged, the two forelegs alone retaining their hold of the dry land. After remaining in this position for something like half a minute it flew away, apparently refreshed. "During the morning," says Mr. Lyell, "I noticed quite a number doing the same thing. In one instance no less than four were to be seen within a space of not more than three yards, and to make sure that I was not deceived I captured several as they rose from the water, and found in each case the body and lower edge of the hind wings quite wet. While in the water the fluttering of the wings, so noticeable at other times, was suspended, and so intent were the butterflies in the enjoyment of their cold bath that they would hardly move, even when actually touched by the net. Apparently the heat of the weather drove them down to the water, as immediately they emerged they flew up again to the hill-sides. I have often noticed butterflies of the *Nymphalidæ* family settling near the pools, and apparently imbibing the moisture from the damp sand round the edges, but never before have I seen butterflies enter the water. Possibly it may be a peculiar habit of this particular species or genus. Numbers of the white butterfly, *Pieris harpalyce*, were flying about at the same time, but I noticed none alight near the water."

SOME interesting observations on the growth of vegetation in the numerous lakes to the east of the Baltic have been lately made by Herr Klinge (*Engler's Bot. Jahrb.*). This growth depends on the mean direction of the wind during the period of vegetation. As south-west winds prevail in that region, the south-west border of a lake is protected, and the grassy and mossy growth naturally begins there, and spreads by degrees round the north and south ends. The north-east bank, on which break the waves from the south-west, shows hardly any trace of vegetation. It is generally steep, and tends to retire under the action of the waves. Something similar is met with in the Baltic: shore-meadows occur in the islands only on the east, wind-protected coasts. Further, rivers are displaced in the direction of the prevailing winds, eating away their eastern banks, while the western grow. The dead arms of the lower Embach are, with few exceptions, on the south side of the river, which, under the action of the wind, has been displaced northwards, *i.e.* (with reference to its direction) to the left, and so, contrary to Baer's law of river-courses. Indeed, the author rejects this law, and holds the principle of displacement according to prevailing winds to be universal. It is noteworthy that this relation has of late been pointed out by several Continental observers independently. Herr Klinge further finds that in the region east of the Baltic, hygrophilous (or moisture-loving) plants grow on the south-west side of the hills, and xerophilous plants on the north-east side.

THE Märjelen Lake, which lies in Upper Valais, lately burst the glacier dam which lay across the valley. According to the Swiss *Vaterland*, a peasant who was close to the lake at the time declares the scene was most terrible and indescribable. When the ice dam gave way, the vast mass of water came tumbling out, sweeping away the huge fragments of the glacier, with the rocks upon it, tumbling into the crevasses, bursting them up in turn, and rising over the glacier in gigantic waves, again to carry all before it. Just at the end of the glacier the valley had narrowed into a little defile, while the face of the glacier was some hundreds of feet high. The water seemed to have tunnelled under the ice, which, attacked above and below, gave way at last with a deafening crash, while the flood hurried down the mountain-side into the Rhone. The lake is nearly 8000 feet above the sea-level, and usually discharges its surplus water by subterranean channels, occasionally bursting its ice barriers as on the present occasion. The cantonal Government are constructing an overflow canal, which, it is hoped, will put an end to these periodical outbursts.

IN a paper printed in the new number of the Transactions and Proceedings of the New Zealand Institute, Mr. Taylor White describes an extraordinary meteor which he saw at Wimbledon, Hawke's Bay, on May 4, 1888, between 8 and 9 o'clock p.m. The nucleus, or head, was of oval form, of a transparent light-yellow colour, as of iron at a white heat. The tail was in the form of the tail of a pheasant, expanded—that is, the two centre streamers were of uniform length, the outer ones gradually shortening, so that the outermost streamer on either side was very much shorter than those in the middle. These streamers were of a dull, opaque orange. They were distinctly divided each from each by dark bands, which consisted of several fine black lines, to, probably, the number of five in each band. Mr. White is unable to fix the number of orange streamers, but would guess ten as probably correct. The colours blue and green were also certainly present. No sound was audible while the meteor was in view. "But," says Mr. White, "after I had gone into the house, and was describing what I had seen, the sound of its striking the earth or sea was heard—a loud and lengthened noise, to me like the violent shaking of all the forest trees, and evidently above ground, thereby differing from the sound accompanying an earthquake—coming from the westward; and this was followed, after a hardly perceptible interval, by a fainter sound, like an echo, to the north-east. The time which elapsed till the sound was heard was from three to five minutes." Various New Zealand daily journals gave full descriptions of the phenomenon at the time. According to the *New Zealand Times*, the apparent size of the meteor was "quite half that of the full moon."

THE editor of the Journal of the Royal Agricultural and Commercial Society of British Guiana contributes to the June number some interesting notes on luminous larvæ. Speaking of a form referable to the *Elateridæ*, or spring beetles, he says its luminosity, when observed in a dark place, is singularly striking and beautiful. The light is emitted along the whole length of the body—the head, the front part of the anterior segment, and the last segment of the body, being altogether luminous, while each intermediate segment gleams from a small area on each side of the back, two regularly-arranged rows of golden brilliants being thus observable. The light is continuous, and very bright, but it is intensified when the little creature is irritated. At intervals, one or more of the dorsal lights will be observed to be very dull or nearly extinguished, but apparently they are never quite put out.

