THURSDAY, OCTOBER 14, 1897.

HINDU CASTES AND SECTS.

Hindu Castes and Sects: an Exposition of the Origin of the Hindu Caste System and the Bearing of the Sects towards each other and towards other Religious Systems. By Jogendra Nath Bhattacharya, M.A., D.L. Pp. xvii + 623. (Calcutta: Thacker, Spink, and Co., 1896.)

IN spite of all the books, essays and census reports dealing with the subject of Hindu castes, the problem of the origin of caste still remains one of the most difficult ethnological and sociological problems. We owe excellent treatises on the caste system as prevailing in certain parts of India at the present day to the industry of men like John Wilson ("Indian Caste," 1877), M. A. Sherring ("Hindu Tribes and Castes as Represented in Benares," 1872), D. C. J. Ibbetson ("Report on the Census of the Panjâb," 1881), E. J. Kitts ("Compendium of the Castes and Tribes found in India," 1885), J. C. Nesfield ("Brief View of the Caste System of the North-Western Provinces and Oudh," 1885), H. H. Risley ("The Tribes and Castes of Bengal," 1891-92), W. Crooke ("The Tribes and Castes of the North-Western Provinces and Oudh," 1896), and others. Eminent Sanskrit scholars, too, have devoted their attention to the caste system as represented to us in the most important works of Sanskrit literature, *e.g.* A. Weber ("Collectanea über die Castenverhältnisse," in his "Indische Studien," vol. x.), and J. Muir ("Original Sanskrit Texts," vol. i., 3rd ed., 1890).

A short time ago M. E. Senart published a most important treatise on the caste system ("Les castes dans l'Inde, les faits et le système," 1896). Proceeding from the modern system of castes, as described in the above-mentioned works, he tries to explain by it the old system of the four castes as found in the Vedic, epic, and legal literatures of ancient India. According to him, the so-called four castes of Sanskrit literature—Brāhmans, Kshatriyas, Vaisyas, and Sūdras—represent not four "castes," but four "classes," viz. the priests, the warriors, the Aryan people, and the non-Aryan slaves. But behind this system of four classes M. Senart discovers traces of a more complicated system, which he thinks was, on the whole, analogous to the modern Hindu system of numerous castes and sub-castes. Against this view of the caste system in ancient India, Prof. H. Oldenberg has quite recently (in the *Zeitschrift der deutschen morgenländischen Gesellschaft*, vol. li. p. 267 *seqq.*) raised serious objections. He shows that there is a natural development from the caste system, as found in the oldest Indian literature, to the theories of the Sanskrit law-books, and that the Buddhistic literature enables us—at least to some extent—to bridge over the gulf between the caste system of ancient India and its modern development. The caste system, as represented in the Pali literature of the Buddhists, has been fully treated by Dr. R. Fick ("Die soziale Gliederung im nordöstlichen Indien zu Buddha's Zeit. Mit besonderer Berücksichtigung der Kastenfrage," Kiel, 1897).

Even more divergent than the views about the historical development of the caste system, are the opinions of scholars regarding the origin of caste. While Mr. Risley considers it "scarcely a paradox to say that a man's social status varies in inverse ratio to the breadth of his nose," Mr. Nesfield asserts that "the question of caste is not one of race at all, but of culture," and Dr. Brockmann believes it to be proved that "the racial origin of all must have been similar, and that the foundation upon which the whole caste system in India is based, is that of function, and not upon any real or appreciable difference of blood."

With such a divergence of opinions, it is not difficult to prophesy that the caste problem is likely to occupy the attention of both Sanskrit scholars and ethnologists for some time to come, and Pandit Jogendra Nath Bhattacharya's book on the "Hindu Castes and Sects" may be welcomed as a solid contribution to the study of one of the most important problems in the history of India. This book has an additional value of its own, as coming from the pen of an intelligent and highly educated native, who at the same time is, if not an orthodox Brāhman, yet a proud member of the Brāhman caste. And it is of the greatest interest to see how such a native views the caste system and the development of sects—so intimately connected with that of castes—in his own country. Besides, a native has opportunities of getting information which it would be very difficult, and often impossible, for any European to obtain.

As to the origin of caste, Pandit Bhattacharya takes it for granted that the whole caste system is a creation of the Brāhmans and their Sāstras—a view of which few ethnologists will approve. Caste, like any other socia institution, must, after all, be a product of natural growth—though (just as is the case with other social institutions) fostered and turned to their own selfish ends by those who profited by it, in our case by the Brāhmans. Our author, indeed, as a staunch advocate of Brāhmanism, denies all such motives of selfishness on the part of the Brāhmans. "Caste," he says (p. 4 *seq.*),

> "has had its origin, no doubt, in Brāhmanical legislation. But there is no ground whatever for the doctrine that it is the outcome of the policy embodied in the Machiavelian maxim *Divide and Rule*. A very little reflection ought to show that the caste system, introduced and enforced by the Brāhmanical Shastras, could not possibly be the cause of any social split. On the contrary, it provided bonds of union between races and clans that had nothing in common before its introduction. . . ." He believes "that the legislation of the Rishis was calculated not only to bring about union between the isolated clans that lived in primitive India, but to render it possible to assimilate within each group the foreign hordes that were expected to pour into the country from time to time. . . . The authors of such legislation deserve certainly to be admired for their large-hearted statesmanship, instead of being censured for selfish ambition and narrowness."

Yet when we read of the extravagant prerogatives of the Brāhman caste, we cannot help admitting that the development, though not the origin, of the caste system is largely due to the ambition and selfishness of the Brāhmans. The position of the Brāhman in Hindu society could not be what it is according to the Sanskrit law-books and according to Pandit Bhattacharya's own description (p. 19 *seqq.*), if the Brāhmans had not used every possible effort to inculcate the doctrine of their own superiority into the minds of the people.

"The more orthodox Sūdras," he tells us (p. 20), "carry their veneration for the priestly class to such an extent, that they will not cross the shadow of a Brāhman, and it is not unusual for them to be under a vow not to eat any food in the morning, before drinking Bipra-charanāmrita, *i.e.* water in which the toe of a Brāhman has been dipped. On the other hand, the pride of the Brāhman is such that they do not bow to even the images of the gods worshipped in a Sūdra's house by Brāhman priests."

If a Sūdra be invited in the house of a Brāhman—that is to say, if he be invited to partake of the leavings of the Brāhman's plate—the Sūdra has to pay a "salutation fee of at least one rupee."

"But when a Brāhman eats in the house of a Sūdra on a ceremonial occasion, the payment of a fee by the host to the guest is a *sine qua non*" (p. 21).

Such customs, and the ideas underlying them, can only be understood by a long history of subjection—a subjection which was all the more thorough, as the ruling class was that of the priests, naturally the most powerful class in a country like India where religion was at all times the main force in the life of the nation.

Taking a bird's-eye view of the caste system, as sketched by Pandit Bhattacharya, we see before us a highly developed system of aristocracy. Here we have not only, as in most of the other countries, one class of society raised by hereditary rank above the rest of the people, but a graduated scale of ever so many distinct classes of society, every one of which claims superiority to the next lower class, the status of every family being determined by the traditions as to their hereditary rank, traditions which, in India, seem to be as trustworthy as a Gotha Almanac.

No man, as Pandit Bhattacharya shows, could pass himself off as a member of a Brāhman caste. The strict rules of etiquette require that every Hindu, when asked, must mention not only the names of his paternal and maternal ancestors, but give also information about his caste, his clan, his family or Gotra, his Pravara or ancestral family priests, his Veda, and the particular sacred books studied by his family. Our author tells us a characteristic story how a shoemaker was found out who wanted to pass as a Brāhman.

"With a view to have a share of the nice eatables provided for the Brāhman guests of a local Dives, he equipped himself like a Brāhman with his sacred thread, and quietly joined the company when they assembled in the evening. As usual on such occasions, one of the party asked him what his name and his father's name were. He said, in reply, that his own name was Ram Chatterjea and that his father's name was Kasi Lahiri. Being thus found out, he was hustled out of the place. His low position in caste saved him from kicks and blows, and while effecting his exit he gave expression to the sad moral of his adventure by muttering, 'a shoemaker cannot conceal his caste even under cover of night'" (p. 30).

Whatever may have been the origin of caste, whether race differences or differences of occupation, nowadays the social status of a man is determined neither by the breadth of his nose nor by his occupation, but by his genealogy. The very profession to the exercise of which the Brāhman owes his high social rank has fallen into contempt, for "according to Hindu notions, a priest is a very inferior person, and no Brāhman, who can live otherwise, would willingly perform the work of a priest" (p. 25). On the other hand, pedigrees are most highly valued. Take, for instance, the high class Rādhiyas or Kulins of Bengal, one of the most aristocratic of the Brāhman castes, who until recently were quite illiterate, yet—

"Their hereditary rank made them highly prized as bridegrooms for the daughters of their well-to-do clansmen, and many of them lived in former times by making marriage their sole profession. A Kulin of a high class might then marry more than a hundred wives without any difficulty, and there are still some who have such large numbers of wives as to necessitate their keeping regular registers for refreshing their memory about the names and residences of their spouses. Not only each marriage, but each visit by a Kulin to his wife brought him valuable presents, and as his wives and children were supported by his fathers-in-law, he could pass his days in comfort without being qualified for any kind of service or profession" (p. 41).

In spite of all the laws of the Sāstras prescribing certain occupations for each caste, there is hardly one profession that may not be exercised by any caste. We find Brāhmans employed as cooks (pp. 11, 22, 63, &c.), others who practise medicine (p. 48), many who live as agriculturists (pp. 50, 55, 131), and even as common servants (p. 131). The Valodras of Gujarat are partly money-lenders, and partly beggars who perform their begging tours on horseback (pp. 74, 81). Among the Audichyas in Gujarat there are also many professional beggars, and some who act as water-carriers (p. 75). The same variety of occupations is also found among other castes.

Pandit Bhattacharya divides the castes into six groups: 1) The Brāhmans, (2) the military castes, (3) the scientific castes (physicians and astrologers), (4) the writer castes (Kāyasthas), (5) the mercantile castes, and (6) artisan and agricultural castes, cowherds and shepherds, and domestic servants.

For every one of the numerous castes and sub-castes belonging to these six principal divisions, the Pandit gives us not only valuable statistics, but also highly interesting historical and ethnological data, which will be welcome to every student of the caste problem.

The second part of Pandit Bhattacharya's book is devoted to a survey of the Hindu sects. By way of an introduction the author states his views concerning the origin of sects and of religion in general. He defines religion as "the art of bringing men under priestly discipline," all religion being denounced by him as "the outcome of human policy," while founders of religious sects should be regarded like conquerors and political rulers. He uses very strong adjectives whenever he speaks of priests and founders of sects, but, strange to say, he never uses such strong language when he happens to speak of the Brāhmans. On the contrary, they are always spoken of as wise law-givers, whose "good and noble" teaching was corrupted by the sect-founders to whom such terms as "quacks" or "jugglers" are freely applied by the author.

The fact is, in speaking of the Hindu sects, Pandit

Bhattacharya is certainly not an unbiased judge, but a strong partisan of Brāhmanism. He denies that the sect-founders are religious reformers in any sense of the word.

"Looked at with the light of sober common-sense and unbiased judgment, the net result of their so-called reformations is that they let loose on society an army of able-bodied beggars, with the most preposterous claims on the charity and the reverence of the laity. Moral teaching of any kind very seldom forms a part of the programmes of our prophets. They teach their followers to sing some songs which tend either to corrupt their morality, or to make them indifferent to work for the production of wealth" (p. 359).

There is, no doubt, a great deal of truth in this criticism, but it is certainly not the whole truth about the religious systems of India. Our Pandit entirely fails to see the weak points of Brāhmanism which gave rise to the formation of the sectarian religions, and he utterly ignores the influence which the great philosophical systems of India exercised on the development of the sects. And altogether, he is too much of a partisan to be a good historian.

Nevertheless, there is a great deal of valuable information to be found also in this part of Pandit Bhattacharya's book. The numerous Hindu sects are grouped by him under the following classes:—(1) Siva-worshipping sects, (2) Sakti worshippers, (3) Vishnu-worshipping sects, (4) the disreputable Vishnu-worshipping and Guru-worshipping sects, (5) the modern religions intended to bring about union between the Hindus and the Mahomedans, (6) Buddhism, and (7) Jainism.

Not only in the chapter treating of the "disreputable sects," but also in the accounts of the Sivites, Sāktas, and Vishnuvites, much will be found that is of greater interest for the history of morality than for the history of religion. There is hardly one crime, however abominable, that is not recommended by one or the other of the so-called Hindu "religions," and the number of sects sanctioning sexual immorality is so large that we really need the assurance of our author "that the moral nature of the Hindus, as a nation, is, generally speaking, far superior to most of their religions" (p. 458). Although we cannot approve of Pandit Bhattacharya's wholesale condemnation of the Hindu sects, we have to admit that many of the latter-day prophets who founded "sects" during the last centuries fully deserve to be denounced as impostors. Take, for instance, Ram Saran, the founder of the Kartabhaja sect in Bengal:—

"To be ready with a pretext for exacting money from his followers, he declared that he was the proprietor of every human body, and that he was entitled to claim rent from every human being for allowing his soul to occupy his body. . . . To enforce his right and to give a pecuniary interest to his followers, the Karta appoints the chief men among the latter as his bailiffs and agents for collecting his revenue. The majority of the dupes of the sect are women, who readily pay the small tax that is demanded of them for the sake of securing long life to their husbands and children."

On the whole, I should like to recommend Pandit Bhattacharya's book rather to the scholar than to the general reader. At any rate, the latter will do well never to forget that the author is himself a member of one of the most aristocratic Brāhman castes. But the student of the history of civilisation in India will find in this book a great deal of useful and highly interesting information.

The value of the book is enhanced by an excellent index and glossary. M. WINTERNITZ.

EXPERIMENTAL MORPHOLOGY.

Experimental Morphology. By Charles Benedict Davenport, Ph.D., Instructor in Zoology in Harvard University. Part First. *Effect of Chemical and Physical Agents upon Protoplasm.* Pp. xiv + 280. (London: Macmillan and Co., Ltd., 1897.)

THE term "experimental morphology" is new, and requires to be defined. We cannot do better than quote the author's own definition.

"Several distinct steps can be recognised in the progress which has been made in the interpretation of form. The earlier studies were concerned chiefly with answering the question, *What* are the differences between the various adult forms? The results of observations and reflections relating to this question constitute the sciences of descriptive and comparative anatomy. Next, a more fundamental inquiry was entered upon: *How* are these forms produced or developed? The results of observations and reflections upon this subject constitute the science of comparative embryology. Finally, in these later days a still more fundamental question has come to the front: *Why* does an organism develop as it does? What is that which directs the path of its differentiation? This is the problem which the new school of 'Entwicklungsmechanik' has set for itself—it is likewise the problem with which this book is concerned.

"The causes which determine the course of an organism's development are numerous, but fall into two general categories: namely, internal causes, which include the qualities of the developing protoplasm; and external causes, which include the chemical and physical properties of the environment in which the protoplasm is developing. . . . It is the purpose of the present work to consider the effects resulting from external causes.

"When we wish to isolate the separate effects in any complex of causes, we must resort to the well-known procedure of experimentation. . . . Accordingly we call in experiment to get an insight into the causes of organic form, and thus justify the name which we have applied to our study."

The author proposes to attack the problem of the influence of external agents upon organisms from four points, viz.: (1) their influence upon the phenomena exhibited by all living protoplasm; (2) their influence upon growth; (3) their influence upon cell division; and (4) their influence upon differentiation. The present volume deals with the first point only, and its scope will be best understood if we say that it treats of the *physiology of protoplasm.*

The book is mainly based upon the work of others, and owes not a little to Verworn. It is, in fact, the author's expressed aim "so to exhibit our present knowledge in the field of experimental morphology as to indicate the directions for further research." It is therefore essentially a work of reference, and is rendered the more valuable in this respect by the addition of a fair bibliography appended to each chapter. The physiological character of the work will be at once recognised when the subjects treated of are enumerated. The action of chemical agents upon protoplasm is first dealt with, including the action of drugs and the relation between molecular composition and physiological action. The question of acclimatisation (immunisation) is considered both for inorganic and organic poisons. The author does not confine himself to the action of external agents upon single cells or unicellular organisms, but includes their action upon the whole organisation of individuals belonging to the higher vertebrates. Thus we find such experiments as those of Calmette upon immunisation to snake venom, and those of Nuttall and Thierfelder upon bacterium-free guinea-pigs, laid under contribution. The influence of oxygen upon the movements of bacteria and unicellular organisms, and the phenomena of chemotaxis in general occupy a special section of the chapter on chemical agents. The interesting observation of Roux, that isolated cells from the blastula of the frog move slowly in fluid, their movements being influenced by the presence of neighbouring cells, is referred to as a special morphologically interesting case of chemotaxis. The effect of adding or removing water to or from protoplasmic organisms: their vitality in circumstances producing desiccation, and the limits of such desiccation in the case of lower organisms, germs and seeds. The osmotic effects of solutions (with a very clear and interesting account of de Vries' fundamental experiments); this section includes also the acclimatisation of organisms to solutions of salt, *e.g.* of fresh-water organisms to sea-water, and *vice versâ*. The effects of mechanical disturbance—mechanical stimulation—upon amœboid movements, and upon direction of locomotion, including the effects of fluid currents (rheotaxis). The effect of gravity (geotaxis). That of electricity, and the differences displayed by different organisms in responding to galvanic currents, some, such as most Protozoa and Mollusca, responding to the positive pole (reacting at the anode on closure of the current)—anode-excitable or anex type—others, such as the Arthropoda and Vertebrata, responding to the negative pole (reacting at the kathode on closure of the current)—kathode-excitable or katex type. The phenomena of electrotaxis (positive and negative) in various organisms, the following general law being laid down for Metazoa: "Positively electrotactic organisms exhibit the katex type of irritability; and negatively electrotactic organisms exhibit the anex type, or, in general, the organism turns tail to the exciting pole." The action of light upon protoplasm, especial attention being given to the experiments of Engelmann with the microspectro-photometer, and those of Marshall Ward on the bactericidal action of the luminous rays. The phenomena of phototaxis and photopathy, including the effects of light in producing both bodily movements of organisms and movements of the protoplasm of cells, *e.g.* of pigment cells in the skin and retina. The effect of heat upon protoplasm, including the phenomena of rigor, both temporary and permanent, in muscle, with an interesting section on acclimatisation of organisms to extreme temperatures.

These are the subjects treated of, and it will be seen from the mere enumeration of them that the book covers a vast field of research: too vast to be really adequately dealt with within the modest limits of 280 octavo pages; nevertheless, it offers a valuable aid to the English student of biology. If we compare it with Verworn's well-known "Allgemeine Physiologie" (a better term, in our opinion, than experimental morphology—at least as applied to the subjects treated in this part of the work), which is a larger book covering the same ground, we find far fewer original experiments and observations, but a more complete account of the literature. Nevertheless, there are several noteworthy omissions. In dealing with the effects of chemical agents, the question of antagonism is untouched, and the important work of Ringer and others upon this subject is unnoticed. The same may be said for the work of Brunton, Cash, and others upon the relations between chemical constitution and physiological action. The chemical changes in protoplasm attendant upon its activity, and the effect of external agents upon such changes, are hardly so much as alluded to. The name of Romanes is nowhere mentioned, although his experiments upon the influence of chemical agents, of light, of gravity, and of electricity upon both animal and vegetable organisms are full of interest. But perhaps the most serious omission is the *relative lack* of allusion to the effects of external agents upon plant protoplasm In view of the light which may be thrown upon the phenomena exhibited by animal organisms by an account of those exhibited by plants under similar circumstances, it is in the highest degree desirable to bring the evidence derived from the two kingdoms together. For although, as the author puts it, protoplasm "must be a very dissimilar thing in different organisms," there must, nevertheless, be somewhere a fundamental identity between protoplasm from all sources. And, indeed, the author admits this:

> "It is with living *organisms* that we have to deal, and, accordingly, no distinction should be made between animals and plants. I have, indeed, made no such distinction; nevertheless, tastes and training have led me to lay especial stress upon animals. Even this is unfortunate, for the problem with which we are concerned is precisely the same problem in all *living organisms*."

