In order to render the instrument perfectly reliable, all that is necessary is that the current of water should be always perfectly uniform, and this is easily attained by fixing the size of the outlet once for all, and also the level of water in the tank. So arranged, the pyrometer works with great regularity, indicating the least variations of temperature, requiring no sort of attention, and never suffering injury under the most intense heat; in fact the tube, when withdrawn from the furnace, is found to be merely warm. If there is any risk of the instrument getting broken from fall of materials or other causes, it may be fitted with an ingenious self-acting apparatus shutting off the supply. For this purpose the water which has passed the thermometer is made to fall into a funnel hung on the longer arm of a balanced lever. With an ordinary flow the water stands at a certain height in the funnel, and, while this is so, the lever remains balanced; but if from any accident the flow is diminished, the level of the water in the funnel descends, the other arm of the lever falls, and in doing so releases two springs, one of which in flying up rings a bell, and the other by detaching a counterweight closes a cock and stops the supply of water altogether.

It will be seen that these instruments are not adapted for shifting about from place to place in order to observe different temperatures, but rather for following the variations of temperature at one and the same place. For many purposes this is of great importance. They have been used with great success in porcelain furnaces, both at the famous manufactories at Sèvres and at another porcelain works in Limoges. From both these establishments very favourable reports as to their working have been received. W. R. BROWNE

THE AGRICULTURAL INSTITUTE OF BEAUVAIS

WE have already referred to the interesting collection exhibited in the Technical School at the Health Exhibition by the Brothers of the Christian Schools. One of the most instructive of their specimen museums is that from their Agricultural Institute at Beauvais.

This Institute was founded in 1855, the late Prince Consort being one of its first patrons. Recently the Agronomical Society of France have extended to it an encouraging hand.

Candidates for admission to the school must be at least sixteen years of age, and must give evidence, either by certificates obtained or by a preliminary examination, of their having successfully studied the recognised branches of a good modern education. The course of instruction extends over a period of three years, and is intended to prepare young men to manage and develop estates and direct all farming operations. Special provision is made, in the third year, for those who wish to qualify themselves for agricultural professorships. The syllabus of subjects is framed by a Board appointed by the prefect of the *département*, and consists of the Director and Professors of the Institute, of the Professor of Agriculture, and the Veterinary Surgeon of the *département*, as also of three other members.

The subjects for the first year are: French language, book-keeping and commercial subjects, elementary algebra and geometry, the fundamental principles of agriculture, rural law and engineering, general zoology, arboriculture, horticulture, physics, chemistry, and linear drawing.

In the second year the students follow more advanced courses of agriculture, zoology, botany, entomology, geology, surveying, levelling, physics, general and analytical chemistry, rural law and engineering, linear drawing, arboriculture, and horticulture.

The instruction for the last year comprises agriculture, arboriculture, horticulture, analytical chemistry, botany, geology, entomology, applied mathematics and mechanics, and architectural drawing.

Science teaching, to be of any use, must be practical; the authorities of the Agricultural Institute, fully convinced of this, attach great importance to laboratory and field work. In the physical laboratory, the work is exclusively of a demonstrational kind, the students not being required to test the accuracy of their knowledge or their familiarity with instruments by the actual and precise measurement of physical constants. Nor do such measurements appear necessary for the object in view. It is, of course, quite different with chemistry, where skill in quantitative analysis is of the highest value to any one who intends to direct the agricultural interests of a district. The students are consequently trained with much care in those branches of analytical chemistry which bear directly upon the science of agriculture. The study of botany, geology, and entomology is encouraged and stimulated by frequent excursions to the neighbouring country, the specimens brought back being compared, classified, and minutely described in appropriate language.

The school has also a model farm of 325 acres, in which the principal operations of farming are extensively carried on. The students visit this farm at stated hours every week; they are familiarised with the chief implements and agricultural appliances, and are required to take part in all the regular work that may be going on.

The Professors have set aside a number of acres for experimenting upon the conditions most favourable to the growth of the principal cereals. These comparative studies are carried out with the assistance of the students mainly for the purpose of showing them how to practically initiate a scientific investigation of an agricultural nature. The results of these studies are fully described in the *Annales de l'Institut agricole*, a yearly publication of considerable merit. A valuable synopsis of the results obtained by the Director of the School, Brother Eugene, will be found in the Educational Section of the International Health Exhibition, Room 5.

From a recent report, we find that there have been, this year, under cultivation no less than sixty-five kinds of wheat, twenty of oats, ten of barley, eight of rye, besides fields of potatoes, beetroot, cabbage, &c. There are also pasture lands for sheep and cows, and a well-stocked poultry yard.