MR. T. D. LATOUCHE, who contributes to the Records of the Geological Survey of India a paper on the sapphire-mines of Kashmir, takes the opportunity to offer some remarks on the extent to which the natives of India know the mineral resources of their country. He thinks he is not far wrong in saying that in very few instances in India have useful minerals been discovered in localities that were unknown to the natives, and in which the ores had not been worked by them at one time or another. Even the more uncivilized hill tribes are more or less well acquainted with the minerals their hills contain, and are by no means in the condition of the Blacks of Australia or the Bushmen of Southern Africa, in whose country the European prospector has found so great a field for his energies. To take a single instance: the Khasis of Assam, who, till the beginning of the present century, had hardly felt the influence of Western civilization, have for ages obtained their iron from an ore which occurs as minute grains of magnetite disseminated in the granite of their hills. Many a highly-trained European geologist might justly have been sceptical as to the possibility of obtaining a productive iron ore from granite, and would very possibly have passed the rock over as being utterly useless for such a purpose. Yet the Khasis discovered the mineral, and in all parts of the hills ancient heaps of slag testify to the use they made of their discovery; moreover, they obtained the ore by a process which was ingenious and even scientific—in fact, a kind of hydraulic mining somewhat similar to the latest process devised for obtaining gold in California. Can it be doubted that, if any other useful minerals existed in their hills, the Khasis would have found and worked them long ago? Similarly, in Kashmir, any mineral deposits that exist are probably well known to the natives, and, if useful, are already worked, and these are not of any great importance.

AT a recent meeting of the Wellington Philosophical Society, New Zealand, Mr. Hulke exhibited a specimen of a strange spider that carried its young on its body without web or filament, but simply attached to the body, until they were able to run by themselves.

MR. JOHN WHELDON has issued Part I. of a catalogue of botanical works, including the library of the Rev. M. J. Berkeley.

THE Glasgow and West of Scotland Technical College has issued its Calendar for the year 1890–91. The main objects of this institution are to afford a suitable education to those who wish to qualify themselves for following an industrial profession or trade, and to train teachers for technical schools.

WE have received the author's Hairless Paper-Pad Holder and Paper-Pad, issued by the Leadenhall Press. The Paper-Pad consists of a block of fifty sheets ($7\frac{1}{2} \times 8\frac{3}{4}$) of smooth and cream-tinted paper mounted together on a stout piece of blotting-paper, the price charged being only that for common scribbling-paper. The Paper-Pad holder is made of light wood, and should be grasped by the left hand, the right hand being free to travel over the surface of the paper-pad which is placed on it. After each sheet is used, it is torn off and placed under the pad and so blotted, and by this means the height of the pad and holder is kept constant. For writing in railway carriages, and for reporting, this form of support will be most serviceable, and it might also be used for the support of sketching-blocks.

MESSRS. MARLBOROUGH, GOULD, AND CO. are issuing what they call Marlborough pamphlet cases, the object of which is to preserve pamphlets from dust and destruction. The cases have no springs or other contrivances that could injure the contents by pressure, and in the bookshelf they resemble ordinary volumes, being "rounded and cloth-backed." The makers have sent us a case specially intended for numbers of NATURE.

THE additions to the Zoological Society's Gardens during the past week include two Brown Bears (*Ursus arctos* ♂ ♀) from Russia, presented respectively by Mr. A. C. de Lafontaine and Mr. D. B. Gellibrand; a Panolia Deer (*Cervus eldi* ♂), a Common Goat (*Capra hircus* ♂) from British Burmah, presented by Mr. Charles C. Galbraith; a Water Pipit (*Anthus spipoletta*), European, presented by Commander W. M. Latham, R.N., F.Z.S.; ten Common Chameleons (*Chamæleon vulgaris*) from North Africa, presented by Mr. W. Mauger; seven Oyster catchers (*Hæmatopus ostralegus*), European, purchased; an Axis Deer (*Cervus axis*), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

OBJECTS FOR THE SPECTROSCOPE.

Sidereal Time at Greenwich at 10 p.m. on August 21 = 20h. 0m. 41s.

Name.	Mag.	Colour.	R.A. 1890.	Decl. 1890.
			h. m. s.	° ′
(1) G.C. 4532	—	Bluish.	19 54 47	+22 25
(2) D.M. + 35° 4001 ...	9	—	20 6 4	+35 51
(3) D.M. + 35° 4013 ...	9	—	20 7 42	+35 51
(4) D.M. + 36° 3956 ...	9	—	20 10 25	+36 19
(5) 13 Sagittæ	6	Yellowish-red.	19 55 5	+17 13
(6) γ Sagittæ	4	Yellow.	19 53 54	+19 12
(7) θ Aquilæ	3	White.	20 5 36	− 1 9
(8) 229 Schj.	6·5	Red.	19 25 26	+76 21
(9) S Cephei	Var.	Very red.	21 36 35	+78 8

Remarks.

(1) This is the so-called "Dumb-bell Nebula." Dr. Huggins's record of the spectrum is as follows:—"The light of this nebula, after passing through the prisms, seemed concentrated in a bright line. This line appeared nebulous at the edges. No trace of the other lines was perceived, nor was a faint continuous spectrum detected. The light from different parts of the nebula is identical in refrangibility, and varies only in degree of intensity." The line referred to is, of course, the chief nebula line, near λ 500, and it will be seen that in this case it was not perfectly sharp and well-defined. It is important that the observation should be repeated by as many impartial observers as possible, as there is still a difference of opinion as to whether the line is really sharply defined or not. Other lines may also be looked for. Prof. Winlock simply observed that the spectrum consisted of a single line, and no continuous spectrum.

(2, 3, 4) These are the three "bright-line stars" first observed by Wolf and Rayet in 1867, and called by them 1st, 2nd, and 3rd Cygnus, respectively. They were subsequently observed in greater detail by Vogel, who found that many lines were common. It has been shown that most of the lines can be explained by a reference to the low-temperature spectra of manganese, iron, and sodium, in addition to the radiation of hydrogen and carbon. The most striking feature of the spectra is undoubtedly the bright band in the blue, which, standing out beyond the continuous spectrum, gives rise to an apparent absorption band on the less refrangible side. My own observations, and those of Mr. Lockyer, have shown that this band is coincident with the blue band seen in the spectrum of the spirit-lamp flame, and is therefore probably due to carbon. This conclusion is supported by the presence of another carbon fluting, near λ 517, which, however, is not so obviously seen because of the brighter continuous spectrum in that region. These are the brightest bands seen in the spectra of comets at mean distances from the sun, and the similarity leads to the conclusion that the structure of comets and bright-line stars is identical (see NATURE, August 7, p. 344). Bright-line stars are therefore probably swarms of meteorites. It is desirable that the coincidence of the carbon bands with those of the "stars" should be confirmed by other observers.