We must, however, take the book as we find it, and although one could have wished it to be more developed in certain directions, it is still the most complete account in the English language of what may be termed (with Verworn) general physiology. This is a subject the study of which has increased so largely of late years, that there is hardly room for it to be more than merely touched upon in text-books of physiology; it has, in fact, grown into a self-contained branch of that science, with a more or less morphological bearing, and, as with the case of the morphology of the cell, is beginning to require a text-book to itself. We are glad to welcome Dr. Davenport's book as an attempt to furnish us with such a text-book in our own language.

OUR BOOK SHELF.

The Story of Germ Life. Bacteria. By H. W. Conn. From the Library of Useful Stories. (London: George Newnes, Ltd, 1897.)

THIS is a laborious and conscientious compilation of facts about bacteria, made ostensibly with the object of removing the slur said to have been cast upon these minute vegetables by an unsympathetic and unenlightened public. Had the writer been rather less ambitious in his desire to impart all the information he has collected, the story he tries to tell might have gained in the telling, and we should have had less of a record and more of a narrative concerning the habits and idiosyncrasies which prevail amongst the members of a microbial community. The tone adopted is often authoritative, and we should be glad to learn on what grounds Mr. Conn ventures to assert so positively that "preventive medicine will always remain unimportant."

The book claims thirty-four illustrations as an addition to the text, which are intended to represent various varieties of bacteria. Does Mr. Conn imagine because he is supposed to be talking to the uninitiated that his pictures of bacteria must be therefore correspondingly large, much in the same way as some people shout at foreigners, with the idea of making themselves more easily understood? As no information is given of the relation which exists between the size of the original object and the terrible travesties by which they are represented in the text, we much doubt if all the persuasive powers of the author will succeed in making the public regard his microbes in a friendly light.

Mr. Conn, however, has the merit of having conscientiously endeavoured to obtain accuracy in the manipulation of his material, a merit which is none too common in the popular treatment of scientific subjects, and the little volume bears throughout the impress of one who is an investigator and not only a writer.

G. C. FRANKLAND.

Natural Elementary Geography. By Jacques W. Redway. Pp. 144. (New York: American Book Co., 1897.)

THE illustrations are so numerous and attractive in this volume, that they make a picture-book of geography. The book has been constructed upon the plan recommended by the Committee of Fifteen appointed to consider the lines along which instruction in elementary science should be given (see NATURE, vol. liv. p. 310, 1896). The view of the Committee was that geography should be the study of the physical environment of man, and this conception has been borne in mind in the preparation of the volume before us. Beginning with familiar facts, the pupil is led naturally to knowledge beyond the range of his observation; generalisations never being made until the materials for their formation have been studied. He is encouraged to think for himself, by making much of the text interrogative, and providing material for the correlation and comparison of the characteristics of different districts; he is shown the value of map drawing and sand modelling in elementary geography, and relief maps give him good general ideas of the topography of the continents.

The pictures illustrate simple subjects, and will instruct as well as interest the young pupils who use the book.

As the book is an American production, it is largely devoted to the geography of the United States, less than two pages being given to the British Isles.

Kew Bulletin of Miscellaneous Information, 1896. (London: H.M. Stationery Office.)

THE Bulletins issued from the Royal Gardens, Kew, during 1896, are bound together with a very full index in the volume before us, the result being a valuable collection of miscellaneous botanical information. Many of the articles were referred to in our Notes when the Bulletins containing them appeared; nevertheless, attention may again be usefully directed to the articles on root diseases caused by parasitic fungi, natural sugar in tobacco, the new rubber industry in Lagos, sheep-bushes and salt-bushes, the cultivation of india-rubber in Assam, the botany of Formosa, German colonies in Tropical Africa and the Pacific, the Highland Coffee of Sierra Leone, and the flora of Tibet. The volume contains a review of the various aspects of the work of Kew since 1887, when the now familiar Kew Bulletin first made its appearance. We reprint this retrospect in another part of the present issue; and it furnishes the best of evidence of the active part which Kew plays in the development of our tropical possessions.

Wild Neighbours: Out-door Studies in the United States. By Ernest Ingersoll. Pp. viii + 301. Woodcuts. (New York and London: Macmillan and Co., 1897.)

THIS collection of articles from various magazines may be recommended to observers, and especially to young observers, of North American life. It contains a good deal of information, is written in an easy style, and bears frequent marks of personal familiarity with the animals described. A foreigner, visiting the United States for the first time, would pick up from this book, very rapidly and pleasantly, such knowledge of the commoner quadrupeds as he might extract from a well-informed naturalist, native to the country, in two or three weeks. The author has the habit of inquiry, and this renders his book particularly fit for young people, who may hope to fall in with grey squirrels, Canadian porcupines, skunks, racoons and wood-chucks. Perhaps the chapter on the "Badger and his kin" might leave the impression that shrews and moles are near relatives of the badger. "Animal training and animal intelligence" is a little bookish; and the performing elephants, &c., have little to do with the main subject. But these are trifles. The book is good of its kind.

L. C. M.

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.*]

Edible Copepoda.

IT is no novelty to biologists that the Copepoda of the sea are edible; but it may interest some of your readers to hear that to-day, when passing through the Labrador current, in about long. 50° W., we caught, cooked, and ate a number of the large Copepoda which swarm there. It certainly seemed a new idea to the captain and some of the British Association passengers, who partook of the Copepoda stew, that it was possible to collect from an Atlantic liner going at full speed a sufficient quantity of these pelagic animals to make a respectable dish.

I may add that the collecting, on Dr. John Murray's plan, is as easy as the cooking. The sea-water is pumped into the ship, and is strained as it runs out through five silk nets of different degrees of fineness—four of them on overflow and taps running continuously day and night, the fifth in the bath worked intermittently for certain hours.

W. A. HERDMAN.

S.s. *Parisian*, September 29.

Brief Method of Dividing a Given Number by 9 or 11.

I SHALL be grateful if you will allow me to communicate, through your columns, to mathematicians generally, but specially to those engaged in teaching arithmetic, two new rules, which effect such a saving of time and trouble that I think they ought to be regularly taught in schools.

Years ago I had discovered the curious fact that, if you put a "o" over the unit-digit of a given number, which happens to be a multiple of 9, and subtract all along, always putting the remainder over the next digit, the final subtraction gives remainder "o," and the upper line, omitting its final "o," is the "9-quotient" of the given number (*i.e.* the quotient produced by dividing it by 9).

Having discovered this, I was at once led, by analogy, to the discovery that, if you put a "o" *under* the unit-digit of a given number, which happens to be a multiple of 11, and proceed in the same way, you get an analogous result.

In each case I obtained the quotient of a division-sum by the shorter and simpler process of *subtraction*: but, as this result was only obtainable in the (comparatively rare) case of the given number being an exact multiple of 9, or of 11, the discovery seemed to be more curious than useful.

Lately, it occurred to me to examine cases where the given number was *not* an exact multiple. I found that, in these cases, the final subtraction yielded a number which was sometimes the actual remainder produced by division, and which always gave materials from which that remainder could be found. But, as it did not yield the quotient (or only by a very "bizarre" process, which was decidedly longer and harder than actual division), the discovery still seemed to be of no practical use.

But, quite lately, it occurred to me to try what would happen if, after discovering the remainder, I were to put it, instead of a "o," over or under the unit-digit, and then subtract as before. And I was charmed to find that the old result followed: the final subtraction yielded remainder "o," and the new line, omitting its unit-digit, was the required quotient.

Now there are shorter processes, for obtaining the 9-remainder or the 11-remainder of a given number, than my subtraction-rule (the process for finding the 11-remainder is another discovery of mine). Adopting these, I brought my rule to completion on September 28, 1897 (I record the exact date, as it is pleasant to be the discoverer of a new and, as I hope, a practically useful, truth).

(1) Rule for finding the quotient and remainder produced by dividing a given number by 9.

To find the 9-remainder, sum the digits: then sum the digits of the result: and so on, till you get a single digit. If this be less than 9, it is the required remainder: if it be 9, the required remainder is 0.

To find the 9-quotient, draw a line under the given number, and put its 9-remainder under its unit-digit: then subtract downwards, putting the remainder under the next digit, and so on. If the left-hand end-digit of the given number be less than 9, its subtraction ought to give remainder "o": if it be 9, it ought to give remainder "1," to be put in the lower line, and "1" to be carried, whose subtraction will give remainder "o." Now mark off the 9-remainder at the right-hand end of the lower line, and the rest of it will be the 9-quotient.

Examples.
9/75309 6   9/ 94613 8   9/58317 3
83677/3,   105126/4,   64797/0.

(2) Rule for finding the quotient and remainder produced by dividing a given number by 11.

To find the 11-remainder, begin at the unit-end, and sum the 1st, 3rd, &c., digits, and also the 2nd, 4th, &c., digits; and find the 11-remainder of the difference of these sums. If the former sum be the greater, the required remainder is the number so found: if the former sum be the lesser, it is the difference between this number and 11: if the sums be equal, it is "o."

To find the 11-quotient, draw a line under the given number, and put its 11-remainder under its unit-digit: then subtract, putting the remainder under the next digit, and so on. The final subtraction ought to give remainder "o." Now mark off the 11-remainder at the right-hand end of the lower line, and the rest of it will be the 11-quotient.

Examples.
11/73210 8   11/85347 1   11/59426 3   11/47568 4
66555/3,   77588/3,   54023/10,   43244/0.

These new rules have yet another advantage over the rule of actual division, viz. that the final subtraction supplies a *test* of the correctness of the result: if it does not give remainder "o," the sum has been done wrong: if it does, then either it has been done right, or there have been *two* mistakes—a rare event.

Mathematicians will not need to be told that rules, analogous to the above, will necessarily hold good for the divisors 99, 101, 999, 1001, &c. The only modification needed would be to mark off the given number in periods of 2 or more digits, and to treat each period in the same way as the above rules have treated single digits. Here, for example, is the whole of the working needed for dividing a given number of 17 digits by 999 and by 1001:—

999/75410836428139 214
75486322750890/104;

1001/75410836428139 214
75335500927212/ 2.

But such divisors are not in common use; and, for the purposes of school-teaching, it would not be worth while to go beyond the rules for division by 9 and by 11.

Ch. Ch., Oxford. Charles L. Dodgson.

Notes on Madagascar Insects.

Having recently received a small miscellaneous collection of rather typical Madagascar insects, collected by my son on that island, perhaps a modest, non-technical letter concerning them might interest your readers. The climate is so deadly to Europeans that insect-collecting is hazardous in the extreme, and I think not much is known of the insects. Some of the Orthoptera are highly curious, possessing antennæ five and six times the length of their bodies, so as to be able to detect danger afar. The Longicorn beetles appear very similar to ours, but the markings on their elytræ are brighter. The beetles generally are remarkable for the extreme brilliancy in colouring of their under surfaces and legs, while the upper surface is dull. I apprehend, therefore, they are *not* ground feeders. The dragon flies appear similar to some of ours, both in size, colouring, and shape. There is a lantern fly, or two, and a mole cricket, much resembling ours.

The spiders are *not* large, but as ugly and venomous-looking as nature knows how to make them. But, oh, the Centipedes!—gruesome-looking, plated, mailed, jointed, spiny-tailed, and, corneous horrors, half a foot long, with twenty legs (each side) their rapidity in travel must be great, while the large curved fangs, attached to the "business end," suggest the deadliest of grips. Had Milton ever seen one, "Paradise Lost" might have contained another horror.

I have had mounted with them a praying Mantis (also from the island), to somewhat neutralise their felonious aspect, though I fear the usual attitude of this most hypocritical of insects (with its extended fore limbs) indicates *anything* but prayer, or even reverence.

The brilliancy in colouring of Madagascar butterflies is not remarkable for a sub-tropical region. Many are like our fritillaries in aspect, while the clouded yellows appear identical. A few of the white butterflies are also like ours.

Rottingdean, Sussex. E. L. J. Ridsdale.

Protective Colouring.

The following instance of apparent consciousness of protective colouring in a young bird seems worth recording. On August 14, while walking in my orchard, which being on a steep slope is terraced with low stone walls, I put up a young Nightjar (*Caprimulgus europæus*) which flew straight to the top of one of the walls and flattened itself down on a broad flat stone. As it was within 6 feet of a hedge on one side, and there were gooseberry bushes, &c., on the other, there was no lack of cover if it had wished to hide. I left it there, and coming again two hours later found it in the same spot. Its colouring matched the stone on which it was lying so closely that had not one known that it was there, it would probably have been overlooked. On being closely approached it flew to another of the walls higher up, and crouched down in exactly the same way. I then tried to catch it with a butterfly net, when it flew over the hedge to a rough field on the opposite side of the valley from which it had, no doubt, come. Alfred O. Walker.

Nant-y-Glyn, Colwyn Bay, October 5.

THE MECHANISM OF THE FIRST SOUND OF THE HEART.

WHILST every one knows that the action of the heart is accompanied by sounds described as the first and second sounds of the heart, it is a remarkable fact that the mechanism by which the former of these phenomena is produced remains undetermined. It may be said to be almost universally accepted that the second sound is the result of the sudden tension of the semilunar valves, caused by the resistance which they offer to reflux of blood from the great vessels into the ventricles on the cessation of the systole. The difficulties which exist are connected with the first sound, and they result mainly from the fact that a number of events occur simultaneously with the systole of the ventricles and with the sound. Two of the most striking of these events, namely, the closure of the auriculo-ventricular valves and the muscular contraction of the walls, are regarded by many authorities as the source of the first sound. Sir Richard Quain in a paper recently read before the Royal Society has given a very graphic account of certain important investigations which lead him to the conclusion that neither of these explanations is correct, and which at the same time enable him to indicate what he believes to be the real explanation of the first sound of the heart.

In the first place, the author of this communication brings forward strong evidence to show that the action of the auriculo-ventricular valves is not the source of the first sound of the heart. This action consists in the simple apposition of the laminæ of these valves and the closure of the orifices by the musculi papillares and chordæ tendineæ, and affords no such tensive force as would suffice to produce the loud and characteristic sound which accompanies systole. More positive evidence is derived from the fact that the first sound can be heard independently of the existence and action of mitral and tricuspid valves in some of the lower animals, especially reptiles such as the python, which the author carefully auscultated in the Zoological Gardens, or when the valves are rudimentary, as in the kangaroo. The mitral murmurs familiar to physicians are, of course, formed at the mitral valve during systole; but they have no relation except in time with the first sound; they are merely accidental complications which occur at the moment of ventricular contraction, and the healthy first sound may be heard along with and independently of them.

In the second place, Sir Richard Quain shows that the muscular contraction of the walls of the heart during systole is not the source of the first sound of the heart. It is true that muscular contraction is accompanied by a sound, but this possesses neither the loudness nor the characteristic tone of the first cardiac sound. In opposition to the old experiments of Ludwig and Dogiel, which appear to show that after cutting off altogether the supply of blood from the cavities, one can still hear a systolic sound, the author puts the experiments of Prof. Holford, who made out that the sounds are heard or cease, respectively, according as blood is or is not admitted into the chambers. The classical observation of Stokes of Dublin that the first sound of the heart gradually disappears in the course of typhus fever, does not prove that muscular contraction causes the first sound, but that the impulse of the heart is so feeble that it is unable to produce the sound at the semilunar valves. The correctness of this view is confirmed by the fact recorded by Stokes, that the last point where the sound disappears in typhus is over these valves, whilst it is at the same point that it first returns. Further, Dr. Alexander Morison, working for Sir Richard Quain, found that in the bloodless heart of a recently killed turtle no sound could be heard during contraction sufficient to expel blood from the cavity. These facts and observations are, in the author's opinion, sufficient to prove that the contractile action of the muscles of the heart are not capable of producing the first sound.

After this destructive criticism, Sir Richard Quain proceeds to consider a third event which occurs during systole, namely, the propulsion of the blood contained in the ventricles into the pulmonary artery and aorta; and herein he finds the agency by which the sound in question is produced. He maintains that the first sound of the heart is caused by the impact of the blood driven by the action of the muscular walls of the ventricles against the block produced by the columns of blood in the pulmonary artery and aorta, which press upon the semilunar valves. Dr. Pettigrew has shown that the column of blood projected from the heart into the aorta (to take the left side only as illustration), is formed by the union of three columns with a spiral motion which is the result of the spiral arrangement of the musculi papillares and of the fibres of the walls of the ventricles, as well as of the spiral shape of the left ventricular cavity itself. By this rifle motion the blood is directed against the segments of the semilunar valves, which are hastily thrown apart, the spiral current being continued for some distance within the aorta. This beautiful rifle mechanism is constructed to give precision to the direction of the moving body against a given point, and to secure also velocity and force. In fact, we have here in nature the mechanism of the modern rifle. A resistance to the stream of blood from the ventricle is offered by the block formed by the column of blood resting on the aortic valves, wedged, and as it were screwed tightly, into each other. Whatever may be the absolute value of the propelling force of the left ventricle, authorities are agreed that the driving power and the resistance are to each other in the proportion of about four to three, the really important point being the relation they bear to each other. Now in this motion and in this resistance we have all the elements for the production of sound, inasmuch as sound is a phenomenon resulting from resisted motion. A sound being produced, we ask, What is it? and the reply must be: The first sound of the heart, the cause of which we seek. This explanation was first suggested to Sir Richard Quain's mind many years ago by a case of disease, in which the aortic valves were completely broken down and had become inadequate to their function. A murmur of such intensity was produced that it was audible three inches from the walls of the chest without a stethoscope. Over the femoral artery, however, there was no murmur, but a sound precisely resembling the first sound, caused by the motion of blood in the artery which received the full force of the ventricular contraction, the valves being destroyed. His attention was thereby directed to the natural obstruction offered by the aortic valves in health to the blood leaving the ventricle. Many observations have been made on the circulation in the femoral artery under like circumstances by continental physicians, but these have had reference to diagnosis only, not to the cause of the first sound of the heart in health.

An objection might be offered to this explanation of the first sound of the heart, that it is heard more distinctly at the apex of the organ, a point removed from the seat of the valves. The observation is correct, and the explanation of it is simple. The muscular walls of the heart are connected with the fibroid ring intimately associated with the semi-lunar valves. The sound produced at these valves is communicated to the apex of the heart through the fibroid ring and the muscular walls, which at the moment of systole are tense and firm. The sound thus conducted reaches that portion of the heart which is uncovered, and which is in contact with the walls of the chest. But, on the other hand, when opportunity offers, it has been found that the sound in question is heard over the aortic valves more distinctly than in any other situation. A remarkable case of this kind has been related by M. Cruveilhier, who was invited to see an infant just born presenting a complete case of ectopia of the heart. He says: "On examining the heart thus exposed, both sounds were distinctly heard over the base, and *not* at the apex."

Lastly, the author has submitted the problem to the test of experiment, and finds that sounds resembling the first and second sounds of the heart can be produced artificially in accordance with his view. A sheep's heart is carefully prepared, and fitted with gutta-percha tubes for inlet and outlet, respectively, of water. If the ventricle be filled from the former, fitted into the left auricle, the water passes into the ventricle, and thence into the aorta, and finally rests upon and closes the aortic valves. If the ventricle be now compressed rhythmically in imitation of systole, and allowed to relax in imitation of diastole, a sound closely resembling the first sound of the heart is produced when the water is propelled from the ventricle into the tube fitted into the aorta; and another sound closely resembling the second sound of the heart is produced when the sigmoid valves close under the superincumbent weight of water in the aortic tube. As the fluid rises in the aortic tube, which is made three feet long, the pressure on the valves increases and the sound becomes more marked; when the fluid, on the other hand, diminishes, the sound becomes less distinct. The terminal piece of small diameter of a binaural stethoscope gently placed over the aorta at its commencement is most suitable for observing the cardiac sounds in this experiment.

It thus appears that the sounds of the heart are both produced at the same point—that is, at the semi-lunar valves; and each of them by its own single and simple agency.

Sir Richard Quain was moved to undertake and continue this inquiry by a desire to obtain a solution of what seemed to be an insoluble problem, and also by a belief that a correct explanation of the first sound of the heart would be of practical value in the study of the clinical phenomena of diseases of this organ. If the explanation given by him is so different from that hitherto accepted as to be calculated to create difficulties in the diagnosis of valvular diseases of the heart, closer consideration will show that this is not the case, but that, like all accurate knowledge, it simplifies and does not confuse. It affords an explanation of the relations of certain morbid phenomena which are at present unintelligible, such, for example, as that a systolic murmur may be heard at the apex, whilst the first sound is audible at the base free from murmur; and it will serve to encourage a closer study of the relation between muscular contraction of the walls of the heart and the tension of the vessels of the system.

THE DIVINING ROD.[1]

IT is certainly advisable to inquire into the foundation of all popular beliefs. In some cases popular feeling, or superstition—call it what you will—has undoubtedly led to the discovery of truths not at first understood or accepted by men of science. As, for instance, the danger in the proximity of the barberry-plant to crops of corn; a danger well known, though unexplained until the microscope was used to trace out the life-history of the minute organism which causes the mischief. On the other hand, careful and unprejudiced inquiry may prove the utter baselessness of some universally accepted belief. We have an instance of this in the statistical inquiry into the connection between the changes of the moon and of the weather. Such a connection is apparently taken for granted by every sailor and farmer; yet a careful analysis of the records shows that the belief is entirely groundless. We are inclined, therefore, to welcome a scientific investigation into the common use of the divining rod for the purpose of finding water or metallic ores.

Turning to the paper of 280 pages which forms the text of this article, we must confess to a feeling of considerable disappointment at the way in which the subject has been treated. What are the points at issue? And what should be the method adopted? Before entering into these questions it may be well to explain in a few words what is the "divining" or "dowsing" about which so much has been written. Here we can recommend Prof. Barrett's paper. He gives a lucid account of the process, clearly distinguishing between the instruments used, which he explains are evidently of no importance whatever, and the physical or mental state of the operator, which is the matter of real moment.

"Divining" or "dowsing" is a method of finding hidden springs or ores by the employment of persons supposed to possess a peculiar faculty not common to mankind in general. This faculty takes the form of a special sensitiveness which causes a forked hazel-twig, or other pointer, held in the hands, to point downward, or upward, when the operator is vertically over the thing sought for. The pointer is a mere "autoscope;" for one dowser used a watch-spring, another a German sausage, and others go with nothing in the hands. The twitching of the rod is, as Prof. Barrett points out, a mere indication of a muscular disturbance, not otherwise very obvious. In the search for water the usual method of divining is for the operator to walk across the ground, rod in hand, stopping at points where involuntary movements cause the rod to turn. At these spots he considers that water is to be found, and he will often go so far as to state the amount that a well sunk there will yield, and the depth at which the spring will be struck. We refer specially to the discovery of water; but the same method is used for the discovery of ores, and sometimes for the tracking of criminals, the feeling responding only, so it is said, to the presence of the particular object for which search is being made.

Two hundred pages of the paper before us are devoted to an "Examination of Evidence," or rather to records of the employment of diviners for the discovery of hidden springs. To this section we will now turn. It is obviously impossible within the limits of this article to analyse the mass of evidence. The difficulty of obtaining trustworthy information as to depth of wells, level of springs, yield of water and other circumstances is very great. Even where no personal feeling enters into the question, the details supplied need the most careful sifting. All we can here do is to take some one district, and see how far Prof. Barrett's records correspond with memoranda of our own, made in the course of a geological examination of the same area. Our notes were taken simply for the purpose of obtaining details of the strata, not to prove or disprove any theory.

Two wells are mentioned as sunk in the Isle of Wight under the advice of a diviner, both counting as successes. As to the first, at Arreton, we are only given the diviner's own uncorroborated account, and not knowing the exact site of his well it is impossible to form an opinion about it. At the other place mentioned, a house called Woodside, at Wootton, near Ryde, two wells had been sunk, under whose advice we know not, in the Oligocene clays, and, of course, they yielded no water. The diviner afterwards selected a site a few yards further south, on the edge of the sheet of plateau gravel which supplies water to all the farms and houses over its area. It did not need a diviner to give this advice; any cottager

[1] "On the So-called Divining Rod, or *Virgula Divina*: a scientific and historical research as to the existence and practical value of a peculiar human faculty, unrecognised by science, locally known as dowsing." By Prof. W. F. Barrett. (*Proc. Soc. Psychical Research*, part xxxii., vol. xiii. July, 1897.)

would have given the same, and water was obtained within seven feet of the surface.

These two successes are the only instances mentioned for the Isle of Wight. We, however, can give four others, all of which were failures. Happening to be at Wootton we came across three other wells being dug under the advice of the diviner—whether the same person as operated at Woodside we do not know. We watched the sinking with great interest, for they were all in strata which a geologist could not advise sinking into, and consequently could seldom examine. Each of the wells was abandoned long before the first water-bearing stratum was reached. In fact, an additional depth of fully two hundred feet would be needed to reach the first spring, and then the supply would be but small and the water bad. A fourth site selected by the diviner was in chalk close to the sea. Some months afterwards a geologist was consulted, and he had to advise that nothing but salt water could be obtained there. The fact that a diviner had previously been consulted was only made known to the geologist by an accident. Thus, instead of the Isle of Wight yielding two successes and no failures, it yields four failures, one success—one that did not need a diviner, and one which, on the diviner's testimony alone, counts as a complete success.

This brings us to the principal criticism that we have to make on Prof. Barrett's collection of facts—that he does not give enough weight to the natural tendency of mankind to conceal their failures. A man making a bet or speculation is inclined to boast of it if it is a success. But if it fails, he usually prefers to hold his tongue. It is much the same with divining. It is perfectly natural that both the diviner and his employer should wish to keep the failure secret.

Though the bulk of the paper is taken up with hearsay evidence, we are given two fairly satisfactory test cases, which should be noted by any one who, on the strength of the numerous reports, is inclined to employ a diviner. One of the cases we allude to is the careful trial made in the adits at Richmond Waterworks, in Surrey. Two diviners were employed independently to locate the springs; with the result that they did not agree, and that when borings were made at the spots indicated, most of them were failures. In another case, Prof. Barrett himself tested the powers of a diviner, who was said to have been highly successful elsewhere in finding both water and ores. In Prof. Barrett's hands he failed completely, though an expert thought-reader might have had fair success. The diviner in this case seems to have been accompanied by persons having a complete knowledge of the position of all the springs, wells, and pipes which the dowser failed to find.

If scientific men still think it worth while to spend time on this investigation, we would suggest certain precautions which must be taken before any results can be accepted. Hearsay evidence, like the bulk of that brought forward, is valueless. When the skill of the dowser is tested, it must be at a place where surface indications will not help. Before boring or sinking the dowser's report must be put into writing, and no additions to his prophecy should afterwards be accepted. The operator should not be accompanied by any one who knows the position of the springs or pipes which he is set to find. His companion should be a stranger who can note the exact spots chosen, and write down at the time the exact nature of the diviner's forecast. The depth to the spring, amount of water expected, and continuous or temporary yield should all be noted. It should be carefully recorded whether the diviner predicts an open fissure, which can be tapped by boring, or advises a sunk well to collect a percolating supply. This last precaution is a very necessary one, for it constantly happens that a small boring, with an area of perhaps ten square inches, misses a fissure, or penetrates it at a spot where the walls come together. On the other hand, a sunk well would have a superficial area of some 4000 square inches, and consequently have a far better chance of obtaining water.

One of the most satisfactory tests would be to set the diviner to map out in some clay district the intricate network of water-pipes and drains of an unknown town. Or, if he prefers still water, to hide a number of bottles, some full and some empty, under a cloth or board, and let the dowser select the full ones without touching or seeing any of them. After shifting the bottles a few times this ought to give a sufficiently large number of tests to enable the percentage of failures to be calculated. But here again there must be no one in the room who knows the position of the bottles.

In conclusion, we must express our opinion that this investigation, undertaken at the request of the Council of the Society for Psychical Research, leaves the question in the same state as it found it. We feel that the accumulation of second-hand evidence is of little use, and that what is wanted is a few careful tests by perfectly qualified and unbiassed observers. The Richmond inquiry was good, but the failure is explained away by the statement that the dowsers employed were not in the first rank, and were young and inexperienced. Unfortunately all the most successful prophets seem to be dead.

NOTES.

THE American Geographical Society has guaranteed Lieut. Peary the sum of 150,000 dollars to meet the expenses of his proposed Arctic expedition. Lieut. Peary has obtained five years' leave of absence, and will start upon his journey about the end of next July. The large meteorite he succeeded in obtaining during the expedition which returned to St. John's, Newfoundland, towards the end of last month, weighs over seventy tons, and is to be placed in the New York Museum of Natural History.

IT is announced that Prof. Sanarelli, director of the Montevideo Institute of Experimental Hygiene, who recently discovered the bacillus of yellow fever, has now succeeded in preparing a curative serum. The details of the discovery will shortly be published.

Science states that Prof. Michael Foster will deliver several lectures in Baltimore in the course of this month, and will visit Boston later to deliver a course of lectures at the Lowell Institute.

DR. FRANK CLOWES has been appointed chemist to the London County Council, in succession to Mr. W. J. Dibdin, who recently resigned the post.

THE Agricultural Committee of the University College of North Wales, Bangor, has acquired a large farm in Anglesey, near Llangefni, for the purpose of providing practical courses of instruction in agriculture, together with field experiments. It is noteworthy that the same site had been previously used for agricultural work, conducted under the auspices of the college long before the present proposal was contemplated.

AT the meeting of the London County Council on Tuesday, the following resolution was adopted:—"That it be referred to the Parks and Open Spaces Committee and to the Technical Education Board to consider and report upon the practicability of laying out plots of ground in certain parks in such manner as will afford assistance to scholars of elementary and secondary schools in the study of practical botany."

THE opening meeting of the new session of the Royal Photographic Society was held on Tuesday evening, the Earl of Crawford, president, being in the chair. The proceedings commenced with the presentation of medals to the successful competitors in the Society's exhibition, the principal award being secured by Prof. Gabriel Lippmann (Paris) for specimens of colour photography by the interference method. The president afterwards delivered his annual address, the subject of which was "Weights and measures as they are used in photography." After suggesting what modification of present customs would best conduce to accuracy in result, facility of manipulation and computation, and increased volume of trade, he spoke of the origin and details of the metric system as applied to the science of photography, and contended that much might be done by the makers of photographic goods by giving metric dimensions to their cameras or plate-holders.

The construction of the half-tide weir and lock across the river at Richmond has been so satisfactory in the results, and has added so much to the appearance of the river, that the inhabitants residing along he banks below this, and those interested in the boating, have for some time past been agitating for a similar weir and locks to be put across the river below Putney. The joint committee appointed by the several parishes in which this part of the river is situated have now obtained a report from an engineer advising that the site of the proposed weir should be situated about half a mile below Putney Bridge, and that the water should be held up to half-tide level. The width of the river at this point is nearly double that at Richmond, and consequently the cost of construction will be greater, the estimate being put at 250,000*l.* In a separate report made by another firm of engineers for the Wandsworth Vestry, the cost is put at 180,000*l.* It is stated that the proposed weir will not in any way interfere with the outfall of the drains and sewers which discharge into this part of the river, or clog the sub-soil drainage of the district.

The annual "Fungus Foray" of the Essex Field Club will be held in Epping Forest on Saturday, October 16, under the botanical guidance of Dr. M. C. Cooke, Prof. Boulger, Mr. E. M. Holmes, Mr. G. Massee, and others. At the evening meeting at Warren Hill House, Loughton, Dr. Cooke will read a paper on "British Mycology during sixty years." Botanists wishing to attend should communicate with the hon. secretaries, Buckhurst Hill, Essex.

The first meeting of the British Mycological Society was recently held at Worksop. On Tuesday, September 14, the woods on the Welbeck estate were explored, but little of note was found. In the evening Mr. George Massee delivered his presidential address on "Mycological progress during the past sixty years," after which he was unanimously re-elected president, and Mr. Carleton Rea hon. secretary and treasurer. During a visit to the demesne of Thoresby, an Entoloma, new to the British fungus flora, was discovered in Budby Wood, namely *E. hirtophyllum*. Other places in the district were explored, and some interesting specimens were obtained.

The annual meeting of the Hull Scientific and Field Naturalists' Club was held on Wednesday evening, September 29; Dr. J. Hollingworth, the president, occupied the chair. The secretaries' report showed that great progress had been made during the year, and that the Club was in a very satisfactory condition. The reports for geology, botany, conchology, entomology, and ornithology testified that good work had been done during the year by the various sections. The botanists have been working out the flora of the East Riding, and have added a number of species to the Club's list of East Riding plants. The programme for the winter session 1897-98 includes lectures upon several very interesting scientific subjects.

A committee, consisting of Sir F. Marindin (chairman), Earl Russell, Sir Douglas Galton, Sir C. Scotter, and Dr. J. S. Haldane, was appointed last February "to inquire into the existing system of ventilation of tunnels on the Metropolitan Railway, and report whether any, and, if so, what steps can be taken to add to its efficiency in the interest of the public." The report of the committee has just been issued in a Blue-book. That many portions of the Metropolitan Railway suffer from want of ventilation is well known. The committee draw attention to the amount of carbonic acid gas in the tunnel air, and to other impurities which arise from the emission of steam, and from the fuel consumed by the engines. After considering the suggested remedies of removing the impure air by fans placed midway between the stations, and the provision of additional openings, the creation of which were objected to by the local authorities on the grounds of public health and depreciation of property, the committee conclude by stating their conviction that pure air can be best obtained with certainty in these tunnels by means of electric working. In the words of the first of the conclusions of the committee, "By far the most satisfactory mode of ventilation of the Metropolitan tunnels would be by the adoption of electric traction."

Particulars of the scientific work of the late Mr. William Archer, F.R.S., whose death we have already announced, are contributed to the October number of the *Irish Naturalist* by Dr. W. Frazer. Mr. Archer's special talent for patient investigations in connection with minute forms of vegetable and animal life was brought out by the Dublin Microscopical Club, which originated in 1849. In 1855 Mr. Archer prepared a list of Desmids obtained in Co. Dublin, illustrated with drawings, for the Zoological and Botanical Association of Trinity College, to which he afterwards added a supplemental list containing additional species. He edited for the second edition of Pritchard's work on Infusoria, the article "Desmidiaceæ," was the discoverer and describer of several new genera and families belonging to the Rhizopods, and published a special communication on *Ballia callitriche* in the *Transactions* of the Linnean Society. He was elected a member of the Royal Irish Academy in 1870, and subsequently served on its Council, and as Secretary for Foreign Correspondence from 1875 to 1880. In 1879 he was awarded the Cunningham Gold Medal. To the *Proceedings* of the Academy he contributed, in 1874, a paper on "Apothecia occurring in some Scytonematous and Sirosyphonaceous Algæ," and, in 1875, another on "*Chlamydomyxa labarynthuloides*, a new species and genus of Freshwater Sarcodic Organism." In June 1875, he was elected Fellow of the Royal Society, and in the following year he was appointed librarian to the Royal Dublin Society. When a large portion of the library of this Society was afterwards transferred to form the present National Library of Ireland, he took charge of the new building, and only retired from his office in 1895.

The piers which have been constructed by the Tyne Commissioners at the mouth of the river, entirely out of dues paid by vessels entering the Tyne, have provided a convenient and much-needed harbour of refuge for this exposed and dangerous part of the North Sea. These piers, which have only been completed about a year ago, after occupying forty years in construction, are causing very serious anxiety to the Commissioners, the North Pier having for some time past shown signs of giving way, and all attempts to stop the undermining of the wall by the waves having failed. In January last, during a very heavy north-east gale, the sea made a clean breach through the wall at about two-thirds from the shore. Acting on the advice of the eminent engineers called in to report on the matter, it has been decided that it will be necessary to take down about 750 feet of the outer end of the North Pier, and reconstruct it on foundations carried to a greater depth below low water to the hard rock; the estimated cost of this work being over 300,000*l.*

The difference of temperature between stations in a valley and upon a hill is one of considerable importance to agriculturists, and has occasionally engaged the attention of observers both in this country and abroad. The Agricultural School at Scandicci, near Florence, has made comparative observations during the whole of the year 1895 at two stations, one being situated in a plain, and the other about 220 feet higher, on the side of a hill, both having a north aspect, and the thermometers sheltered from rain and terrestrial radiation. The detailed observations and generalisations are published in the *Bollettino Mensile* of the Italian Meteorological Society for August last. The results are very interesting, and show that in the plain the minimum temperature is generally lower, while the maximum is higher than that on the hill; in other words, the plain is colder during the night and warmer during the day. The mean annual temperature in the plain was nearly 3° below that on the hill.

Euclid's eleventh axiom has furnished material for discussion for many generations of mathematicians, and the latest contribution we have received in this direction is a series of short notes by Mr. Warren Holden, of Girard College, Philadelphia, beginning with a reprint from the *American Mathematical Monthly*, of an attempt to demonstrate the axiom, and including two separate proofs of the thirty-second proposition not involving the use of the term "parallel." Seeing that mathematicians have so fully investigated the geometry of non-Euclidian space, it need hardly be mentioned that Mr. Holden's proofs are based on alternative assumptions.

The Stone Age of Phenicia has been elucidated by Prof. G. Zumoffen, and he has published his results in an illustrated paper in *l'Anthropologie* (viii., 1897, pp. 272, 426). Typical palæolithic implements have been found at seven stations. The forms known under the names of Chellian and Mousterian occur as well as other types. The Neolithic Age is characterised in Phenica, as everywhere else, by the presence of polished stone implements and coarse pottery. Four new stations have been discovered, in addition to the two found by Mr. Chester and described by Dawson in 1884.