(5) The spectrum of this star is a well-marked one of Group II., the bands 2–9 being wide and dark. It is probably one of mean condensation, and the bright carbon flutings should therefore be well seen. It will be interesting also to know what dark lines, if any, are present at this stage.

(6) A star of the solar type (Vogel). Is the temperature increasing (Group III.) or decreasing (Group V.)?

(7) A star of Group IV. Observations of the comparative intensities of the hydrogen and other lines are required, in order that the temperature relatively to other stars of the group may be determined.

(8) This is a relatively bright star of Group VI., showing the secondary bands 2, 3, 4, 5, and 8, in addition to the usual carbon bands, which are very wide and dark. As in other stars of the group, further details, especially the presence or absence of solar lines, should be looked for.

(9) This variable of Group VI. will reach a maximum about August 25, the period being about 485 days. The magnitude at maximum is 7·4–8·5, and that at minimum about 11·5. I may repeat that we as yet know nothing of the spectroscopic changes which accompany the increase of light in a star of this kind, and continuous observations will therefore be of the utmost value. It has been suggested by Mr. Lockyer that the chief variation may be the relative paling of the principal bands at maximum. Colour changes should also be noted.

A. FOWLER.

MOSCOW OBSERVATORY.—Prof. Th. Bredichin has issued the second volume of the second series of *Annales de l'Observatoire de Moscou*, and it contains some interesting papers. In one "On the Origin of Periodic Comets," Prof. Bredichin brings forward many important facts. He first points out the similarity of the elements of some comets, and adduces evidence to show that they probably once formed part of a single comet which has become disintegrated by explosions and planetary perturbations; the multiple comets of Biela, Liais (1860), and 1882 II. being quoted as examples of such a development. After deducing the expressions for eruptions which do not take place in the plane of the orbit of the generating comet, and applying them to some examples, the elements of twenty-nine comets having a period less than 100 years is given, and some considerations relative to their perihelion distances, small inclinations, and direct movement are urged, as opposed to the hypothesis of the immediate transformation of parabolic to elliptic orbits. Two tables of 290 non-periodic comets arranged in the order of their perihelion distance (q), and 44 comets which have developed comæ, will be useful, irrespective of the fact that they demonstrate that when the value of q is sensibly greater than 1 the comet has little ability to develop eruptive phenomena and to produce new comets. A division of periodic comets into four groups is made, the periodic time of the respective groups being 73·8, 33·1, 14·1, and 6·0 years, and it is shown that the values of the eruptive action increases as the period decreases. The influence of Jupiter and Saturn on cometary orbits is, of course, considered, and some relations are pointed out between the times of revolution of the above-mentioned groups and those of these two planets. In another long paper "On the Origin of Shooting Stars," Prof. Bredichin attempts to prove that all meteors are ejections from comets. A paper by M. P. Sternberg gives the results of some determiuations of the length of the seconds pendulum made by Prof. Bredichin and himself in 1888–89 in various parts of Russia and Europe; and another paper, by M. Ceraski, "On Luminous Clouds," contains some interesting facts. On June 26, 1885, from observations made at two stations, separated by 10 kilometres, the vertical height of a luminous cloud was found to be nearly 75 kilometres. A map is also given for putting down observations of the paths of Perseid meteors, and this, with the eleven papers, renders the volume for 1890 as good as its predecessors.

LEANDER MCCORMICK OBSERVATORY.—Vol. i., Part 4, of the Publications of the Leander McCormick Observatory of the University of Virginia contains some double-star observations made in 1885–86. The working list from which the double stars were selected contained all known pairs between −30° and 0° having distances less than 4″, and several very close and difficult pairs north of the equator. The observers were Messrs. F. P. Leavenworth and Frank Muller, and the measures appear to have been made with much care.

COGGIA'S AND DENNING'S COMETS (*b* AND *c* 1890).—The following ephemerides are given by Dr. Berberich in *Astronomische Nachrichten*, No. 2984:—

Ephemerides for Berlin Midnight.

1890.	Coggia's Comet. R.A.	Decl.	Brightness.	Denning's Comet. R.A.	Decl.	Brightness.
	h. m. s.	° ′		h. m. s.	° ′	
Aug. 21	11 27 54	+16 49·2		15 28 28	+42 1·8	2·09
23	11 33 1	15 23·7	0·27	30 9	38 58·4	
25	11 37 55	14 0·8		31 51	35 54·3	2·17
27	11 42 37	12 40·2	0·23	33 33	32 50·0	
29	11 47 8	11 22·0		35 16	29 46·5	2·21
31	11 51 29	10 6·1	0·20	37 0	26 44·6	
Sept. 2	11 55 41	8 52·3		38 45	23 44·9	2·21
4	11 59 45	7 40·7	0·17	40 31	20 48·4	
6	12 3 41	6 31·1		42 18	17 55·5	2·16
8	12 7 31	5 23·4	0·15	44 5	15 6·8	
10	12 11 14	4 17·6		45 53	12 22·6	2·08
12	12 14 51	3 13·5	0·13	47 42	9 43·5	

The brightness at discovery has been taken as unity.

SEXUAL SELECTION IN SPIDERS.