The decorative art of the Indians of the North Pacific Coast is the subject of a very instructive and well-illustrated paper by Dr. Franz Boas (*Bull. Am. Mus. Nat. Hist.*, New York, vol. ix. p. 123). The subjects are almost exclusively animals; each animal is characterised by certain symbols, and great latitude is allowed in the treatment of all features other than symbols. For example, the symbols of the beaver are large incisors, scaly tail, and a stick held in the fore-paws; of the hawk, a large curved beak, the point of which is turned backward so that it touches the face, &c. These symbols are often applied to human faces. It appears that the artist first tried to characterise the animals he intended to represent by emphasising their most prominent characteristics; these gradually became symbols, which were recognised even when not attached to the animal form. Dr. Boas very cleverly traces the distortions that result from the endeavour of the artist to adjust the animal to the decorative field in such a manner as to preserve as far as possible the whole animal and bring out its symbols most clearly, but without any idea of perspective. The representations are combinations of symbols of the various parts of the body of the animal, arranged in such a way that if possible the whole animal is brought into view. The arrangement, however, is so that the natural relation of the parts is preserved, being changed only by means of sections and distortions, but in such a manner that the natural contiguity of the parts is preserved. The success of the artist depends upon his cleverness in designing lines of dissection and methods of distortion. When he finds it impossible to represent the whole animal he confines himself to rearranging its most characteristic parts, always, of course, including its symbols. There is a tendency to exaggerate the size of the symbols at the expense of other parts of the subject.

Prof. Penck publishes in the *Zeitschrift der Gesellschaft für Erdkunde zu Berlin* an important contribution to the literature of the geology of the North-west Highlands of Scotland, from the standpoint of geomorphology. The author visited the region in question after the International Geographical Congress in 1895, and concentrated his attention chiefly on two points—the conditions under which the Torridonian sandstones were laid down, and the dynamical interpretation of the phenomena of the Ben More and Moine thrust-planes. The breccias lying immediately over the old gneiss are compared with formations observed by Dr. J. Walther in the peninsula of Sinai, and Prof. Penck suggests that the Torridon sandstones were laid down under climatic conditions similar to those now found in the latter region. From a minute discussion of the "experiments in mountain-building" of Cadell, Willis, and others, it is concluded that lateral thrust action only affects strata near the surface, but that in a typical case three different forms of displacement occur: simple sliding near the surface, a complex movement of sliding and dislocation below that, and a movement resembling the first in the lowest layers of all. These three stages in the formation of "fold"-mountain ranges are recognised as being at present exposed in the North German Plain, the Alps and Appalachian Mountains, particularly the Glarus Alps, and the north-west of Sutherlandshire, respectively.

The idea that the many varieties of igneous rock found in a single district may have originated by differentiation from a single deep-seated rock-magma, is now familiar to geologists; but a more novel idea is suggested by Prof. Cole in a recent paper on "Slieve Gallion" (*Sci. Trans. Roy. Dublin Soc.*, vol. vi. part 9). He suggests that the fundamental earth-magmas may really be of extremely simple composition, and that the mineral complexity of plutonic rocks as we know them depends on the number of times an original magma has been remelted in a new environment, absorbing (or being absorbed) by substances of different composition. He is led to this conclusion by the phenomena of a granitic intrusion of Devonian age in the "Dalradian" schists of Slieve Gallion. The intrusive rock varies in composition from an aplite to a quartz-diorite, according to the surrounding material which it has partly absorbed as it intruded through it.

The current number of the *Centralblatt für Bakteriologie*, Part ii., contains a paper by Messrs. Russell and Weinzirl on the rise and fall of bacteria in cheddar cheese. Determinations of the number of bacteria per gram in American cheddar cheese were made at different stages of the ripening process, whilst the varieties present were roughly classified under the heads of lactic acid bacteria, gas-producing bacteria, casein-digesting bacteria, and inert bacteria or those having apparently no effect on casein in milk cultures. In samples of green cheese examined immediately after it was removed from the press, a diminution in the numbers of bacteria present was noted as compared with the initial number present in the milk. This period of bacterial decline, however, generally lasts but two days, and is followed by a very marked increase in the numbers present later on, so much so that in the course of a few days, generally from eight to twenty, the germ contents may increase many-fold. This active bacterial growth is not by any means equally distributed amongst all the varieties of microbes present, but is almost exclusively confined to the lactic acid group of organisms, the gas-producing bacteria as well as the casein-dissolving varieties rapidly disappearing. The relation between this pronounced multiplication of the lactic acid bacteria and the ripening process in cheese is not yet exactly established, although the presumption is that these organisms are mainly responsible for these changes. This presumption is rendered more likely by the fact that Freudenreich, studying Emmenthaler or Swiss cheese, found the same coincidence between ripening and multiplication of lactic acid bacteria, and Lloyd, in his investigations of English cheddar cheese, arrived at the same result and came to a similar conclusion. The maximum period of bacterial development is followed by a period of final decline; in the course of time cheese may become sterile, although an examination of a hard dry skim cheese over two years old exhibited the presence still of a few lactic acid bacteria.

THE Clarendon Press has issued an "Account of the Herbarium of the University of Oxford," prepared by Prof. Vines, from the collection made by Gregory of Reggio in 1606 down to the present time. The herbarium includes, among others, the very interesting collection of British plants made by Dillenius to illustrate the third edition of Ray's *Synopsis*.

THE early publication is announced of a monograph of the British species of *Potamogeton* or pondweed, by Mr. Alfred Fryer, an acknowledged authority on the genus. It will be brought out by Messrs. L. Reeve and Co. in fifteen monthly parts, royal 4to, each with four plates, coloured or uncoloured, by Mr. Robert Morgan.

THE *Journal de Physique* for September contains papers by M. R. Swyngedauw on the dynamical and statical explosion-potentials of a condenser; by M. L. Décombe, on multiple resonance; by M. Michel Petrovitch, on a graphic method of integrating certain differential equations; by M. A. Gouy, on a heating-stove of constant temperature; and by M. Potier, on asynchronous motors.

THE *Kew Bulletin* for October contains an interesting correspondence between the authorities of Kew and those of the colony of Sierra Leone, on the economical value for trade purposes of the oil of the "butter and tallow tree" of Sierra Leone, *Pentadesma butyracea*, belonging to the Guttiferæ. Its application to the manufacture of soap is suggested. In this number is also a plan of the Botanic Garden at Freetown, Sierra Leone.

IN connection with the *Revue Semestrelle des publications mathématiques* it is proposed to issue an index supplement to the last five volumes (1893-1897). The subject-matter will be tabulated under four different headings, namely, an index of journals, a subject-matter index, a biographical index, and a list of authors. As the *Revue* is issued by the Mathematical Society of Amsterdam with the view of providing a summary of current mathematical literature, the present volume should prove a useful work of reference to specialists.

A SERIES of chapters on "The Great Meteoric Shower of November," which have been published in *The Observatory* from the pen of Mr. W. F. Denning, of Bristol, have been reprinted by Messrs. Taylor and Francis, and form a pamphlet of fifty-two pages. The work is illustrated, and contains a large collection of interesting facts with reference to the great shower of Leonids, so it will be useful to intending observers of the brilliant displays expected during the ensuing few years.

THE latest number of the *American Naturalist* is the first which has appeared under the new editors. Dr. Robert P. Bigelow, of Boston, is now the responsible editor, and, following the system under which *Science*, the *Astrophysical Journal* and other American periodicals are conducted, he is assisted by an editorial board consisting of a large number of associate editors. The place which it is hoped the journal will take is between the strictly technical serial and the general scientific newspaper. "Every scientific man, as such" (writes the editor), "may well read two general scientific journals—the weekly scientific newspaper and the monthly review of scientific progress." The *American Naturalist* will aim at providing investigators with the latter form of scientific information. Authors of papers intended for beginners, such as "Some Birds of the Garden," "Some Common Weeds," are politely informed that their contributions are not wanted, and very technical works of interest to only a limited number of specialists will be declined. What the editors desire is scientific papers written by scientific people and of interest to scientific workers in more than one field. The desire is a praiseworthy one, and we hope the fulfilment of it will exceed the editors' expectations.

THE following are among the papers and other publications which have recently come under our notice:—"P. J. van Beneden, La vie et l'œuvre d'un zoologiste," by Dr. Ad. Kemna (Antwerp: J. E. Buschmann). This biography of a great investigator, with an analysis of his contributions to science, and their bearing upon the progress of natural knowledge, is a publication the like of which is not often met with in this country. The account covers 135 pages, and forms a tangible testimony to a life of service to science.—A geological map of part of Trail Creek mining division, West Kootenay District, British Columbia, has just been published by the Geological Survey of Canada.—Part vi. of Mr. Oswin Lee's work, "Among British Birds in their Nesting Haunts" (Edinburgh: David Douglas) has been published. The ten plates contained in this new part of Mr. Lee's attractive work illustrate nests of the heron, crossbill, kestrel, wheatear, whitethroat, and solan goose.—"On the Nature of the Röntgen Rays," by Sir G. G. Stokes, F.R.S. This—the first Wilde Lecture of the Manchester Literary and Philosophical Society—was delivered on July 2, and appears in the latest number of the Memoirs and Proceedings of the Society (vol. 41, part iv.).—"Recent Advances in the Science of Hygiene," an address delivered to the Haslemere and District Sanitary Aid Association, by the Hon. Rollo Russell (London: Economic Printing and Publishing Company).

A PAPER, by Prof. G. Linck, on the relations between the geometric constants of a crystal and the molecular weight of its substance (*Zeitschrift für Krystallographie*, vol. xxvi.) is summarised in the October number of the *American Journal of Science*. It is pointed out in the abstract that Prof. Linck has already called attention to the fact that the characteristics of crystals, that is, their geometric and optical constants, stand in direct relation to the atomic or molecular weight of the elements contained in them. This is most clearly shown in the eutropic series: a eutropic series being defined as a series of substances, crystallising similarly, but differing, only in that they each contain a different element, though the elements are yet similar according to the periodic system of Mendeléeff. If such a series is arranged according to increasing molecular or atomic weight, then the series, for all characteristics of the crystal, remains unchanged. The fundamental law of these phenomena the author has designated "Eutropy." For the present investigation it was necessary to know the system to which the crystal belonged, its axial relations, the specific gravity and the atomic weight. Tables computed from these data lead to the following conclusions: (1) The actual volumes of the various chemical compounds, if formed into equivalent crystals, stand in a very simple relation to each other. (2) The weights of these equivalent volumes stand in the same relations to each other as the molecular weights. (3) The volumes in a eutropic series increase with increasing molecular or atomic weights. (4) The weights of equivalent volumes always increase with increasing atomic weights. (5) Bodies which are isomorphous but not eutropic likewise stand in a very simple relation to each other according to their crystal volume or their actual volume as the case may be. (6) Many crystals which have heretofore been considered eutropic or isomorphic are not so, since they probably possess a larger or smaller molecular weight according to the number of atoms.

THE additions to the Zoological Society's Gardens during the past week include a Common Marmoset (*Hapale jacchus*) from South-east Brazil, presented by Mrs. A. H. Browne; a Crowned Duiker-Bok (*Cephalophus coronatus*, ♂) from West Africa, presented by Mr. A. Nightingale; a Nightjar (*Caprimulgus europæus*), British, presented by Mr. Richard Catter; Dusky Parrot (*Pionus fuscus*) from Guiana, presented by Mr. F. Scammell; a Scarlet Snake (*Cemophora coccinea*), an American Black Snake (*Zamenis constrictor*), two Testaceous Snakes (*Zamenis flagelliformis*), a Mexican Snake (*Coluber melanoleucus*), a Hog-nosed Snake (*Heterodon platyrhinos*), a King Snake (*Coronella getula*) from Florida, presented by Mr. J. H. Fleming; a Sœmmerring's Gazelle (*Gazella sœmmerringi*, ♂), a Striped Hyæna (*Hyæna striata*) from Egypt, deposited; a Golden Plover (*Charadrius pluvialis*), a Grey Plover (*Squatarola helvetica*), a Ringed Plover (*Ægialitis hiaticula*), a Bar-tailed Godwit (*Limosa lapponica*), British, an Eyra (*Felis eyra*) from South America, purchased.

OUR ASTRONOMICAL COLUMN

CONJUNCTION OF VENUS AND JUPITER.—These rilliant planets may now be observed near together in the morning sky, and are rapidly approaching each other. Conjunction will occur on October 19 at 9h., when Venus will be only 0° 28′ N. of Jupiter, but they will be below our horizon. As a spectacle for the naked eye the varying positions of the two objects will be very interesting at about this period. Their times of rising and distances from each other on several mornings will be as follows:—

Date.	Venus rises.	Jupiter rises.	Approx. distance.	Sun rises.
	h. m.	h. m.	°	h. m.
Oct. 16	3 37 a.m.	3 59 a.m.	4	6 27
,, 17	3 40 ,,	3 56 ,,	3	6 28
,, 18	3 43 ,,	3 54 ,,	2	6 30
,, 19	3 46 ,,	3 51 ,,	1	6 31
,, 20	3 49 ,,	3 48 ,,	¾	6 32
,, 21	3 52 ,,	3 45 ,,	1½	6 34
,, 22	3 55 ,,	3 42 ,,	2¼	6 36
,, 23	3 58 ,,	3 40 ,,	3¼	6 38
,, 24	4 1 ,,	3 37 ,,	4¼	6 40

The star η Virginis (mag. 4·1) will be about 5° E. of the two planets on October 20. Venus will pass 0° 15′ N. of the star on October 23, while Jupiter will pass 0° 15′ S. of it on November 15. On the morning of October 24 the waning crescent of the moon will be about 7° S. of Venus, and a similar distance S.E. of Jupiter.

Conjunctions of Venus and Jupiter are not separated by a constant interval, but occur once at an interval of about 304 days, and then twice at intervals of about 443 days, as the following table of twelve conjunctions ending with that of October 29, 1899, will show. But this sequence is not invariable, for in the years 1861, 1862, and 1863 and 1882, 1883, and 1884, three successive conjunctions occurred at the interval of about 443 days.

Date of conjunction.	G.M.T.	Relative positions.	Interval in days.
	h.	° ′	
1888 January 2	4	♀ 1 51 N.	—
1888 November 1	9	1 31 S.	304
1890 January 18	21	0 26 S.	443
1891 April 7	9	0 13 N.	444
1892 February 5	22	0 1 S.	304
1893 April 28	17	0 4 N.	448
1894 July 19	20	0 51 S.	448
1895 May 18	4	2 5 N.	303
1896 August 2	11	0 40 N.	442
1897 October 19	9	0 28 N.	443
1898 August 19	6	1 51 S.	304
1899 October 29	13	♀ 0 33 S.	436

On October 21 next, at about 6.45 a.m. the relic of the great red spot, if still visible, will be presented nearly on the central meridian of Jupiter, and if the weather is clear, an excellent opportunity will thus be offered for securing an early observation of this remarkable feature

THE LEVEL OF SUNSPOTS.—Prof. H. Riccò brings together some statistics in reply to the recent discussions relating to the question of "Are sunspots cavities or not?" (*Astrophysical Journal* for August). The observations discussed were derived from a series of drawings of sunspots made by the method of projection in the years 1880 to 1890 at Palermo with a refractor of 0·25m. aperture, and at Catania with a refractor of 0·33m. aperture. The projected image was in all cases 0·57m., a size sufficient to satisfactorily show the principal details of the spots. The result of the discussion, as will be seen from the following figures, shows that the number of spots near the limb, whose projected form gave a result conforming to the theory of Wilson, greatly exceeds the number of contrary or uncertain cases. The facts show that from the years 1881 to 1892 the proportion of cases favourable, unfavourable, and neutral, were in the proportion of 7·3 to 1 to 2. If greater weight be given, as Prof. Riccò says, to spots near the sun's limb, the penumbra of which conforming to the appearance of a cavity seen in perspective is invisible on the side opposite the limb, "I have found twenty-three cases of this sort in the eleven years, and only one contradictory case." Prof. Riccò acknowledges the importance of the problem of the constitution of sunspots and the difficulties involved, and advocates Mr. Evershed's suggestion that the radiations of sunspots should be studied in a more complete manner.

THE ORBIT OF COMET 1822 IV.—On July 13, 1822, Pons, at Marlia, near Lucca, in Italy, discovered a comet which, two months later, reached its maximum brightness, developing about this time a stellar nucleus of the ninth or tenth magnitude. The observations extended over a period of several weeks, and the most satisfactory elements computed were obtained from the investigation carried out by Encke. A new and interesting computation of the elements of this comet has been undertaken by Dr. A. Stichtenoth (*Untersuchung über die Bahn des Cometen* 1822 IV., Leipzig, 1897, W. Engelmann) in his Doctor's dissertation presented before the Göttingen faculty. These new elements, which are not found to differ very much from those obtained by Encke, depend on 456 observations, which for the most part have been reduced directly from the original observations. Referred to the ecliptic they are as follows:—

$$T = 1822 \text{ October } 23{\cdot}772734, \text{ Paris M.T.}$$
$$\log q = 0{\cdot}0588426$$

$$\left.\begin{aligned} \Omega &= 92^\circ\ 44'\ 23''{\cdot}01 \\ i &= 127\ 20\ 47{\cdot}95 \\ \omega &= 181\ \ 4\ 38{\cdot}08 \end{aligned}\right\} 1822{\cdot}0.$$
$$e = 0{\cdot}9963021$$

The investigation tells us that the period of revolution corresponding to the above value of the eccentricity, namely 0·9963021, amounts to 5449·0 years; but on account of the length of the elliptical orbit, this value of the eccentricity can be varied considerably without in any way interfering with the calculated positions: thus the period of revolution may be said to lie between 4504 and 8748 years.

A point of additional importance and of considerable interest which this new discussion of the observations discloses, is that an examination of the original manuscripts of Gambart and Olbers shows that the appearance of this comet was somewhat analogous to that of Comet Holmes. Gambart observed, namely on 1822 July 26, a sudden brightening of a stellar-like condensation in the nucleus, which at the beginning of August had completely disappeared. On September 20 and 21 Olbers observed a similar increase in brightness, but the decrease took place more slowly than in the previous case. It appears, therefore, that sudden variations in the brightness of the cometary matter which occurred in this comet were similar to those which were recently noticed (1893 January 16) in Comet Holmes, and can be easily explained on the meteoritic hypothesis.

The above interesting fact, connected with this nearly forgotten comet, adds an extra feature to this most thorough and complete "Arbeit," and Dr. Stichtenoth is to be congratulated on bringing his computation to such a successful issue.

The late Alvan G. Clark.—Prof. Hale gives a brief obituary notice of the late world-renowned optician, Mr. Alvan Clark (*Astrophysical Journal* for August), which is accompanied by an excellent illustration showing him at the Yerkes Observatory with the crown lens of the 40-inch. In this notice Prof. Hale remarks: "It was no small proof of devotion to his work and interest in its successful termination that he should be willing to leave his home after a nearly fatal stroke of apoplexy, and to undertake a journey of over a thousand miles in order to accompany the 40-inch objective to its destination." We gather, also, that Mr. Clark considered the question of the possibility of constructing an objective still larger than his last great masterpiece, and, although fearing the effect of flexure, he considered it might be possible to still further increase the aperture without endangering the performance of the objective. Mr. Carl Lundin, who has been in the firm for five-and-twenty years, will continue to carry on the business.

A PLEA FOR A BUREAU OF ETHNOLOGY FOR THE BRITISH EMPIRE.

At the meeting of the British Association at Liverpool last year, Mr. C. H. Read, of the British Museum, read a paper before the Anthropological Section, which deserves more notice than has been accorded to it. He urged that "what is needed in this country, with its vast colonial possessions, is a Bureau of Ethnology, such as has now existed for some time in the United States. The value of such an institution for our empire can scarcely be estimated. That its tabulated researches would be of the greatest importance to science will not be doubted; but its strongest claim to existence as a national institution is the immense service it would render, first, to the officers governing our distant possessions, and, second, to the Central Government at home, who would thus have in the compass of a modest library a synopsis of the history, manners, customs, and religious beliefs of the innumerable races composing the British Empire. In a word, we should have at hand the means of understanding the motives which influence the peoples with whom we are constantly dealing, and thus be able to avoid the disagreements arising from ignorance of their cherished prejudices and beliefs." He then referred to the Bureau of Ethnology in Washington, which was created with the quick decision of a practical people when they realised that they had at their doors a race that was fated to disappear within a measurable time, and that it was their duty to record the history, beliefs and culture of the vanishing American Indian before the opportunity had passed away for ever.

Prof. Max Müller, at the meeting of the British Association which was held at Cardiff in 1891, is reported to have said: "Our American friends have perceived that it is a national duty to preserve as much as can still be preserved of the languages and thoughts of the indigenous races who were the earliest dwellers on American soil. They know that the study of what might be called intellectual geology is quite as important as that of terrestrial geology, and that the study of the lower strata contains the key to a right understanding of the higher strata in the growth of the human mind. Coming generations will call us to account for having allowed the old world to vanish without trying to preserve its records. Some years ago I had succeeded in persuading a Secretary of State for the Colonies that it was the duty of the English Government to publish a series of colonial records, containing trustworthy information on the languages, customs, laws, religions and monuments of the races inhabiting the English colonies. Lord Granville saw that such an undertaking was a national duty, and that the necessary funds should be contributed by the various colonies. Think what a magnificent work this would have been! But while the American Government has pushed forward its work, Lord Granville's scheme expired in the pigeon-holes of the Colonial Office. America may well be proud of Major Powell, who would not allow the treasures collected by various scholars and Government officials to moulder and perish."

The splendid series of reports and the collections of ethnological specimens in the National Museum at Washington, attest to the ability with which this department is conducted. The appropriation by Congress for the fiscal year 1891–92 "for the purpose of continuing ethnological researches among the American Indians" was 50,000 dols. During the same year six ethnologists and seven archæologists were on duty in the field, besides the work done in the Bureau in Washington.

Mr. Read, however, did not propose that in England we should found a Bureau on precisely the lines of the American one. The conditions of the two countries are not sufficiently alike, but the point he urged was: "If the Government of the United States thinks it worth while to be at so much pains, and to incur such an outlay, in order to place on record the history of the one race with which they have to deal, how much more is it the duty of Great Britain to attempt some record of the many vanishing or, at any rate, quickly-changing races within her borders? I would not only say that it is a duty, but I contend that it would be greatly to the interest and profit of England to institute an ethnographic survey of the native races within and upon the borders of her empire. Colonial history is not very ancient—some of it very recent indeed; but how common it is in the history of almost all our colonies to find skirmish after skirmish with the natives arising from ignorance of the native customs and beliefs on the part of the white man, resulting in much trouble to the latter, and, in far too many cases, in the annihilation of the unfortunate natives. The study of ethnology would not entirely prevent such misunderstandings, but it would tend to remove them more quickly if they should occur. An officer who, possessing other qualifications, applies himself to the systematic study of the peoples around him, so that he can readily enter into their methods of thought, and interpret their actions as well as their words, is, I contend, a more valuable agent than one who merely gives his mind and his time to his strictly official business, and his work should be considered of greater value by his superiors at home." Mr. Read alluded to the attempt in this direction of one of the Governments of India, the Madras Presidency, and the labours of Mr. Man and Mr. Portman in the Andaman Islands, Sir Harry Johnston in Africa, and of Sir William McGregor in New Guinea. He advocated (1) that the reports should be systematised and on a uniform method in an office in London; (2) that such work should be held to be part of the duties of the officer on duty abroad; and consequently (3) the officer should obtain credit for such work when well done.

The following resolution was referred to the Council of the British Association: "That it is of urgent importance to press upon the Government the necessity of establishing a Bureau of Ethnology for Great Britain, which, by collecting information with regard to the native races within, and on the borders of, the Empire, will prove of immense value to science and to the Government itself." The Council subsequently appointed a Committee consisting of the President (Lord Lister) and General Officers, with Sir John Evans, Sir John Lubbock, Mr. C. H. Read, and Prof. E. B. Tylor. The report of this Committee was presented to the Council of the Association at the Toronto meeting. It dealt with the urgency, so far as science is concerned, of the need of collection of facts and with the benefit to the Government of these inquiries. Finally it was pointed out that "the collecting of the necessary information for the Bureau could be done with but little expense and with a very small staff only, if the scheme were recognised and forwarded by the Government. The Bureau itself, the central office, would be of necessity in London. The Colonial Office would obviously present some advantages. The British Museum has been suggested, with good reason, and there appears to be no insuperable difficulty if the Trustees are willing to undertake the responsibility of controlling such a department. The staff would not be numerous. A director accustomed to deal with ethnological matter would necessarily direct the conduct of inquiries, and until the material assumed large proportions two or three clerks would probably suffice. If the value of the results were considered to justify it, the increase of the area of operations over the world would probably call for additional assistance after the Bureau had been at work for a few years" The Council resolved that the Trustees of the British Museum be requested to consider whether they could arrange for the proposed Bureau to be established in connection with the Museum; and if they are unable to sanction this proposal, that the authorities of the Imperial Institute be requested to undertake its establishment.

The present writer remarked some years ago:—"Such a Bureau would serve as a great stimulus to those who are interested in native races, but who require encouragement and direction. There can be little doubt that an immense number of isolated observations are lost for the lack of a suitable depository, the observers being fully aware that these are too casual to be of much value; when accumulated, however, the case is very different. Were it known that a record of any obscure or rarely observed custom would be duly filed and classified and be readily available to any one who was studying native folk-lore, the probability is that many memoranda which otherwise would be lost would find their way to the Bureau. It cannot be too often or too strongly insisted upon, that now is the time for the collection of all anthropological data in every department of that far-reaching science. To many, results alone are interesting, and there is too frequently a danger to generalise from imperfect data. Posterity will have plenty of time in which to generalise and theorise, but it will have scarcely any opportunity for recording new facts. This century has been one of most rapid transition. The apathy of our predecessors has lost to us an immense amount of information: let not this reproach be applied to us by our descendants."

A decade ago, that distinguished Indian officer Major R. C. Temple wrote: "I have no hesitation in saying that to us Englishmen such studies are not only practical, but they are in some respects of the first importance. The practices and beliefs included under the general head of folk-lore make up the daily life of the natives of our great dependency, control their feelings, and underlie many of their actions. We foreigners cannot hope to understand them rightly unless we deeply study them, and it must be remembered that close acquaintance and a right understanding beget sympathy, and sympathy begets good government; and who is there to say that a scientific study which promotes this, and, indeed, to some extent renders it possible, is not a practical one?" A. C. HADDON.

INSECTS AND YEASTS.[1]

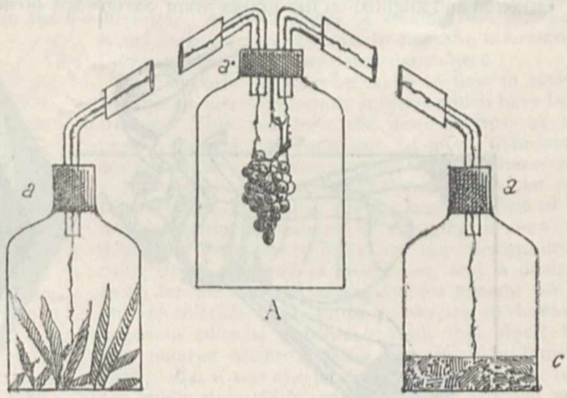
IN the Portici Laboratory for Agricultural Chemistry, Dr. Amedeo Berlese has been making interesting investigations on the manner in which some insects—ants and flies especially—contribute to the diffusion, preservation and multiplication of alcoholic ferments.

It had been formerly observed by Dr. Berlese that on the trunks, both of fruit and forest trees, hidden in the fissures of the bark, the cells of alcoholic yeasts (*Saccharomyces apiculatus* and *Saccharomyces ellipsoideus*) are commonly found. It was natural to suspect that ants, which are constantly travelling up and down trunks and branches, and perhaps also flies, should be among the chief agents in disseminating yeast cells on trees. Dr. Berlese had also observed that these cells are often more numerous on the sunny side of the trees, where insects, especially flies, are likely to linger.

The first series of experiments was to show that ants, starting from an infected soil, and being themselves infected with yeast cells, carry them for a distance up stems and branches, infecting the fruits which they visit, and thence travelling further may carry on the yeast-infection into a sterilised soil.

The apparatus used was very simple (Fig. 1). Inside a large glass jar A, well closed and carefully sterilised, a bunch of grapes was hung, after due sterilisation by successive washing and immersion in carbon disulphide and boiling water. The jar containing the grapes communicated by means of two long glass tubes (about 1·30 m. each) with a glass bottle on each side. These long tubes and the bottles were also carefully sterilised, and connected, by means of corks, so as to form, together with the central jar, a closed system, into which, however, air could penetrate after filtering through sterilised cotton wool. Fourteen of these combinations were prepared, into each of which, in one of the side bottles B, non-sterilised substances were introduced, probably containing yeast cells, such as soil, bark of vines, bark of vine-poles and of oak-trees. In the second side bottle C, the same substances were introduced, but after careful sterilisation. Inside the long tubes were put slender vine branches connecting the substances in the side bottles B and C with the grapes in the central jar A. These vine branches, previously sterilised, were the paths along which the ants were to travel on their way from the infected material in B to the grapes in A, and thence onwards to the sterilised material in C. Before introducing the insects it was verified that each apparatus was internally sterile. Some apparatus were left without insects during all the time of the experiments for more than two months, in order to show that where no insect had been introduced the grapes remained sterile, bearing on their surface neither moulds, nor yeasts, nor bacteria.

Large numbers of ants were collected from the trunks of trees. One species—the *Cremastogaster scutellaris*—was preferred, because it lives in trees, and is very common on vines and vine-poles. The ants were collected with due precaution into sterilised glass vessels, and thence introduced into the bottle B of each apparatus, in numbers varying from a minimum of about 100 to a maximum of about 5000. In the bottle B the ants remained for a few days, then gradually and guardedly advanced up the sterilised branches, congregating and halting at stations on their upward way in the long tubes; generally about two days passed before the first ants appeared on the sterilised grapes in A; thence they passed down the second tube into the bottle C. In this way, starting from B, the most adventurous of the ants which reached C, had travelled a distance of 3·20 m., about equal to the actual height of many vines from the soil, over which ants must travel when they climb up to visit the grapes. The ants used in these experiments suffered probably from want of ventilation; they attacked the corks in efforts to escape, and congregated in great numbers near the cotton wool through which the outer air filtered. Many, however, visited the grapes in search of food, biting the surface of the berries, or absorbing the juice where these had been purposely punctured. In one apparatus where the grapes were unripe, their acid juice proved rapidly poisonous to the ants: an interesting observation, for it gives evidence in favour of the protective character



B FIG. 1 C

of the acids existing in fruit juices before maturation. A small number of ants reached the bottle C. After ten or twelve days most of the ants were dead, and the experiments were ended. The grapes and the materials in C, that had been previously sterilised, were now separately tested to see if through the agency of the ants they had been infected with yeasts. The grapes were removed from the jars with due caution to prevent air-infection, and after shaking off gently all insects still adhering to the fruit; whole berries or small portions of the stalks of the bunches were dropped, without delay, into test-tubes containing sterilised grape-must; and the plugged test-tubes were then left in the thermostat for several days, at a temperature favourable to alcoholic fermentation.

The results obtained are remarkable. In the ten experiments in which ants were introduced, the infection of the grapes in A, and of the material in C, with yeasts and moulds was evident; but varied chiefly according to the various nature of the places from which the ants originally came, and also with the nature of the non-sterilised material in B. When the ants came from a vineyard, and the material in B was ordinary soil or bark of vines or of vine-poles, the germs conveyed to the grapes in A, and to the sterilised material in C, were chiefly moulds together with *Saccharomyces apiculatus* and *ellipsoideus*; *S. apiculatus* was far more abundant than *ellipsoideus*. In one case, when B contained oak bark and the ants had been collected on oak trees, the infection of the grapes and of the material in C showed abundance of *Saccharomyces apiculatus*, with some *S. ellipsoideus* and *S. pastorianus*. When the ants and the bark in B came from olive-trees no yeasts were observed in the

[1] Rapporti fra la Vite ed i Saccaromiceti. Ricerche sui mezzi di trasporto dei Fermenti alcoolici. Amedeo Berlese. *Rivista di Patologia Vegetale e Zimologia*, 1897.

test-tubes. Moulds were in all cases abundant. In those cases where the grapes had been left in the apparatus some days after the ants were dead, moulds developed rapidly on the grapes, and probably destroyed all the yeasts; for in the test-tube cultures moulds were abundant, and no yeasts were observed.

Many experiments were carried out by Dr. Amedeo Berlese to prove that yeasts are abundantly distributed through various kinds of flies.

Small pieces of meat, carefully sterilised by washing in sublimate solution and then in water, were exposed on a terrace, some inside a close wire net which prevented contact with insects, and others so as to favour the visits of flying insects only. Several individuals of the *Sarcophaga carnaria* were noticed visiting the exposed meat. After two hours' exposure to the flies, and thirteen hours' exposure to the air, the pieces of meat were dropped into test-tubes containing sterilised must, and the sediments obtained after fermentation examined for yeasts. It was found that whenever the meat had been exposed to flies, yeasts were far more abundant than when the flies had been excluded. *Saccharomyces apiculatus* was the yeast that appeared more abundantly disseminated by the meat-flies; far ess abundant was *Saccharomyces ellipsoideus*. It was calculated that the quantity of yeasts carried to a piece of meat by flies in a given time is about twenty-six times the quantity that would be carried by air alone.

In other experiments, flies were made to visit grapes that had been previously carefully sterilised. The flies were attracted to the grapes by concealing near them, but so that the flies could not touch them, pieces of meat. The flies that were chiefly attracted and alighted on the grapes were *Sarcophaga carnaria*

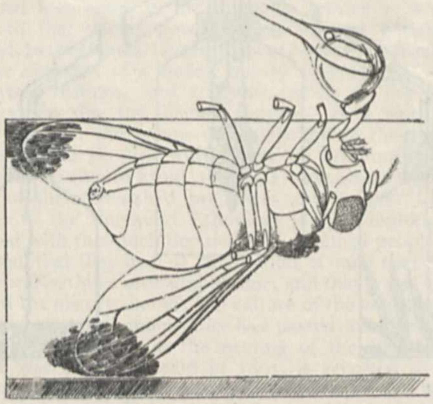


FIG. 2.

and the blue meat-fly, *Calliphora erythrocephaia*. The grapes were found abundantly infected with *Saccharomyces apiculatus*, and in a far minor degree with *S. ellipsoideus* and *S. pastorianus*: moulds and *Dematium* were abundant. In control experiments, where flies had not been allowed to touch the grapes, these contained no yeasts. Strong infections with *S. apiculatus* were also obtained by imprisoning blue meat-flies and *Sarcophaga* inside a wire netting in which sterilised grapes had been hung.

On experimenting in a similar manner with the cellar-midge or vinegar-fly, the *Drosophila cellaris*, it was found that it conveyed in great abundance *Saccharomyces ellipsoideus* and *pastorianus*, and also in smaller quantity *Saccharomyces apiculatus*, besides, of course, *Bacterium aceti*, *Dematium*, and many moulds. Sterilised grapes, when visited by the cellar-midge, cause rapid fermentation of the grape-must in which they are sown.

How do winged insects convey yeasts?

Several experiments with various kinds of flies showed that ferments are often more abundant in the bodies of the flies than in their legs and feet. It is also easy to observe the presence of cells, similar to those of yeast, in the excrements of flies. Dr. Berlese was thus brought to study experimentally the passage of yeast cells through the digestive tract of meat-flies and cellar-midges.

The best experiments to prove the passage and the preservation of yeast cells inside the bodies of insects were made with meat-flies. The living flies, as shown in Fig. 2, were laid on their backs on a glass plate and pinioned there by glueing the extremities of their wings to the glass; the legs of the fly thus secured were removed, in order to prevent infection of the external part of the body by the legs. The external part of the body of each fly was carefully sterilised by repeated brush washings with corrosive sublimate solution. Thus fixed on its back, externally sterilised, and secured inside a glass Petri-box, each fly was regularly fed for several days, either with sterilised grape-must, or with pure cultures of yeasts in must. The excretions of the fly were easily collected by means of a sterilised platinum loop, and examined by inoculation in sterilised must for yeast cells. This method gave full assurance that any living cell found in the excretions had passed through the intestine. The pinioned flies did not lose their desire for food, but eagerly sucked up with their proboscis the grape-must presented to them on the platinum loop, living on for several days, when kept at a temperature of from 18° to 20° C. It was observed that when the flies had been kept fasting they eagerly and completely sucked up all the yeast-laden must offered to them; but when the flies had been well fed they became more dainty, and sucked only the liquid portion of the sweet drop, leaving a residual semi-solid lump consisting largely of yeast cells; this would prove that in the act of suction with the proboscis, flies can probably at will use a filtering process to separate the solid from the liquid parts. In numerous experi-

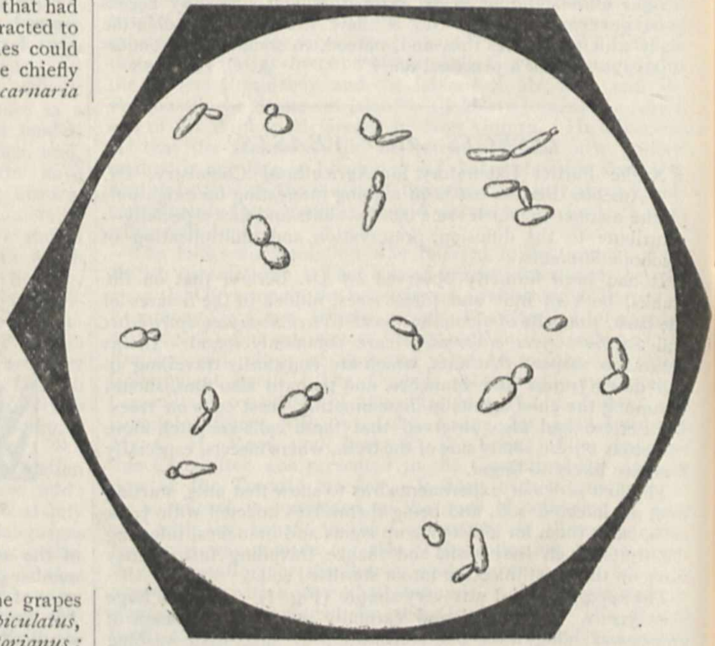


FIG. 3.