EVERY student of zoology who, of late years, has attempted to follow the drift of all that has been written on the subject of natural selection cannot fail to have observed that the less important, though not less interesting, hypothesis of sexual selection has received relatively little attention. It must be seen, in fact, that to all intents and purposes the hypothesis has remained in the state in which it was left by Mr. Wallace's criticisms—lately repeated and extended in "Darwinism"—of Mr. Darwin's views. And further, it will probably be admitted that this circumstance is to be attributed, not to the fact that there exists amongst zoologists unanimity of opinion on the point—far from it; but to the fact that, owing to the great practical difficulties in the way of making fresh observations on the courtship of new groups of animals, there has been little or nothing to add to what has been already said. Consequently any contribution to the subject should be gladly welcomed; and no apology is needed for drawing attention to a paper on the "Sexual Selection of Spiders," which was published last year in the United States of America.

Moreover, since the paper in question is one of the occasional papers of the Natural History Society of Wisconsin, it is not likely to obtain a wide circulation, at all events on this side of the Atlantic, and to meet with that attention which all who read it must admit that it deserves. The author, Mr. G. W. Peckham, whose name has been for some years past well known to those who have devoted their time to the study of spiders, has in the present instance produced a work of much greater general interest than any that he has published before. For the series of observations which constitute a large part of its subject-matter affords a means of testing in practically an unworked order of animals—and one especially favourable for the purpose—the two hypotheses respecting sexual ornamentation formulated by Mr. Darwin and Mr. Wallace. And since the conclusions to be derived from these observations are, in the opinion of the author, all in favour of Mr. Darwin's views, it will be of interest to see from a critical examination of the contents of the paper to what extent this opinion is supported by the facts therein set forth.

Mr. Darwin's theory of sexual selection, or in other words the theory that the brilliant colours and ornaments of the male are due to the constant preference by the female of the best-decked males, is too well known to need further explanation here. Mr. Wallace, rejecting this theory on the grounds that there is but little evidence in its favour and much that is directly opposed to it, has put forward an alternative hypothesis which may be briefly epitomized as follows. The production of colour in organisms is normal, and needs no special accounting for; the more brilliant colouring of the male, the development of plumes, &c., is attributable to the greater vigour and activity of this sex, and when this colouring becomes intensified at the breeding season it is because vitality is then at a maximum; the duller colouring of the female, at all events in birds, is due, through the agency of natural selection, to the toning down or elimination of the normal tints on account of her special need for concealment.

Before proceeding to test these two theories in the light thrown upon the subject by a consideration of the secondary sexual characters of spiders, Mr. Peckham, turning his attention to other groups, urges the following cases as inexplicable by Mr. Wallace's views. If, it is asked, there is a causal relation between high vitality and ornamentation, how are we to account for the brilliant colours of some tropical pigeons which are remarkable neither for pugnacity nor activity? and how for the gaudy plumes of the birds of Paradise, which are by no means noticeable for fierceness of disposition? But in the case of these two objections the flaw seems to be the assumption that pugnacity and activity are the only criteria of high vitality.

It is clear, moreover, that at the time these were advanced the author had never read Mr. Wallace's last work, "Darwinism"; for on p. 292 of this volume reference is made to the birds of Paradise, and their gaudy adornment is spoken of in connection with the wonderful activity they display. The following question is also raised. Quoting *verbatim*—"Perhaps the most difficult fact to reconcile with the [Mr. Wallace's] theory is the absence of ornamentation and bright colour in the bats. They have a wide expanse of integument, and great activity, the conditions specified by Mr. Wallace for the development of gaudy pigment, and nothing, apparently, in their habits to keep it down; but, except in the frugivorous bats, we find little difference between the sexes, nor is there any appreciable approach to bright colours" (p. 9).

At first sight this objection seems to be valid; for, if we admit the truth of the author's premises, it seems that his conclusion is a just one. But can this be done? Is it the case that there is nothing in the habits of bats to keep down the development of gaudy pigment? Surely not. These animals are nocturnal or crepuscular, spending the day suspended from the roof of some cave or other dark secluded spot, and only issuing forth at nightfall to exercise their activity in hunting for prey. Thus that great expanse of integument above referred to—namely, the wings—is never exposed to the rays of the sun, and few things, if any, are more antagonistic to the development of gaudy pigment than absence of light.

These cases, then, do not seem upon examination to be seriously opposed to Mr. Wallace's views. But turning to the spiders, we find that the objections are of a somewhat different order from those hitherto considered. For after passing in review all the principal families of this group, and studying their moults, it is concluded (1) that there is no evidence to show that there is a causal relation between high vitality and adornment, since, in the first place, as a rule, the savage and powerful female is less, sometimes very much less, brightly coloured than the male, who is comparatively weak and unaggressive; and, in the second place, many of the sluggish and sedentary spiders, such as, *e.g.*, the *Epeiridæ*, are brilliantly tinted, whilst other active, restless forms, such as most *Lycosidæ*, are relatively dull-coloured; (2) that when the male differs from the female he departs in proportion from the normal colouring of the group, and that when the female, as well as the male, is showily attired, the resemblance between them is due to the partial or complete transmission of the male colouring to the female, the completeness of the resemblance depending upon the age of the male at the time of the acquisition of his adornments; and (3) that there is no reason to think that the females have had their colours toned down for the sake of concealment at the time of nesting, for in the *Attidæ*, where sexual differences of colour are best marked, the females have covered nests.

Mr. Wallace's theory, then, however satisfactory it may be in the case of butterflies and birds, fails apparently in every essential respect when applied to spiders. It is necessary, therefore, to look elsewhere for an explanation.

Now, when we consider the secondary sexual characters of the *Attidæ*, the first fact that strikes the attention is that these characters exist in the males as modifications in the form of the falces, palpi, first pair of legs, or clypeus—that is, of those portions of the anterior part of the body which are in full view when the male is approaching the female—and, moreover, that these modifications in form result often in an increase of surface for the development of gaudy, often strongly iridescent, hues.