ments with blue meat-flies, flesh-flies, and cellar-midges, it was proved that when the flies are fed with sterilised must the excreta contain no yeasts, especially if gathered after repeated evacuations; but if, on the contrary, the flies are fed with pure cultures of *Saccharomyces apiculatus*, or of other yeasts, the excreta soon contain in great numbers the yeast that was in the food. The yeast cells contained in the excreta are living, for, when sown in suitable liquids, they multiply with great rapidity. Figs. 3 and 4 give an example of the multiplication, during eighteen hours, of the cells of a yeast (*Saccharomyces pastorianus*) emitted by a blue meat-fly, which had been fed with grape-must containing that yeast. The vitality of the yeast cells is also unimpaired when given to the flies with meat juice containing no sugar. The temperatures prevailing during ingestion of yeast cells in flies influence the rapidity of their multiplication in the excreta. Thus, when *Saccharomyces apiculatus* is given to the flies, the cells in the excreta are in active germination when the prevailing temperature is from 20° to 25° C.; on the other hand, germinating cells are scarce if the fly has been kept at 8° to 10° C. This suggests that inside the digestive tract of the insect external conditions may influence the multiplication of the yeast cells. To prove this, some blue meat-flies were fed only once with a pure culture of *Saccharomyces apiculatus*, and then for the remaining days of their life with sterilised grape-must. Comparing the approximate number of cells of *S. apiculatus* originally given in the food with the great numbers of the same cells gathered successively in the excreta during several days, it was evident that the yeast cells had greatly multiplied. It was calculated that in the droplet of must containing the *S. apiculatus*, with which each fly was first fed, the number of yeast cells must have been about 500,000; now, continuing to feed these flies with sterilised must, the number of yeast cells expelled each time from the intestine was reckoned to be from 400,000 to 600,000, and perhaps more. In one of these pinioned flies, that lived for eight days, the yeast cells calculated for one excretal drop on the seventh day of confinement were more than 2,500,000; this fly, which had been fed originally with about 500,000 yeast cells, must have emitted, during the eight days in which no yeast was given to it, about 35,000,000 cells. In some cases, especially when excretion was not frequent, the excrementitious droplet was one mass of *S. apiculatus*. There can be no doubt, therefore, that the yeast cells increase in numbers while inside the body of the insect. This was further proved by pinioning, in the manner described, some blue meat-flies just caught, feeding them exclusively with sterilised must, and examining all the excreta during the remaining days of their life;

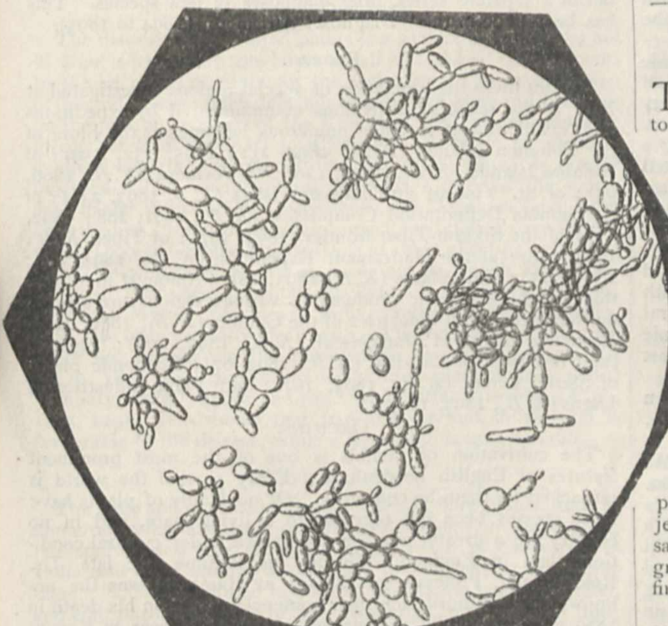


FIG. 4.

it was found that *S. apiculatus* cells, not very abundant at first, increased greatly during the succeeding days; in these cases all the yeast cells excreted were derived from the *Saccharomyces* contained in the insect before captivity, gathered with its food whilst in the free state.

On pinioning blue meat-flies in a Petri-box, and feeding them exclusively with sterilised must, *S. apiculatus* appears commonly in the excreta, but rarely is *S. ellipsoideus* observed. This may be due both to the scarcity of *S. ellipsoideus* in the usual food of the meat-flies, and to the struggle between the various yeasts and other organisms that develop in the digestive tube. On feeding a blue meat-fly only once with a mixture of *S. apiculatus* and *S. mycoderma*, and then feeding it with sterilised must exclusively, it was observed that at first the excreta contained both the yeasts in about equal proportions; but gradually *apiculatus* had the upper hand on continuing to feed with must; but if the insect was made to fast, the quantity of *S. apiculatus* in the excreta diminished rapidly, and those of the *mycoderma* greatly increased. This shows how greatly the conditions inside the intestine of the insect must influence the development of the different yeast germs.

Some observations by Drs. Amedeo and Antonio Berlese, on the internal anatomy of flies (*Drosophila cellaris* and common flies), contribute much to explain how it is that the yeasts can accumulate in great numbers and multiply inside the organism of these insects. It is known that the juices sucked up by means of the proboscis do not go directly into the intestine, but are stored up in the crop, or *ingluvies*, a special organ which, through a long tube, communicates with the œsophagus, at the upper part of the digestive tract. On examining the crop of many flies, it was found replete with a syrupy liquid, a concentrated sugar solution, capable of rapidly reducing Fehling's solution, in which yeast cells are observable, besides *Dematium*, *Torulæ*, *Bacteria* and ciliated infusoria. It is probable that in the sugary solution contained in the *ingluvies* (unless the solution be too concentrated to permit the process) the multiplication of the yeast cells must chiefly occur.

The experiments of Dr. Amedeo Berlese thus prove conclusively the great part that insects, especially ants and several kinds of flies, take, not only in the distribution (as was hitherto known), but also in the preservation and multiplication of alcoholic ferments. Insects, far more than atmospheric air, contribute to the dissemination of yeasts, which they convey rather internally than externally. There is, moreover, reason for believing that during the cold season some yeasts are chiefly preserved and, perhaps, increased within the organism of insects.

ITALO GIGLIOLI.

TEN YEARS' WORK OF THE ROYAL GARDENS, KEW.[1]

THE completion of the tenth annual volume of the *Kew Bulletin* has made it desirable to publish a detailed index to the whole series. As the number of volumes has increased it has become more difficult to find the information they may contain on any particular subject.

The opportunity may be taken to pass in review briefly the more important subjects which have been treated. This will have the more interest as the period covered has been one of more than usual activity in the development of our tropical possessions.

Kew, from its first establishment as a national institution in 1841, has always been applied to by men of business desirous of engaging in new industries. Response to individual inquiries gradually came to be regarded as insufficient, and a demand arose for the prompt publication for general use of any information likely to be of service to those engaged in colonial pursuits. With this object the first number of the *Bulletin* was issued in January 1887. But it was also intended to serve another purpose. When public attention is engaged by any particular subject, inquiries about it are numerous. To say all there is to be said about it, once for all, in the pages of the *Bulletin* effects a great saving in labour. To quote the prefatory notice to the first number:—

"It is hoped that while these notes will serve the purpose of an expeditious mode of communication to the numerous correspondents of Kew in distant parts of the Empire, they may also be of service to members of the general public interested in planting or agricultural business in India and the Colonies."

On March 18, 1887, the First Commissioner of Her Majesty's Works and Public Buildings (Mr. Plunket) informed the House of Commons:—"In response to the demands for the publication more speedily than in the annual report of information received from abroad, I have sanctioned the publication of a monthly bulletin, which can be purchased for a small sum."

Publication was originally intended to be "occasional." It has not been found practically possible to keep up an absolutely regular monthly issue. This, however, has been approached as nearly as circumstances would allow.

The original intention was to confine the *Bulletin* to colonial and commercial information. The suggestion of a larger scope having been raised in Parliament, especially with regard to reports on expeditions, the materials collected by which had been entrusted to Kew, to notices of interesting plants or objects received and the important plants sent out, Mr. Plunket further decided that the "*Bulletin* . . . should be made the vehicle of all printed matter suitable for its pages, which it is desirable to issue from Kew." As a sequel the *Bulletin* became, what it remains, a continuous record of Kew work in all its various aspects.

[1] Reprinted from the *Kew Bulletin of Miscellaneous Information*, No. 120.

BOTANIC STATIONS.

The establishment and development of the institutions known as Botanic Stations belongs almost entirely to the period under review. These stations were first suggested in 1885 to meet the special requirements of the smaller islands in the West Indies (*K.B.*, 1887, June 1–12), where "a great want was felt for reliable information on the culture of new economic plants and plain practical hints as to the best means to be employed for rendering them of the greatest value" (p. 7). This information was intended to be supplied by a regular system of bulletins supplemented by the maintenance of stations with nurseries attached for supplying seeds and plants. The officers in charge of the stations were men selected mostly from Kew, with a sound knowledge of gardening and capable of showing experimentally the conditions under which tropical economic plants might best be utilised as objects of remunerative industry.

The scheme met with the approval of the late Earl of Derby, and has been supported by successive Secretaries of State.

The details of its working have devolved largely on Kew, which has been continuously drawn upon for men, plants, advice, and information.

The first Botanic Stations were started at Grenada and Barbados, in 1886. These were soon followed by similar stations at St. Lucia (1889), Dominica and other islands in the Leeward Group (1889), St. Vincent (1890), and afterwards at British Honduras (1894). There are now nine stations in all in the West Indies.

The Grenada station was established on a spot just outside the town of St. George, described by the Governor as a "good site, well watered, accessible, and apparently suitable in every way." The first grant was 300*l.*, with a further sum of 1000*l.* towards establishing and laying out the garden and providing a house for the curator. The objects of this garden were stated as follows: "To introduce and distribute plants of great economic value, to supply practical hints respecting new and promising industries, and to develop and improve existing minor industries" (*K.B.*, 1887, June 12). An account of the interesting station at St. Vincent, established on the site of the old botanic garden that existed from 1765 to 1823, was given with a drawing of the curator's house (*K.B.*, 1892, 92). Several references are made to the excellent work done in the Botanic Garden at Dominica, which promises to be one of the most attractive and useful in the West Indies (*K.B.*, 1893, 148).

Following the example of the West Indies, there have been established five Botanic Stations on the West Coast of Africa. The earliest was started at Lagos by Sir Alfred Moloney in 1888; the next at Aburi on the Gold Coast, in which Sir W. Brandford Griffiths took a deep personal interest, in 1890. Since then stations have been established both at the Gambia (1894), in the Niger Coast Protectorate (1891), and at Sierra Leone (1895). A further station has been established in Fiji by the efforts of Sir John Thurston (1889). The results attained by these Botanic Stations have been so promising that a strong wish has been expressed by the local authorities to obtain similar institutions at Bermuda, Bahamas, and the Seychelles.

FRUIT TRADE.

One of the most interesting developments in Colonial enterprise in recent years has been the increasing trade in fruit. Jamaica led the way, largely owing to the encouragement of the late Sir Anthony Musgrave, by supplying the United States with bananas and oranges that hitherto had had no local commercial value. The Jamaica fruit trade is now of the annual value of more than half a million sterling, and employs a considerable number of vessels wholly engaged in it. The trade in fruit between the Southern Colonies of the Old World (the Cape and Australia) and the mother country, is another instance of commercial activity in a new direction. It is not ten yet years old, but the value of the fruit annually imported is very considerable. The first steps in this direction were undertaken on the suggestion of Kew, and led to the excellent display of fruit made at the Colonial and Indian Exhibition in 1886. This showed so strikingly the capabilities of the Australian Colonies and the Cape to ship fresh fruit to this country during the winter months, that considerable effort was made to establish what is now regarded as an important trade.

In the *Bulletin* for the years 1887 and 1888 will be found a summary of information not accessible in any other form in regard to the capabilities of various parts of the Empire for the production of fruit. This was brought together through the aid of reports obtained by the Secretary of State for the Colonies, and is still the most authoritative source of information on the subject. The efforts now being made to ship various tropical fruits from the West Indies direct to this country is another direction in which great results may ultimately be attained. The popular taste for the consumption of bananas is increasing. It has been shown that many such fruits can be brought to the home country in a fresh condition and find a ready market.

Information is also given respecting certain kinds that have been introduced with the aid of Kew from the West to the East Indies (*K.B.*, August 1, 1887). Among these the Tree Tomato, the Chocho, and the Cherimoyer have proved useful additions to the food supply of hill stations in India and Ceylon. On the other hand new varieties of bananas and mangoes, the Durian and the Mangosteen, have been transferred from the East to the West Indies.

DECADES KEWENSES.

Under the title of "Decades Kewenses" descriptions of plants new to science have reached the thirtieth decade. These are based on specimens contributed from every region on the earth's surface from the extreme heights of Tibet to the shores of the remotest islet in the Pacific Ocean. Further, owing to the increased impulse to exploration and commercial enterprise in Tropical Africa, it was thought desirable to publish at once, but in a separate series, brief diagnoses of new species. This has been done in the "Diagnoses Africanæ" (1894 to 1895).

FLORAS.

Besides these the vegetation of special regions investigated at Kew as the result of collections communicated by expeditions and travellers, appear under numerous headings as the Flora of the Solomon Islands (*K.B.*, 1894, 211; 1895, 132, 159); of Aldabra Islands (*K.B.*, 1894, 146); of Formosa (*K.B.*, 1896, 65); of St. Vincent and adjacent islets (*K.B.* 1893, 231); of the Gambia Delimitation Commission (*K.B.*, 1891, 268; 1892, 45); of the Sikkim-Tibet frontier (1893, 297); of Tibet (*K.B.*, 1894, 136); of the Hadramaut Expedition (*K.B.*, 1894, 328; 1895, 315); Siam plants (*K.B.*, 1895, 38). Amongst investigations of the economic products of various regions are articles on the Agricultural industries of the Gambia (*K.B.*, 1889, 242), Economic plants of Madagascar (*K.B.*, 1890, 200); Agricultural resources of Zanzibar (*K.B.*, 1892, 87); Economic plants of Sierra Leone (*K.B.*, 1893, 167); and Plant industries of Lagos (*K.B.*, 1893, 180).

ORCHIDS.

The cultivation of orchids is one of the most prominent features of English horticulture. Every part of the world is ransacked for them by collectors. Of no family of plants have more species been got together in a living state, and in no country are a greater number maintained under cultural conditions than in England. During his lifetime, the late Dr. Reichenbach, Professor of Botany at Hamburg, was the acknowledged authority for their nomenclature. On his death in 1889 vigorous public pressure was brought to bear on Kew to take up his work. This was done, though not without difficulty, in addition to its other duties, and in 1891 the publication of technical descriptions of new species was commenced. Twenty decades of "new orchids" have been published in the *Bulletin*.

HORTICULTURE.

Of horticultural interest a list enumerating 766 species and varieties of orchids that flowered at Kew during the year 1890 has been published (*K.B.*, 1891, 52), affording useful information as to the time and duration of the flowering period of orchids cultivated in this country. The highest number of species flowered in one month was 125 in May; the lowest was 85 in January. Some species, as for instance *Cypripedium longifolium*, *Masdevallia pulvinaris*, and *Odontoglossum crispum*, were in flower all through the year.

The cultivation of tropical and sub-tropical plants on the Riviera was described (*K.B.*, 1889, 287), with notes on the principal palms, cycads, bamboos, agaves, and other succulent plants. To this was added a list of some of the most interesting other species established on the Riviera, revising in many cases the names under which they had hitherto been recognised. A further contribution was made to this subject by a paper written by Mr. J. G. Baker, F.R.S., on the agaves and arborescent ilaceæ on the Riviera (*K.B.*, 1892, 1). As few botanists have attended much to these plants, it has been very difficult for cultivators to obtain names for their collections. A correct determination of cultivated Riviera plants is also of value to Kew, as it assists in the interchange or purchase of new and desirable specimens required for the establishment.

An important paper on horticulture and arboriculture in the United States, prepared by the curator, Mr. G. Nicholson, whilst on a visit, as a judge in horticulture at the Columbian Exposition at Chicago (*K.B.*, 1894, 37), has rendered it possible to obtain a more complete representation of the trees and shrubs of the United States in the Arboretum of the Royal Gardens, and has brought before horticulturists in this country many interesting plants that had not hitherto received the attention they deserved. Nearer home, a paper on Horticulture in Cornwall (*K.B.* 1893, 355) affords a fairly representative picture of the possibilities of Cornish horticulture, where, owing to the mildness of the climate, types of the vegetation of New Zealand and the Himalaya do better even than under glass at Kew. The "cultivation of vegetables for market" and the possibilities of market gardening in Great Britain (*K.B.*, 1895, 307) discusses an important economic problem.

Among other horticultural subjects dealt with are the storing of home-grown fruit (*K.B.*, 1895, 31, with an illustration of a fruit room), and a detailed account of the prune industry in France and California.

PLANT DISEASES.

The diseases of cultivated plants is a subject on which the aid of Kew is frequently sought on behalf of Colonial Governments by the Secretary of State for the Colonies. The investigation of fungoid diseases often demands considerable time and attention on the part of members of the Kew staff, while those caused by insects render it necessary to secure the assistance of specially qualified experts to whose courtesy this establishment is greatly indebted. The several diseases that have affected the sugar-cane in the West Indies, Queensland, and Mauritius have been described in a series of important articles extending over several years (1890-96), whilst diseases such as those affecting arrowroot in St. Vincent, bananas in Fiji, cocoa-nut in British Honduras, coffee in East Africa, onions in Bermuda, wheat in Cyprus, pepper in Mysore, potatoes in India, vanilla in the Seychelles, have also been carefully dealt with. Of considerable practical value are articles on the preservation of grain from weevils (*K.B.*, 1890, 144), and on the well-known plant malady called "anbury" and "finger and toe," which attacks turnips (*K.B.*, 1895, 129). It is shown that free acid present in the soil is favourable to the disease, while a free alkali is unfavourable.

FIBRE PLANTS.

The large and increasing interest taken in fibre plants, and the numerous references made to this establishment on the subject, rendered it desirable to place within reach of cultivators in India and the Colonies a summary of information respecting them. This is contained in a series of articles begun in 1887, and continued with more or less regularity to the present time. The total number amounts to about seventy. As might be expected, those of chief importance relate to Sisal hemp and Ramie, or China grass, subjects which have received much attention in various parts of the Empire. These articles are of value, not only in encouraging the cultivation of plants yielding fibres likely to be in actual demand, and yielding remunerative results, but in preventing expenditure upon those that are known to be useless.

Many fibres have been traced to the plants yielding them for the first time. For instance, the Mexican whisk, or *Raiz de Zacaton*, was identified, from specimens communicated by the Foreign Office, at the root of a species of *Epicampes*, a grass distributed over the highlands of Mexico. The plants yielding the fibre called Istle, used, not for rope making, but as a substitute for animal bristles in the manufacture of cheap nail and scrubbing brushes, were found to belong to a group of Agaves with short leaves, of which *Agave heteracantha*, *Zucc.*, is the type. The first information respecting African bass, a fibre obtained from *Raphia vinifera*, was published in the *Kew Bulletin* (*K.B.*, 1891, p. 1). This is now a regular article of export from our African Colonies; and the same thing may be said of the bass fibre obtained from the Palmyra palm in Ceylon (*K.B.*, 1892, 148), and of Madagascar Piasava yielded by a new species of *Dictyosperma* (*K.B.*, 1894, 358). A continuous account of the hemp industry in Yucatan, and of the similar industry lately started in the Bahamas, is given over the whole period. The origin of the white-rope fibres which appeared in commerce as Bombay aloe fibre, and as Manila aloe fibre, have been traced to *Agave vivipara*, a New World species now naturalised and fairly abundant in many parts of the East Indies (*K.B.*, 1893, 78).

The recent attempts to extract and to utilise the valuable fibres contained in the China grass (*Boehmeria nivea*), and Ramie or Rhea (*B. tenacissima*), have been placed on record in a series of articles which have been of considerable service to manufacturers in this country and also to our planting Colonies. The habits and requirements of the plants and the conditions necessary for their successful cultivation have been carefully discussed.

RUBBER PLANTS.