Thus, in *Salticus formicarius* the ♀ has short vertical reddish-black falces, while those of the ♂ are horizontal, much enlarged, and copper-green in colour; and in *Icius palmarum* "the falces in the ♂ are compressed, horizontal, and three times as long as the face, the fang equalling the falx in length; the front surface of the falces is dark bronzy rufus, and on each outer edge is a wide band of snowy-white hairs. In the ♀ the falces are vertical, and only as long as the face, and the snowy-white hairs are absent. The ♂ is rendered still more striking by the long snowy-white hairs which cover his clypeus, while the forehead, and a space just below the first row of eyes, is covered with bright red hairs. All this ornamentation is lacking in the ♀."

The clypeus, too, is liable to a considerable amount of variation with sex. Thus, in *Dendryphantes capitatus* this part in the ♂ is conspicuously marked by several white bands, which contrast strikingly with the dark colour of the rest of the face; in the ♀ the whole clypeus is whitish, and in no way conspicuous. Again, in *Mopsus mormon* there is a high vertical ridge of hairs extending over the forehead in the ♂; in the ♀, on the other hand, these hairs are wholly absent. So, too, in the *Theridiidæ*, the heads of the males are frequently higher, in many species very much higher, than in the females.

With regard to the palpi and first pair of legs, it will be sufficient to say that in Keyserling's "Arachniden Australiens" thirty-four males are described (in the family *Attidæ*), having well-developed fringes or tufts of hair on the palpi, while there are only five females so ornamented, and several of these to only a moderate extent; and that in the ♂ of *Synageles picata* the tibia of the first pair of legs is enlarged and flattened, and the anterior face of the enlargement is of a brilliant steel-blue colour; in the ♂ of *Philæus metallescens* the anterior legs are elongate, of a brilliant steel-blue colour, and ornamented with rings, spots, and fringes of hairs, whilst in the females of these two species the legs are neither modified nor adorned to any remarkable extent.

It must be understood that the few instances here given of the secondary sexual characters have been selected out of a number cited by the author, who could himself have filled a volume on the subject. Sufficient, however, have been given to show how commonly the anterior portion of the body varies in different ways in the male sex; and "it is of high importance to note that the bright-coloured hairs or metallic scales as well as the protuberances are either on the anterior surface, or in some way so placed as to be plainly in view from the front."

In seeking for an explanation of these sexual characters it does not appear that any of them are of special advantage to their possessors in the way of procuring food, avoiding enemies, fighting with rivals, &c.; consequently they cannot be attributed to the action of natural selection. But when considered in connection with the habits of the *Attidæ* at the time of mating, it is clear to the mind of the author that the clue is to be found in the theory of sexual selection. The courtship of a number of captive species is described, and described with a sense of the ludicrous which is quite irresistible. The following two may be selected as instances.

On p. 37 we read of *Saitis pulex*:—"On May 24, we found a mature female, and placed her in one of the larger boxes, and the next day we put a male in with her. He saw her as she stood perfectly still, twelve inches away; the glance seemed to excite him, and he at once moved towards her; when some four inches from her he stood still, and then began the most remarkable performances that an amorous male could offer to an admiring female. She eyed him eagerly, changing her position from time to time so that he might be always in view. He, raising his whole body on one side by straightening out the legs, and lowering it on the other by folding the first two pairs of legs up and under, leaned so far over as to be in danger of losing his balance, which he only maintained by sidling rapidly towards the lowered side. The palpus, too, on this side was turned back to correspond to the direction of the legs nearest it. He moved in a semicircle for about two inches, and then instantly reversed the position of the legs and circled in the opposite direction, gradually approaching nearer and nearer to the female. Now she dashes towards him, while he, raising his first pair of legs, extends them upward and forward as if to hold her off, but withal slowly retreats. Again and again he circles from side to side, she gazing towards him in a softer mood, evidently admiring the grace of his antics. This is repeated until we have counted 111 circles made by the ardent little male. Now he approaches nearer and nearer, and when almost within reach whirls madly around and around her, she joining and whirling with him in a giddy maze. Again he falls back and resumes his semicircular motions, with his body tilted over; she, all excitement, lowers her head and raises her body so that it is almost vertical; both draw nearer; she moves slowly under him, he crawling over her head, and the mating is accomplished."

Again, on p. 47, concerning *Dendryphantes elegans*:—"While from three to five inches distant from her, he begins to wave his plumy first legs in a way that reminds one of a windmill. She eyes him fiercely, and, he keeps at a proper distance for a long time. If he comes close she dashes at him, and he quickly retreats. Sometimes he becomes bolder, and when within an inch, pauses, with the first legs outstretched before him, not raised as is common in other species; the palpi also are held stiffly out in front with the points together. Again she drives him off, and so the play continues. Now the male grows excited as he approaches her, and while still several inches away, whirls completely around and around; pausing, he runs closer and begins to make his abdomen quiver as he stands on tip-toe in front of her. Prancing from side to side, he grows bolder and bolder, while she seems less fierce, and yielding to the excitement, lifts up her magnificently iridescent abdomen, holding it at one time vertical, and at another sideways to him. She no longer rushes at him, but retreats a little as he approaches. At last he comes close to her, lying flat, with his first legs stretched out and quivering. With the tips of his front legs he gently pats her; this seems to arouse the old demon of resistance, and she drives him back. Again and again he pats her with a caressing movement, gradually creeping nearer and nearer, which she now permits without resistance, until he crawls over her head to her abdomen, far enough to reach the epigynum with his palpus."

From these cases and the others that are given it is established that the attitudes and antics of the males are such as to display to the best advantage whatever adornments they possess, and it is concluded that the female selects as her mate the male which pleases her best on account of some superiority over his fellows in adornment either of colour, or special outgrowths, or both. Hence is deduced the further conclusion that the sexual ornaments of the male result from the constant preference by the females of the best-decorated males. But it is obvious that this conclusion is open to the same criticism as that advanced against Mr. Darwin's explanation of the sexual ornamentation of, *e.g.*, birds—namely, the criticism that the conclusion rests upon an inference and not upon a fact; and that the most important link in the whole chain of evidence is wanting—namely, the proof that the females select as partners the most beautiful males. This it will be remembered, is perhaps Mr. Wallace's strongest objection to the hypothesis of sexual selection; and when we consider all the cases that are quoted in this work it will be seen that many of those that are advanced as supporting this hypothesis are equally explicable by Mr. Wallace's views. Thus, although it is certainly the case that the females are as a rule the more powerful and more ferocious, yet, on the other hand, judging from the descriptions given of the contests and dances of the males, it seems to be this sex which excels in activity; and if activity be a criterion of high vitality we at once see the connection between high vitality and ornamentation. Again, from the fact that the female watches with attention the antics and gambols of the male, it is inferred that she is admiring the display of his agility and beauty: that, of course, may be the case, but is it not conceivable, considering the ferocity of her disposition, that she is merely on the alert to ward off an unwelcome advance, or is but awaiting a favourable opportunity to seize and destroy her persecutor? Or again, if it be asked why it is that the males perform the strange antics in the presence of the females if it be not for display, it may be answered that the excitement of the males, always great during the breeding season, attains to a maximum at that time in the society of the females, and shows itself in the performance of the strange antics that are so graphically described. The same objection may be made to the idea expressed on p. 41 that the seemingly terrible battles of the males are all sham affairs gotten up for the purpose of displaying before the females. The fact that the males fight when there is no female to watch them makes it more probable that the combats are due to playful excitability or genuine ferocity. And lastly, not only, as above stated, is there a lack of evidence to show that the female prefers as partner the most beautiful male; but, more than that, it appears that the success of one male over another in courtship may be attributed to excess of vigour. Thus, in the case of *Astia vittata*, a species in which there are two types of male, it is stated on p. 54 that "the *niger* form is much the more lively of the two, and whenever the two varieties were seen to compete for a female, the black one was successful. He is bolder in his manners . . ."[1]

Thus Mr. Peckham has not yet brought forward a sufficient number of facts to carry to all minds that conviction of the truth of the theory of sexual selection which he feels himself. But whatever be the value of the criticisms here advanced, and of others that will doubtless be thought of, everyone will admit that the paper contributes a number of new and interesting facts to the subject of sexual adornment, and most of its readers will probably feel inclined to think that the balance of the evidence, so far as spiders are concerned, tends to support the explanation proposed by Mr. Darwin. R. I. POCOCK.

THE TERMINOLOGY OF HYDROLYSIS, ESPECIALLY AS EFFECTED BY "FERMENTS."

ALL who consider the meaning of words, and who desire, as far as possible, to remove ambiguity from the terms employed in denoting chemical change, must have felt some dissatisfaction with the nomenclature used, chiefly by physiologists, in describing and discussing the remarkable phenomena

[1] In connection with this passage it is necessary to explain that at the time it was written I was not aware that Mr. Poulton, in his new work on "The Colours of Animals," cites the case of *Astia vittata* as affording the strongest support to the theory of sexual selection; nor did I see Mr. Wallace's review of this work in NATURE of July 24 (p. 289) until after the present article had been sent to the publisher. Consequently I had no means of knowing what Mr. Wallace's opinion on the point might be—except in so far as his reply to Mr. Poulton is the only one that common sense would immediately suggest to any man who holds Mr. Wallace's views on sexual ornamentation, or who criticizes the subject without prejudging it. —R. I. P.

presented by the living cell and which attend digestion. As Messrs. Brown and Morris in their paper "On the Germination of the Gramineæ" (Chem. Soc. Trans. 1890, 458) have done me the honour to accept several of my suggestions, I venture to regard the opportunity as one which should not be lost of discussing the terminology of fermentation phenomena.

Changes such as a glucose undergoes when it is resolved into carbon dioxide and ethyl alcohol take place under the influence of the living organism, and there is every reason to believe only *within* the cell: they involve the formation of products containing in the gross neither more nor less than the original elements of the compound fermented; and when the products are compared with the compound from which they are derived, it is seen that their production in all cases involves the separation of carbon atoms which were directly united, and also considerable rearrangement of the constituent elements.

Changes such as that which cane-sugar undergoes on inversion take place not only within the cell but equally well without it under the influence of a substance which, although not living, is of vital origin: they appear always to involve the fixation of the elements of water; and the products of their action bear a very simple relation to the original substance, viz. always that of an alcohol to its ether, no separation of directly-united carbon-atoms, or any molecular rearrangement such as attends the former class of actions, taking place. The agents derived from organisms which effect changes of this second kind are spoken of as *unorganized ferments;* changes of the first kind are said to be conditioned by *organized ferments, i.e. organisms.*

There is thus, at the outset, a difficulty in assigning a consistent meaning to either term—fermentation or ferment; diverse phenomena produced by diverse agents being included under a single designation.