The investigation of rubber-yielding plants has resulted in drawing attention not only to new sources of supply, but in increasing the quantity available for commercial purposes. The remarkable rubber industry started in the Colony of Lagos in 1889 is described (*K.B.*, 1895, p. 241), and a figure is given of the plant, which hitherto had not been known as a source of commercial rubber. The Lagos rubber industry in two years developed into an export value of nearly 400,000*l*. A somewhat similar industry has been started on the Gold Coast by the efforts of Sir Alfred Moloney, with exports in 1893 of the value of 218,162*l*. Practically all the more important sources of commercial rubber are reviewed, while particulars respecting two rubber plants, such as *Forsteronia gracilis* in British Guiana, *F. floribunda* in Jamaica, and *Sapium glandulosum* in the United States of Columbia, are also given. It may be added that information is desired by this establishment respecting the plants yielding the Esmeralda rubber of Guiana (*K.B.*, 1892, 70) and that exported from Matto-grosso in Brazil. There is a doubt as to the distinction, if any, existing between caoutchoucs yielded respectively by the Ule and Tuno trees of Central America. One of these is usually referred to *Castilloa elastica*, but botanical specimens are necessary of each tree to definitely decide the point.

SPECIAL ARTICLES.

These include the results of investigations made at Kew into plants yielding Paraguay tea, or maté, so largely consumed as a beverage in South America (*K.B.*, 1872, 132); vanilla-yielding plants cultivated in tropical countries (*K.B.*, 1895, 169); the plants yielding Sisal hemp, (*K.B.*, 1892, 21); the timber of the Straits Settlements (*K.B.*, 1890, 112); the species and varieties of *Musa* cultivated for food or ornament (*K.B.*, 1894, 229); tropical fodder grasses (*K.B.*, 1894, 373: 1896, 115); Chinese white wax (*K.B.*, 1893, 84); the arrowroot industry of St. Vincent (*K.B.*, 1893, 191); tuberous Labiatæ (*K.B.*, 1894, 10); Canary rosewoods (*K.B.*, 1893, 133); American ginseng (*K.B.*, 1893, 71); palm weevil in British Honduras (*K.B*, 1893, 27); and sheep bushes and salt bushes (*K.B.*, 1896, 129). In addition several articles have appeared describing the various forms in which tea is met with in European and Asiatic commerce. P'u-êrh tea is made into balls as big as a man's head, or into cakes; compressed or tablet tea is manufactured from tea dust by steam machinery; while another form known as brick tea is used in Chinese Mongolia and Tibet. Lao tea is not used for making an infusion, but prepared wholly for chewing purposes. A pickled tea, called Leppett tea, is eaten as a preserve with other articles. The white tea of Persia has been shown to consist of the undeveloped leaf-buds of China tea thickly coated with fine hairs giving them a silvery appearance. A singular beverage known as Faham tea is prepared in Mauritius from the leaves of an orchid (*Angræcum fragrans*) (*K.B.*, 1892, 181). This is described as agreeable and used as a digestive; it is even recommended in diseases of the respiratory organs. The leaves themselves mixed with ordinary tea impart to the latter an extremely pleasant perfume.

The discovery of seedling sugar-canes at Barbados (*K.B.*, 1889, 242) has rendered it practicable to raise new serviceable varieties, and probably to improve the yield of this valuable plant. A seedling raised at Kew has yielded excellent results in Queensland, and has been largely propagated under the name of "Kewensis" (*K.B.*, 1896, 167). The possibility of preparing a palatable butter from the oil of the cocoa-nut (*K.B.*, 1890, 230) is an instance of the advance made in the chemistry of familiar vegetable products. Canaigre (*K.B.*, 1890, 63) will probably prove a most valuable tanning agent, while the preparation of cutch from the bark of mangrove trees (*K.B.*, 1892,

227) may bring into profitable use stretches of vegetation in the tropics that have hitherto been regarded as perfectly useless. Amongst new economic plants should be mentioned *Coffea stenophylla*, the highland coffee of Sierra Leone (*K.B.*, 1896, 189), which in certain localities may prove a formidable rival of the Arabian coffee.

The publication of a note on Jarrah timber (*K.B.*, 1890, 188) has led to the extended use of this and similar Australian hard woods for the purpose of paving the carriage-ways of London streets instead of the cheaper but less durable white pine. The collections of Australian timbers in Museum III. were of special service in this direction.

A paper on Natural Sugar in Tobacco (*K.B.*, 1896, 49-55) recorded some scientific facts of great novelty and interest, and solved an important fiscal problem.

DRUGS.

Many little-known drugs have been investigated. The seeds of *Sophora secundiflora* have a singular use among the Indians of Mexico, where they are taken as an intoxicant. Half a seed is said to produce exhilaration followed by sleep lasting two or three days (*K.B.*, 1892, 216).

Derris elliptica, now growing in the Economic House at Kew, yields the Malayan fish poison known as "Aker Tuba" (*K.B.*, 1892, 216). From the account given of Natal Aloes and of the plants supposed to yield this product (*K.B.*, 1890, 163) it appears that it differs in some important respects from the more commonly known Cape Aloes. The discovery of the plant, also in the Kew collection, yielding the true Star Anise of commerce is noticed (*K.B.*, 1888, 173). The manufacture of quinine in India, and the wide distribution at a nominal price of this valuable medicinal agent amongst the natives (*K.B.*, 1890, 29), is one of the most important services which European rule has rendered to the Indian Empire. Paraguay Jaborandi (*Pilocarpus*) is discussed (*K.B.*, 1891, 179) from materials sent to this country by H.M.'s *chargé d'affaires* at Buenos Ayres in 1881. The origin of myrrh and frankincense is discussed in considerable detail (*K.B.*, 1896, 86), while the first authentic information respecting the district whence Siam Benzoin or Gum Benjamin of commerce is obtained is the subject of another article (*K.B.*, 1895, 154). Next to Gum Benjamin, Siam Gamboge is the most interesting of Siamese products (*K.B.*, 1895, 139). The peculiar Ai Camphor prepared in China from a shrubby composite, a species of *Blumea*, is described (with a plate) from information supplied by Dr. Augustine Henry (*K.B.*, 1895, 275). The plants yielding the leaves known as coca, and the drug cocaine, with their characteristics, are discussed (*K.B.*, 1889, 1), with a suggestion that a plant long cultivated at Kew (*Erythroxylon Coca*, var. *novo granatense*) might be suited for cultivation at a lower elevation than the type. The little-known Iboga root of the Gaboon and Bocca of the Congo, possessing tonic properties, is traced to *Tabernanthe Iboga*, Baill. (*K.B.*, 1895, 37); the tree yielding the Ipoh poison of the Malay peninsula is identified with that yielding the Upas poison of Java (*K.B.*, 1891, 24); but the remarkable point is brought out that while in Java the Upas tree (*Antiaris toxicaria*) furnishes a very effective arrow poison, in the Malay peninsula the juice of what is regarded as an identical species is apparently innocuous, and the defect is remedied by the use of arsenic.

FOOD GRAINS.

A series of articles on the food grains of India by Prof. A. H. Church, F.R.S. (1888 to 1893), supplements the information contained in his published handbook on the same subject. The materials for these investigations were supplied from the Museums of the Royal Gardens.

MISCELLANEOUS NOTES.

In 1891 a series of miscellaneous notes was begun, in which were recorded appointments on the Kew staff as well as those made on the recommendation of Kew by the respective Secretaries of State to Colonial and Indian Botanical Gardens. The notes also included a record of contributions made to the gardens, herbarium, and museums, the movements of expeditions and travellers engaged in botanical exploration, notices of Kew publications, and facts of interest connected with the daily work of the establishment. Later there were added paragraphs on general economic subjects too short to appear as separate articles. The detailed index now published will afford the means of reference to these scattered notices.

APPENDICES.

The Appendices remain to be noticed. Of these three have been regularly issued at the end of each volume since 1891. Previously the information contained in them had appeared as one of the monthly numbers of the *Bulletin*. (1) Lists of seeds of hardy herbaceous and of trees and shrubs offered in exchange by Kew to Colonial, Indian, and foreign botanical gardens; (2) Lists of new garden plants annually described in botanical and horticultural publications. These are indispensable to the maintenance of a correct nomenclature in the smaller botanical establishments in correspondence with Kew, and afford information respecting new plants distributed from this establishment in regular course of exchange with other botanic gardens; (3) Lists of the staffs of the Royal Gardens, Kew, and of botanical establishments at home and in India and the Colonies in correspondence with Kew.

In Appendix III., 1890, will be found a complete index to the Reports on the Progress and Condition of the Royal Gardens, Kew, from 1862 to 1882. This index is useful as a means of easy reference to the numerous notices respecting economic and other plants.

CORRECTIONS.

In so varied a range of subjects some amount of error, it is hoped not considerable, doubtless exists. A few statements which subsequent research have shown to be probably erroneous must be corrected.

The case of poisoning from Turnsole (*Chrozophora tinctoria*) described in *K.B.*, 1889, 279-280, was in all probability not due to that plant, but to *Datura Stramonium*.

The source of the well-known Chinese preserved ginger, which in *K.B.*, 1891, 5, was attributed to *Alpinia Galanga*, ultimately appeared to be, as pointed out in *K.B.*, 1892, 16, the ordinary commercial plant, *Zingiber officinale*. Some mistake had been made apparently in the plants transmitted to Kew as yielding the commerical product.

The figure of a *Musa* given in *K.B.*, 1894, 247, as *Musa Fehi* may be identical with that species. But all that is certain about it is that it represents *M. Seemanni* of Baron von Mueller.

THE DUKE OF DEVONSHIRE ON SCIENTIFIC EDUCATION.

IN opening a new technical college at Darlington on Friday last, the Duke of Devonshire made some valuable remarks upon the advantages of scientific instruction, and the need for the organisation of secondary education. Subjoined are a few extracts from the *Times* report of the address.

SCIENCE AND ART ESSENTIAL TO COMMERCIAL PROSPERITY.

The case for technical education, and for the improvement of technical education, the case for the adequate provision of the scientific and artistic education of our people, is within our judgment essential to the continued efficiency of our manufacturing and commercial interests, without the prosperity of which the people could not continue either to prosper or even to exist. Science and art now enter so largely into the practical conduct and management of every one of our industries that a knowledge of the principles of science and of art is as indispensable to their successful conduct as the possession of bodily strength is necessary for the working of the raw materials. Take the case of the industries in which you yourselves are specially interested—the mining, the iron, and the steel industries. Science enters into every operation by which you extract coal or iron from the earth; science enters into every process by which you convert coal into coke, into every operation in which iron ore, with the aid of coke, is converted into iron. Again, into every process in which the iron is converted into steel, and into every one of those processes by which steel is converted into the thousand articles in which it serves the purposes of the community, it is science and science only which has created, and which continues to improve, those vast and powerful machines by means of which the heat which is generated from coal is converted into power, and applied to the service of man. In every one of these processes—to speak only of those with which you are most familiar in this district—improvement and development are constantly taking place; and if in any respect your knowledge of any one of these latest discoveries and any one of these processes is deficient, by that extent you are placed at a disadvantage in the competition which you have to carry on with the other nations of the earth. I am not going to say that the theoretical knowledge of the principles of science is indispensable to every manual worker, but I do not think that it can be denied or doubted that the higher the average intelligence of the manual worker, the more valuable are his labours. It is also an undoubted fact that there are an increasing number of positions, ranging from that of the chief manager of a manufacturing establishment which may employ thousands of hands, to that of the foreman or superintendent of a subordinate branch of such an establishment, to whom the knowledge of what I have spoken is indispensable. It is also undoubted that that supply of knowledge and intellectual ability cannot be found unless we give access to the attainment of such knowledge to the most of the working classes. These are not altogether theoretical speculations, but I think they are at the present moment, at all events, matters of practical Interest.

FOREIGN COMPETITION DUE TO SUPERIOR TECHNICAL INSTRUCTION.

Many of you will remember that last year, or the year before, there was a great deal of discussion on the subject of the intense competition to which some of our principal industries were exposed. Although I believe that this scare was to a great extent exaggerated, I do not think that any one will say it was altogether without foundation, or that to-day the condition of some of our industries does not require close examination, probably some caution, and certainly considerable energy, in order to retain it in its present position. And if this panic, exaggerated as it may have been, has led us to anticipate and to ward off the blow, rather than to wait until it has actually been received, I do not think that it can have done anything but good. I think you ought to remember that even those who have been the foremost in combating anything in the nature of alarm or panic, have been forced to admit that there are certain of our industries on which serious inroads have been made by foreign competition. All, almost without exception, agree that in cases where such successful inroads have been made the cause is, in a great degree, due to the superior excellence of the technical preparation of the workers of foreign countries. I am quite aware that there are many other causes which may, in the opinions of many, be supposed to hamper us in the industrial race ; but most of those causes are subjects of a controversial character, into which I do not think I have either time or inclination to enter to-day. But whatever the opinion on the subject of those causes may be, at any rate there can be no reason why we should not address ourselves at once, and with energy, to attempt to remove one cause at least which is obvious, which is patent, which is not controversial, and in the removal of which employers and workmen should seek to cooperate without the slightest antagonism or opposition of interests.

EXTENSION OF TECHNICAL EDUCATION.

It is very satisfactory to know that we have been doing of late years a good deal to remove any inferiority under which we may labour in respect of the technical training of our people. If we compare the position of the technical instruction of the present day with that which existed ten or even five years ago, there is ample ground for congratulation. Many, I think I may say most, of our counties and county boroughs have displayed great energy in framing and carrying into effect large schemes for the scientific education of the people. Public opinion was never at any time so favourable to institutions adapted to provide for the local needs of the districts, even though those institutions might involve the community in considerable expense. The nation realises, as it never has at any previous period, that the welfare of its industry depends upon the training of its workers, and, still more, upon the training of the directors of its industries. It is understood that it is not enough to start a scheme of technical education and to expect that it will go of itself ; and the only means for preserving its continued efficiency is an incessant watchfulness, and a readiness to adopt and seize upon every improvement which the development of science or of manufacture itself may suggest. A body of experienced teachers, such as many counties now possess, aided, supported, and encouraged by intelligent committees, is capable at the present day of rendering enormous services not only to your own community, but to the nation at large. We ought to remember that this work is only begun, that whatever progress we have made we are far from having attained the perfection which has been attained by some of our competitors ; and if I may recur once more to the subject of competition, I may say that I believe that in the opinions of some of the most competent and thoughtful observers much more alarm is felt on account of what they know has been done on the subject of a scientific and an artistic training of the population of other countries, and by what they know of the inevitable results which will follow from that completeness of training, than from any actual inroad which has yet been made upon our industrial and commercial supremacy.

THE ORGANISATION OF SECONDARY EDUCATION.

But there is, as I believe, an urgent necessity for action, both swift and prudent. While much, I think most, depends upon what may be done by local effort, I admit that something yet remains to be done by the Government with the assistance of Parliament. The progress which we have already made, and the tentative struggle in which we have been engaged for the last few years, have revealed the existence in our educational system of a considerable gap which requires to be filled. All the experts agree, in order that the people should take full advantage of the special scientific courses now provided for them, that they must go to them better prepared than they are now. Your own expert, Mr. Robson, the secretary of the county education centre, has called attention to that point. He says :—"The lesson has been learned by the many which was only realised at that time (a few years ago) by the few—namely, that before specialised technical instruction can be given in an ideal form we require not only a larger supply of competent instructors, but the students must have gone through a course of secondary education not at present available. In other words, there must be an organised system of secondary education provided beyond and above our most admirable elementary school course, instead of the present chaotic jumble existing between the elementary school and the University." Accordingly, I am glad to see from the same report that the county committee of education have devoted a considerable amount of attention to the improvement of the secondary schools in the county. But their powers should be extended, and that was one object of the measure which was brought before Parliament in the session before last. I hope that, at all events, the part of the measure which referred to secondary education will very speedily reappear ; and not only reappear, but that some of the difficulties, some of the controverted questions connected with elementary education have been, for a time, at all events, disposed of, and that it will reappear with some of its revolutionary provisions extended. A reform of secondary education, no doubt, will require great energy and some self-sacrifice on the part of many. Probably also it may require some expenditure of money. I do not see why it should require any large call upon either Imperial or local resources. The large majority of secondary schools are now in private hands, and I know no reason why they should not continue to remain so, provided the local authorities are able to secure some guarantee of their efficiency. Secondary schools, such as they might be when reformed, would very soon furnish the technical classes, such as those you are establishing here, and increase the number of students qualified, as they cannot be now, to take advantage of those courses for their own benefit, and for the benefit of the community in which they exist. I hope that, although I have devoted my remarks almost exclusively to one topic—the necessity for improving the scientific and commercial education of our people—you do not imagine for a moment that I feel indifferent to the higher aspect of education which concerns the training and the character of the students. That is the work, however, rather of the school and for the schoolmaster, than of the science class or scientific teacher. The two need not conflict together, nor exclude each other. I know that the highest province of education is to raise the character of the student, and to make him not only an accomplished workman, but a good citizen. Do not suppose for a moment that those who, like myself, are merely interested in the promotion of technical education are indifferent to the higher side of the question ; but it is because of the urgent necessity which we feel exists at the present moment to cultivate more than we have hitherto done the study of certain sciences and certain arts which are ultimately connected with the industrial training and prosperity of the people, that I on this, as on other occasions, have ventured to urge the sub'ect most strongly upon you.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. J. B. Peace, of Emmanuel College, has been appointed Demonstrator of Mechanism and Applied Mechanics, in the place of Mr. Dunkerley, resigned. Mr. H. Higgins, of King's College, has been re-appointed Demonstrator of Anatomy.

Prof. Bradbury has been re-appointed Assessor to the Regius Professor of Physic.

Mr. A. Munro (Queens') and Mr. Lay (St. Catharine's) have been appointed Moderators, and Mr. Macdonald (Clare), with Mr. Bennett (Emmanuel), Examiners, for the Mathematical Tripos 1898. Sir R. S. Ball has been appointed an Elector to the Isaac Newton Studentships.

Mr. W. G. Fraser, Senior Wrangler 1896, has been elected to a Fellowship at Queens' College. At Trinity College Mr. W. Morley Fletcher, First-class Natural Sciences Tripos 1894-95, and Mr. F. W. Lawrence, bracketed fourth Wrangler 1894, bracketed second Smith's Prizeman 1896, have been elected to Fellowships.

AT the opening of the session of the Royal College of Science on Wednesday, October 6, Prof. Roberts-Austen, C.B., D.C.L., delivered an address and distributed the prizes. He said that in this memorable year they would remember that the part taken by His Royal Highness the Prince Consort in establishing the School of Mines, out of which the Royal College of Science had grown, made the students participants in the beneficent care which Her Majesty the Queen had ever taken to promote the advancement of science and the industrial progress of her people. At the opening ceremony, on May 12, 1851, at the museum in Jermyn-street, where the School of Mines found a home, the Prince Consort had used the following words :—"I rejoice in the proof thus afforded of the general and still increasing interest taken in scientific pursuits, while science herself, by the subdivision into the various and distinct fields of her study, aims daily more and more at the attainment of useful and practical results. In this view it is impossible to estimate too highly the advantages to be derived from an institution like this, intended to direct the researches of science and to apply their results to the development of the immense mineral riches granted by the bounty of Providence to our isles and their numerous colonial dependencies." Prof. Austen said that the last words he had quoted, struck a note which was singularly tuneful and harmonious in this year when the bonds which join the mother country to her possessions had been so materially strengthened. It might fairly be claimed that the Empire had derived advantages from the establishment of the Royal School of Mines, and from the Royal College of Science. Having taken the Prince Consort's words as his text, Prof. Austen passed in review the position of technical teaching in the fifties, and indicated the nature of the work done by the distinguished body of men, including Playfair, Hofmann, Huxley, Tyndall, Percy, Warrington Smyth, and others, who had gathered round Sir Henry de la Beche, and he showed that the great success of the students in all parts of the world had been attained by recognising that the main duty of the professors had been, not to train specialists but to give men such all-round training as should enable them to deal successfully with any problems they might encounter in life. He then spoke of the great importance to students of general culture, pointing out that it was not without reason that the designer of the Jermyn Street Museum had placed a statue of Athena in a prominent position in the lecture theatre, for Mr. Ruskin had said that the myths which had gathered round the name of Athena pointed to her as "the directress of human passion, resolution, labour, and of practically useful art. She does not make men learned, but prudent and subtle; she does not teach them to make their work beautiful, but to make it right." Prof. Austen said that the students' work would never be right if they neglect the treasures of thought which come to us from antiquity. He urged them day by day to devote a few moments to the effort to really understand some marvel of the fifteenth century construction, by Da Vinci or by others who designed it at a time before the professions of engineer and architect were divided. Or they might examine some fragment of Japanese art metal work which in itself epitomised an advanced knowledge of metallurgy. If they used the museum in this way they would find that they were insensibly widening their intellectual field, and, at the same time, cultivating it with success.