Fermentation.—The difficulty is in part met by restricting the term fermentation to changes such as occur, for example, during alcoholic fermentation; and there would seem to be no occasion to apply it more widely so as to include changes of the second kind, these, as before remarked, being apparently all cases of *simple hydrolysis.* This is true, even if the explanation of fermentation suggested by Baeyer in 1870 (cf. *Ber.*, 1870, 63; Journal of the Chemical Society, 1871, 331) be accepted, which represents fermentation proper as the outcome of hydrolysis—an explanation which the increase of knowledge in the interval entirely favours; inasmuch as hydrolysis takes place in the two cases with different results, and affects compounds of different types. Moreover, it is to be noted that not only is it impossible to represent the phenomena of fermentation proper as the outcome of simple hydrolysis, but that also, in certain cases, synthetic as well as analytic changes occur; in the case of butyric fermentation, for example. In fact, in many instances, apparently two series of concurrent changes take place: the one series involving what, in the light of Baeyer's explanation, may be termed *recurrent* as distinguished from *simple* hydrolysis; the other involving the interaction of the molecules of one or more products of this recurrent hydrolysis. There is thus an advantage in employing a somewhat empirical expression in connoting phenomena which do not all conform to one absolute type, but which have a common origin, as they are the outcome of protoplasmic activity, especially as most fermentations are attended with evolution of gas.

But it is to be remembered that, whereas carbohydrates and allied compounds such as glycerol, lactic acid, &c., are said to undergo *fermentation,* the decomposition of albuminoids under the influence of organisms is commonly termed *putrefaction;* this distinction, however, is made on account of the character of the products, not because there is any reason to suppose that the changes which occur are essentially different in character from those which the carbohydrates undergo. The want of a term indicative of the fact that the action is one which takes place under vital influence without reference to the character of the change—equally applicable to simplifications such as occur during alcoholic fermentation and to complications such as occur during butyric fermentation—is also felt in the case of changes such as alcohol undergoes under the influence of *Mycoderma aceti* and *vini,* or which ammonia undergoes on nitrification, and in the converse change of denitrification. Dr. W. Roberts has proposed to speak of changes induced by enzymes (*v. infra*) as cases of *enzymosis;* the corresponding term *zymosis* might well be employed as the synonym of fermentation, and would probably be found to be of more general application: thus alcohol may be said to undergo oxidation by zymosis or zymic oxidation under the influence of *Mycoderma aceti;* and in discussing putrefactive changes, it would be possible to speak of zymic changes as distinct from those arising from the unassisted interaction of the zymic products. Zymosis is preferable to *zymolysis,* as the effect is not always one of simplification.

Ferments.—The expression *ferment* is more frequently than not employed as the equivalent of *unorganized ferment;* consequently it is applied to the very agents which are incapable of producing fermentation proper. This has been so generally felt to be the case that several words have been coined in place of unorganized ferment, notably *zymase* and *enzyme* (cf. Dr. W. Roberts, Roy. Soc. Proc., 1881, xxxi. 145): the objection may be made to the former that it is indicative of vitality; the latter, however, is expressive, and serves only to indicate the vital origin of the agent, thus differentiating it from agents such as the mineral acids which act very similarly.

Enzymic action or enzymosis[1]—to use the phrase suggested by Dr. Roberts—appears, as already remarked, always to involve decomposition by means of water. On this account, in 1880, in the second edition of my "Introduction to the Study of Organic Chemistry" (Longmans; footnote, p. 190) I put forward the following suggestions:—

"Decompositions like those of starch into dextrose, of cane-sugar into dextrose and lævulose, of the fats into glycerine and an acid, or of ordinary ether into ethylic alcohol, which involve the fixation of the elements of water, may all be said to be the result of *hydrolysis;* and those substances which, like sulphuric acid, diastase, emulsin, &c., induce hydrolysis may be termed hydrolytic agents or *hydrolysts.* The substance hydrolyzed is the *hydrolyte.* The mere fixation of the elements of water, unaccompanied by decomposition, as in the conversion of ethylenic oxide into glycol, $C_2H_4O + OH_2 = C_2H_4(OH)_2$, may be termed hydration in contradistinction."

It is usually necessary to employ a specific enzyme (hydrolyst), or one of a very limited number, to effect the hydrolysis of any particular hydrolyte, and hence physiologists are in the habit of speaking of *amylolytic* ferments, *proteolytic* ferments, &c., meaning ferments capable of *splitting up* starch, proteids, &c. But the terms amylolytic, proteolytic, &c., are confusing to the student who has learnt that electrolysis signifies splitting up *by means of* electricity, and hydrolysis splitting up *by means of* water—not the splitting up *of* electricity or *of* water. As electrolysis and even hydrolysis are well-established terms which it would scarcely be politic to alter, it appears highly desirable to abandon the use of terms such as amylolytic, proteolytic, &c., and I would suggest that an enzyme capable of inducing the hydrolysis of starch should be termed an *amylo-hydrolyst;* one which affects albuminoids, a *proteid-hydrolyst;* one which affects fats, a *glyceride-hydrolyst.*

One case remains in which the use of the term ferment cannot be avoided by the adoption of this proposition—that of the so-called rennet ferment. It may well be that this is also a hydrolyst, and that in all cases the formation of a curd, clot, or coagulum initially involves hydrolysis—or, perhaps, hydration merely—and the consequent interaction of molecules of the product or products; but of this we know nothing at present, and the observed phenomena are of so different a character that it is desirable to connote such changes by a distinct expression. I would suggest that we should term the rennets *thrombogenic enzymes* or *thrombogens.* HENRY E. ARMSTRONG.

[1] Sheridan Lea's zymolysis (cf. *Journal of Physiology,* 1890, xi. 254) is open to the objection above made to zymase.

SCIENTIFIC SERIALS.

L'Anthropologie, sous la direction de MM. Cartailhac, Hamy, et Topinard, tome i., No. 2 (Paris, 1890).—The covered mortuary-chambers at Les Mureaux (Seine-et-Oise), by Dr. Verneau. Through the accidental displacement of the soil in a field at Les Mureaux an important discovery was made in the winter of 1888–89 of a subterranean sepulchral passage, a so-called *allée couverte,* which was densely packed with human bones, intermingled with various stone, bone, and other objects. As in other constructions of the kind, this mortuary passage was divided into two paved and walled-in chambers, varying in width from 1·85 m. to 2·10 m. Owing to the thickness of the stone walls dividing these chambers, considerable labour must have been required to effect an entrance whenever a fresh burial took place. It would appear that sixty or more skeletons had been deposited in these chambers, but unfortunately many of the bones were damaged or utterly destroyed by the workmen originally engaged in the excavations. In the course of M. Verneau's examination of these sepulchral chambers, he discovered that a special burying-place had been allotted to children close to the stone hearth, which was placed at the entrance of the *allée*, while the adult skeletons had been deposited in other parts of the chambers. He is of opinion that the *foyer* or hearth was designed to facilitate the ventilation of the air before the chamber was opened for the deposition of fresh bodies, but the presence in the surrounding ashes of half-burnt animal bones suggests the possibility that these rudely constructed hearths may have been used for the preparation of funeral repasts. The great number of artificially perforated cranial bones proves that the process of trepanning was of frequent occurrence amongst the Neolithic tribes of Les Mureaux. The great variety of cranial types, which range from the extremes of brachycephalism to those of dolichocephalism, shows that a blending of several distinct races had taken place prior to the settlement of these early people. The objects found at Les Mureaux, moreover, indicate that these tribes must have had communication with distant regions, for while the stones of which the *allée* is built have been obtained from the opposite shores of the River Seine, some of the shells, as patella, purpura, and others used for ornamentation, must have been derived from intercourse with people of the remote sea-coast. Perforated flint and bone pendants were found on several of the skeletons, as many as five of these objects being suspended around the neck of a very young child.—On the dietary of the Lapps, by M. Rabot. The author has borrowed so largely from the narratives of earlier foreign travellers, and more especially from those of Dr. Broch and other Danish writers, that his work can lay no claim to originality. According to the author it would seem that we are justified in assuming that the sedentary Lapps and most of those who have entirely given up a nomadic life live almost exclusively on fish, while the pastoral section of the people prefer animal food.—The cephalic index in the population of France, by Dr. Collignon. The author here shows how we may trace in the distribution of various cephalic indices the main centres of the different races which have occupied the French territories. Among the various peoples settled in France he distinguishes three groups—namely, (1) a Ligurian or Iberian people, the representatives of the Cro Magnon and other primitive tribes, who exhibited the dolichocephalic type, with a short stature and a brunette coloration. This race appears to have spread from the Gulf of Lyons to the Maritime Alps. (2) A Celtic brachycephalic race, which predominated in the districts extending from the Mediterranan to the eastern limits of France. (3) A blonde dolichocephalic people, who had forced themselves wedge-like through the Celtic mass of the population, separating it into two sections, and advancing from north-east to south-west.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, August 11.—M. Duchartre in the chair.—On the equilibrium and mutual reaction of the volatile alkalies, by M. Berthelot. The author has considered the cases of the mutual reactions of water, hydrochloric and sulphuric acids on piperidine, and has determined the various heat changes which result. He has also investigated the amount of heat developed in the action of ammonia and the fixed alkaline bases on the same compound. Pyridine and aniline have been similarly experimented upon.—On the meteoric iron of Magura, Arva (Hungary), by MM. Berthelot and Friedel. An examination of two samples of this meteorite has led the authors to the conclusion that the numerous small crystals are quartz, and not diamonds as has been supposed.—On an electric lamp called the Stella lamp, destined for use in mines, by M. de Garson.—On some new hydrates of gases, by M. Villard. The preparation of the hydrates of propane and of the fluorides of carbon is described.—On a new fatty acid, by M. E. Gerard. The new acid is intermediate between palmitic and stearic acids, and presents analogous properties; nevertheless its melting-point is notably lower than that of the more fusible of these two homologues. The author proposes to call it daturic acid.—Researches on the purple produced by *Purpura lapillus*, by M. Augustin Letellier.—On the multiplication and fertilization of *Hydatina senta* (Ehr.), by M. Maupas. This communication completes the work recorded in a former paper (*Comptes rendus*, cix., 1889) on the following infusorians: *Cycloglæna lupus* (Ehr.), *Notammata* species (?), and *Adineta vaga* (Davis), and consists of observations of two specimens of *Hydatina senta*.—On a peculiarity in structure of aquatic plants, by M. C. Sauvageau.—On the reputed digestive power of the liquid in the covered capsule of Nepenthes, by M. Raphael Dubois. The author has come to the following conclusions: (1) that this liquid contains no digestive juice comparable to pepsin, and that the Nepenthes are not carnivorous plants; (2) that the phenomena of disintegration or false digestion observed by Hooker were without any doubt due to the activity of external micro-organisms and not to the secretion of the plant.—Anatomical researches on hybrids, by M. Marcel Brandza. It has been found that (1) certain hybrids present in their structure a juxtaposition of particular characters such as are found in both parents; (2) in other cases the structure of different parts of the hybrid is, for every tissue, simply intermediate between that of the parents; (3) other hybrids have in certain organs a structure intermediate between that of the tissues of both parents, whilst in other organs a juxtaposition of anatomical characters peculiar to the parents is observed.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

Swanage: its History, Resources as an Invigorating Health Resort, Botany, and Geology: edited by J. Braye (Everett).—Hand-book of Cyclonic Storms in the Bay of Bengal: J. Eliot (Calcutta).—Cyclone Memoirs, Part 2:—Bay of Bengal Cyclone of August 21–28, 1888 (Calcutta).—Waterways and Water Transport in Different Countries: J. S. Jeans (Spon).—The Protoplast: E. C. C. Baillie (Nisbet).—Smithsonian Report, 1886, Part 2, and 1887, Part 2 (Washington).—Obs. Meteorolójicas hechas en el Observatorio Astronómico de Santiago, 1882–84, 1885–87 (Santiago de Chile).

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