THE new University Hall at Bangor, for women students of the University College of North Wales, was formally opened on Saturday last by Miss Helen Gladstone. Mr. Acland delivered an address on "Secondary Education in England and Wales."

AFTER an examination by the Agricultural Department of the Reading University Extension College, Mr. J. C. Fryer has been elected to the Senior Agricultural Scholarship given by the County Council. The Scholarship is of the annual value of 30*l.* (which may be increased at the discretion of the sub-committee to 50*l.*) per annum for two years, and is tenable at the Reading University Extension College.

THE Committee for the establishment of University Fellowships in the University of Wales have just presented their report to the Senate. The proposed Fellowships are to be confined to graduates of the University who are in the active pursuit of original investigation, and in residence at some constituent college or other seat of learning. They are to be tenable for two years, with possible renewal for a third year in cases of exceptional merit. It is proposed that the Fellowships should not be tenable concurrently with other similar endowments or paid appointments, as the Fellowships contemplated are to be of sufficient value to enable the holders to devote their whole time to research.

AS the result of the past session's work students of the Engineering Department of University College, Liverpool, have gained the following successes :—Mr. W. H. Riddlesworth, holding a County Council Scholarship, succeeded in gaining the University Scholarship in open competition, which is the blue ribbon of the University in this subject. Mr. Riddlesworth has since been appointed private assistant to Dr. Francis Elgar, Manager Director of the Fairfield Engineering and Shipbuilding Company, Limited. Mr. E. Brown, holding a Ranger Scholarship, has been awarded the Sir David Gamble Scholarship for the purpose of prosecuting a research and continuing his studies in electrotechnics. Mr. P. S. Couldrey and Mr. C. H. Stewart, holders of City and County Scholarships respectively, have been awarded National Scholarships. Mr. E. J. Kipps, holding a Derby Exhibition from the Bootle Technical School, succeeded in securing the second place in the list of Whitworth Exhibitions. Mr. R. Nelson, the Sir Edward Harland Scholar, also obtaining a Whitworth Exhibition. Mr. F. H. Phillips, the holder of the Sir Richard Moon Scholarship from Crewe, has been awarded a Royal Exhibition in connection with the Science and Art Department examinations. Mr. W. L. Brown, after completing a lengthy research upon the Elasticity and properties of cement in connection with his University Research Scholarship, which has been accepted by the Institution of Civil Engineers, has been appointed by Sir Benjamin Baker to a position on the Central London Railway. Mr. J. T. Farmer, who was awarded an 1851 Exhibition Scholarship, after completing a research at Montreal on the action of jets of water, which was published by the Royal Society of Canada, has been the recipient of the honorary degree of M.Sc. of the Montreal University.

THE recent munificent gifts to Owens College, Manchester, were briefly mentioned in last week's NATURE. A full report of the meeting of the Court of Governors of the College at which the announcements of the donations were made, appeared in the *Manchester Guardian* of Wednesday, October 6, from which we reprint the resolutions of thanks passed by the Court. No apology is needed in referring again to gifts so liberal as those which Owens College has just received. The following are the resolutions which were adopted by the Court :—(1) "That the Court has heard with the greatest satisfaction and pleasure of the magnificent offer by Mr. Christie of a sum not less than 50,000*l.*, being the third at his disposal of the balance of the estate of the late Sir Joseph Whitworth, for the erection of a College hall and the completion, so far as the amount available will extend, of the College buildings; that the Court desires to express to Mr. Christie its sincere thanks for his splendid gift, which will meet a most important and long-felt need, and, besides adding to the outward importance and dignity of the College, greatly promote the cohesion of its inner life; that the Court requests the Council to provide for the association of the late Sir Joseph Whitworth's name with the proposed new buildings, in accordance with Mr. Christie's desire; and that the Court recognises with the deepest pleasure the proof furnished by Mr. Christie's present magnificent offer, as well as by his former gift of the buildings of the Christie

Library, of the deep personal interest taken by him in the progress of the College as a place of higher education and learning." (2) "That the Court accepts with great pleasure the munificent offers of two friends of the College of the sums of 10,000*l.* for the erection, and of 5000*l.* towards the maintenance, of suitable buildings for the physical laboratory, and requests the Principal to convey to them its sincere thanks for their wise and opportune generosity, which will enable the College to advance and develop a scientific teaching and research of the highest public importance and utility." (3) "That the Court accepts with great pleasure the generous and useful gift of Mr. Edward Holt to the College, and desires the Treasurer to express their best thanks to him. The Court also hopes that the Council will take steps to associate the name of Mr. Holt in some permanent manner with the new gymnasium."

SEVERAL of the London polytechnics have commenced the present session with some new developments in their day work. The Battersea Polytechnic is inaugurating day courses in technological chemistry, specially adapted to persons engaged in those industries for which a knowledge of chemistry is useful. The South-west London Polytechnic is not only developing its day engineering courses, but is also providing special facilities for students who wish to enter for the examinations of London University, and is starting a day department for women, in which opportunities will be given to pursue advanced studies in art, science, and languages. The East London Technical College, People's Palace, is further developing the day courses which were commenced last year. Courses in physics and electrical engineering are now given, as well as in chemistry and mechanical engineering, while facilities are offered to students to study for the various subjects of the London B.Sc. examinations. The Borough Polytechnic, besides adding considerably to its provision of scientific and technical instruction for artisans, has opened a technical day school for boys, which is specially designed to fit its pupils for entering on industrial life.

SCIENTIFIC SERIALS.

American Journal of Science, September. — Principal characters of the Protoceratidæ, by O. C. Marsh. The genus *Protoceras*, described by the author in 1891, from the Miocene of South Dakota, is now known to include some of the most interesting extinct mammals yet discovered. It likewise represents a distinct family, and thus deserves careful investigation and description. Before this discovery, no horned artiodactyles were known to have lived during Miocene time, and Protoceras is thus the earliest one described. The type specimen, moreover, had a pair of horn-cores on the parietals, and not on the frontals, as in modern forms of this group. The animal was apparently a true ruminant, nearly as large as a sheep, but of more delicate proportions. Another notable feature is the very large, open nasal cavity. This peculiar feature is of even greater importance than the horn-cores, and indicates clearly in the living animal a long flexible nose, if not a true proboscis. The paper is illustrated by a series of admirable plates.—The theory of singing flames, by H. V. Gill. If a singing flame is produced by inserting a burning gas jet into a tube, the pressure during a condensation forces the burning gas back into the nozzle of the jet. This can be made evident by observing the image of the flame in a rotating mirror, when a small flame is seen below the level of the nozzle, corresponding to the gaps in the main flame.—Oscillatory discharge of a large accumulator, by J. Trowbridge. The discharge from a large number of Planté cells is characterised by a sibilant flame which, by quickly separating the spark terminals, can be drawn out to a length of several feet. It closely resembles the light produced by passing an electric spark through lypocodium powder. When a photograph of this flaming discharge is examined, it is seen to have an intensely bright spark as a nucleus. By using an arrangement to blow out the flame, it was found possible to examine the spark by means of a revolving mirror. The photographs then showed five or six distinct oscillations. The author concludes that a cell may be regarded as a leaky condenser, and that its discharge is always essentially oscillatory.—Electric discharges in air, by the same author. The voltaic arc is a kind of flaming discharge as above described. Its resistance may be studied by the damping method. The author fed an arc light by a continuous current and by a condenser discharge, and found the resistance to be 0·8 ohms, which was independent of the length of the arc.—On *Pithecanthropus erectus*, by L. Manouvrier. The degree of fossilisation of the Trinil remains is such that the femur attains the weight of 1 kilogram, whereas prehistoric femurs of the same size do not exceed 350 grams. The important fact established by Dubois is that the craniological inferiority of human races increases with their antiquity. The known anthropoid genus to which the intermediate Pithecanthropus is most closely allied is the Gibbon (*Hylobates*). If the Pithecanthropus was a simple precursor of man, it was superior enough to the other animals to survive unless the human species hastened to annihilate this dangerous competitor. If it was an ancestor, its species lives yet in its human descendants.

Wiedemann's Annalen der Physik und Chemie, No. 9.—Action at a distance, by P. Drude. Action at a distance may be defined as a relation between two bodies such that the energy of the system depends not only upon their velocities, but also upon their mutual position. Contact action may take place by impact or through the intermediary of an elastic solid or a fluid, compressible or incompressible. Gravitation has not yet been reduced to a contact action, owing chiefly to the fact that its velocity of propagation through space has not yet been ascertained. According to Laplace, this velocity must be at least ten million times that of light.—Grey and red incandescence, by O. Lummer. Draper's assertion that all bodies begin to glow at the same temperature has been disproved by H. F. Weber and Emden, who showed that the first indication of a grey misty light occurs at temperatures ranging from 403° (German silver) to 423° (gold). The grey glow appears to fluctuate and flit about, but the image becomes fixed as soon as the red glow sets in. This may be explained by the constitution of the eye. The rods perceive the grey glow. The fovea centralis contains no rods, and hence the light is not seen if looked at direct. The cones, on the other hand, are the instruments of colour perception. They alone line the fovea centralis, and hence the red light is seen in its proper place. At a sufficiently feeble intensity the solar spectrum appears colourless along its entire length.—Glow on insulated conductors in a high-frequency field, by H. Ebert and E. Wiedemann. The authors place a wire or rod in a bulb or cylinder placed between the terminal condenser plates of a Lecher wire system, so that it hangs parallel to the axis of the condenser. A slight exhaustion suffices to produce a blue glow against both ends of the rod on the glass surface, which spreads out in all directions, and shows forms resembling Lichtenberg's figures. As exhaustion proceeds, the glow extends over the surface of the rod, and forms a bridge across the middle. The occurrence of this bridge is retarded by making the rod thicker, or using several wires, or substituting a tube for the rod.—Discharge inside a wire gauze box, by the same authors. If a cylindrical box of wire gauze is placed inside an exhausted tube, the glow of the gas is observed to penetrate inside the gauze, especially if the box is short.—Method of making lines on glass visible as light on a dark ground, by F. F. Martens. If a glass plate is illuminated through its end surfaces, no light penetrates through the large surfaces owing to total reflection. But if lines are etched into them or cut with a diamond, they appear bright on a dark ground.—Electric viscosity of insulators, by G. Quincke. The logarithmic decrement of a glass sphere suspended from the arm of a balance in ether is increased from 0·0210 to 0·0608 in a field produced by 2000 volts. The difference may be termed the electric viscosity.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, October 4.—M. A. Chatin in the chair.—On ancient glass mirrors backed with metal, by M. Berthelot. A description of some mirrors, of Gallo-Roman origin, dating from the third or fourth century. The metallic backing consists of lead, which would appear to have been applied in a molten state to the glass.—On the number and symmetry of the fibrovascular bundles of the petiole, in the measurement and classification of plants, by M. A. Chatin.—Observations on the sun, made at the Observatory of Lyons with the Brunner equatorial during the second quarter of 1897, by M. J. Guillaume. The results are summarised in three tables, showing the sunspots, their distribution in latitude, and the distribution of the faculæ in latitude.—Orthogonal systems for the derivatives of the θ-functions of two arguments, by M. E.

Jahnke.—On the differential linear congruences, by M. Alf. Guldberg.—A new method of testing metals, by M. Ch. Frémont. The size of the test pieces employed is much reduced (20 mm. × 10 mm. × 8 mm.), and the resulting deformations enlarged ten times by photography. Methods are given for measuring the tenacity, ductibility, fragility, and homogeneity of the sample with sufficient accuracy for practical purposes.—Study of the normal variation of the earth's electric field with height, in the upper regions of the atmosphere, by M. G. Le Cadet. The results obtained show that the intensity of the electric field of the atmosphere diminishes when the height above the surface of the earth is increased.—On the fogging of the negative in radiography, by M. V. Chabaud.—On the solubility of liquids, by MM. A. Aignan and E. Dugas. A criticism of the work of Alexejew on the same subject.—Action of gravity on the growth of the lower fungi, by M. Julien Ray. The action of gravity is to retard the growth. The experiments were carried out upon cultures of *Sterigmatocystis alba*, some of which were at rest, and others moving uniformly in a vertical plane.

NEW SOUTH WALES.

Linnean Society, August 25.—Prof. J. T. Wilson, President, in the chair.—Descriptions of Australian Micro-Lepidoptera; Part xvii., *Elachistidæ*, by E. Meyrick. The number of species recorded in this paper was 254, referable to thirty-seven genera. Nearly the whole of the species are new to science.—Note on the occurrence of sponge remains in the Lower Silurian of New South Wales, by W. S. Dun. Until last year fossiliferous rocks of Ordovician age were not known to occur within the geographical boundaries of New South Wales. A species of *Protospongia*, associated with graptolites in a bluish slate, is recorded from Stockyard Creek, County of Wellesley, N.S.W. The specimens, which are pyritised and show no great amount of detail, were collected by Mr. J. E. Carne, of the Department of Mines. The Wellesley beds are probably of the same age as those of the Castlemaine and Bendigo districts of Victoria, certain fossils from which have been reported upon by Mr. T. S. Hall.—Descriptions of two new species of *Pultenæa*, by R. T. Baker. Mr. Baker exhibited, on behalf of Mr. C. E. Finckh, of the Technological Museum, a specimen of a comparatively rare fish, *Moncentris japonicus*, Houtt., caught by a fisherman at Newcastle. In regard to this fish, Mr. Ogilby pointed out the presence of luminous discs, which he believed were of use as traps; he also remarked that no articulation of the scales so as to form "a coat of mail" existed in Australian specimens, such as is attributed to *Monocentris japonicus*. The presence of two separate dorsal fins removes this genus from the *Berycidæ*, and its nearest ally is the rare deep-sea *Anomalops*, with which it agrees also in the presence of luminous glands and of membranous interspaces between the bones of the cranium.—Mr. Brazier sent for exhibition six specimens of *Helix vermiculata*, Müller, obtained alive by him on July 13, 1897, on the buffalo-grass in the Waverley Cemetery. This is the first Australian record of this introduced European species, whose home is France, Spain, Italy, &c.—Mr. Hedley exhibited, by permission of the Curator of the Australian Museum, a specimen of *Cancellaria granosa*, Sowerby, taken from the stomach of a schnapper hooked nine miles east of Wollongong, N.S.W., in 30–40 fathoms. An interest attached to this specimen is that though the species is well known in Tasmania, Victoria, and South Australia, it has not apparently been recorded previously from the coast of N.S.W. Mr. Hedley remarked that an exploration of the deep, cold-water current that lay off the coast would result in adding many other southern forms to our known fauna. A previous instance of such is the record [P.L.S.N.S.W. (2) iv. p. 749] of *Crassatella kingicola*, Lamk., a characteristically Tasmanian species trawled in 17 fathoms off Merimbula, N.S.W. If fishermen could be induced to search the stomachs of fishes, a mass of valuable data would soon accumulate.—Mr. Norman Hardy read a note on, and exhibited specimens of, feathered arrows from the island of Espiritu Santo, New Hebrides. It has long been held as an ethnological axiom that no arrow from any Pacific island was feathered. This rule is now shown to have its exception, and for the first time the locality whence these feathered arrows come is now published.

GÖTTINGEN.

Royal Society of Sciences.—The *Nachrichten* (mathematico-physical section) part 2, 1897, contains the following memoirs communicated to the Society:—

May 15.—George Landsberg: The algebra of the Riemann-Roch theorem. O. Mügge: Translations and other related phenomena in crystals. J. R. Schütz: The principle of the absolute conservation of energy.

May 29.—J. Orth: Researches carried out in the Pathological Institute at Göttingen.

June 19.—A. Hurwitz: Linear forms with integral variables. L. Krüger: A theorem in the combination of observations.

July 3.—E. Ehlers: East African Polychæte worms. C. Fromme: On magnetic hysteresis. P. Gordan: Hermite's reciprocity-theorem.

July 17.—W. Voigt: Determination of relative thermal conductivity by the isothermal method.

July 31.—F. Klein: A new mannscript relating to Bernhard Riemann. A. Wiman: Note on the symmetrical and alternating interchange-groups of *n* things. H. Minkowski: General theorems on convex polyhedra.

BOOKS RECEIVED.

BOOKS.—Memory and its Cultivation: Dr. F. W. Edridge-Green (K. Paul).—Elements of Human Physiology: Dr. E. H. Starling, 3rd edition (Churchill).—Electricity in the Service of Man: Dr. R. Wormell, revised and enlarged by Dr A. M. Walmsley (Cassell).—Botanical Observations on the Azores: W. Trelease.—Royal Gardens, Kew, Bulletin of Miscellaneous Information, 1896 (Eyre).—A Question of the Water and of the Land: Dante Alighieri, translated by C. H. Bromby (Nutt).—The Dwelling-House: Dr. G. V. Poore (Longmans).—Lumen: C. Flammarion, translated (Heinemann).—15 Lezioni Sperimentali su la Luce: A. Garbasso (Milano).—Year-Book of the U.S. Department of Agriculture, 1896 (Washington).—The Principles of Chemistry, 2 Vols.: D. Mendeléeff, translated by G. Kamensky, edited by T. A. Lawson (Longmans).—The Machinery of the Universe: Prof. A. E. Dolbear (S.P.C.K.).—Sleep: its Physiology, Pathology, Hygiene, and Psychology (Scott).—A Memoir of Wm. Pengelly, F.R.S.: edited by his daughter, Hester Pengelly (Murray).—Missouri Botanical Garden, 8th Annual Report (St. Louis, Mo.).—Œuvres Complètes de Christian Huygens, tome septième (La Haye, Nijhoff).—Elementary Manual of Magnetism and Electricity: Prof. A. Jamieson, 4th edition (Griffin).—The Principles of Alternate-Current Working: A. Hay (Biggs)—A Text-Book of Applied Mechanics: Prof. A. Jamieson, Vol. 2 (Griffin).—The Works of Archimedes: edited in modern notation, with introductory chapters, by Dr. T. L. Heath (Cambridge University Press).—Theory of Groups of Finite Order: Prof. W. Burnside (Cambridge University Press)—The Röntgen Rays in Medical Work: Dr. D. Walsh (Baillière).—Darwin and after Darwin: Dr. G. J. Romanes, III. (Longmans).—John Hunter: S. Paget (Unwin).—Les Fonds Electriques et leurs Applications: A. Minet (Paris, Gauthier-Villars).—Die Meteoriten in Sammlungen und ihre Literatur: Dr. E. A. Wülfing (Tübingen, Laupp).—Luce e Raggi Röntgen: Prof. R. Ferrini (Milano, Hoepli).

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