At the end of each year the students are put through a practical examination, when they are expected to give satisfactory evidence of their competency to deal with the general working of the farm. It is also required by the programme of the Institute that the students shall visit exhibitions of an agricultural character which may be held in the vicinity, and attend with their Professors certain markets and sales of live stock.

The attention of the students is maintained and quickened by requiring them to write, with considerable care, notes of all their courses, as well as detailed reports of what they may have seen in their visits or met with in their excursions. Several volumes of these reports, notes, and theses, together with typical herbaria, specimens of grain and seeds, may be seen in the Exhibition, Room 5.

Besides superintending the museum and giving instruction in the laboratories, the Brothers teach drawing, physics, chemistry, botany, geology, zoology, &c., leaving such subjects as rural jurisprudence and engineering, agriculture, and the like to other eminent professors.

IS SALPA AN EXAMPLE OF ALTERNATION OF GENERATIONS?

THE chances against the accidental discovery of a great natural law are so great that we cannot feel surprise that naturalists are slow to believe that Salpa, the animal in which Chamisso discovered alternation of generations, is not an example of alternation.

The historical associations which render the life-history of Salpa so interesting to the naturalist have induced me to restate briefly my reasons for believing that the solitary Salpa is a female and the chain Salpa a male; since a recent contributor to NATURE ("Recent Morphological Speculations," by R. N. G., in NATURE, May 15, p. 67) rejects my observations for reasons which a little examination will show to be inconclusive.

The author characterises my opinion as "Brooks' theory," but it is neither a theory, nor was I the first to describe the phenomenon in question. Embryological observations by Kowalevsky must be received by all

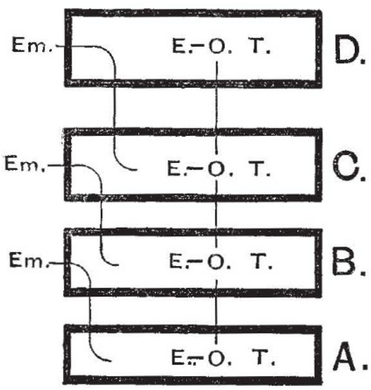

Fig. 1

naturalists with the greatest respect, and I therefore call the attention of R. N. G. to the fact that this great observer published, while my first paper was in the press, the following account of the life-history of Salpa (see *Arch. f. Mik. Anat.* xi. 604):—"Bei den Salpen giebt es bekanntlich zwei Generationen, in der einen entwickelt sich der aus vielen eikeimen bestehende Eierstock, welcher in den Stolo hineingeht, und sich hier zu je einem Eie vertheilt, sodann die einzelnen Knospen resp. Kettensalpen in welchen weiter aus diesem Eie ein Embryo entsteht, wieder mit einem aus mehreren Eikeimen bestehende Eierstock."

No one will question the statement that the animal in whose body an ovum is produced is the mother of the

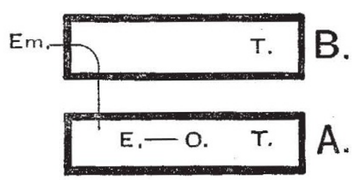

Fig. 2

embryo to which this ovum gives rise, and if the egg which is fertilised in the body of the chain Salpa is developed, as Kowalevsky and I have stated, in the body of the solitary Salpa, the latter is certainly a female, and as no one has ever observed the production by a chain Salpa of more than one embryo, either from an egg or by budding, there is no true alternation of generations.

This view is in no sense a "morphological speculation," nor should it be spoken of as "Brooks' theory." It is either an observed fact or an erroneous statement, and its untruth can be proved only by observation.

R. N. G. lays much stress upon the life-history of Pyrosoma, a closely related but less modified form, and regards it as an "indirect negation" of my statement that the solitary Salpa is a female, and the chain Salpa a male. Our knowledge of Pyrosoma and of other Tunicates certainly leads us to believe that Salpa is the descendant of a hermaphrodite ancestor, but it proves nothing more.

The fact that nearly all the Arthropods are bisexual does not disprove the hermaphroditism of Balanus. It simply shows that Balanus is the modified descendant of bisexual ancestors.

While the life-history of Pyrosoma cannot be quoted to disprove the statement that the solitary Salpa has an ovary, it can help us to understand the way in which the present life-history of Salpa has been acquired, and thus show that my own view is not very anomalous after all.

As the phenomena are very complex, I have attempted to exhibit the leading features by diagrams, and Fig. 1 shows the points of greatest importance in the life-history of Pyrosoma.

The egg gives rise, by a process which does not here concern us, to several sexual animals, one of which is represented by A in Fig. 1. It has a testis, T, and an ovary, O, which consists in part of "generative blastema," and, in part, of ova in various stages of growth. It is, therefore, a hermaphrodite. One of the ova, E, is very much larger than any of the others. This hermaphrodite,

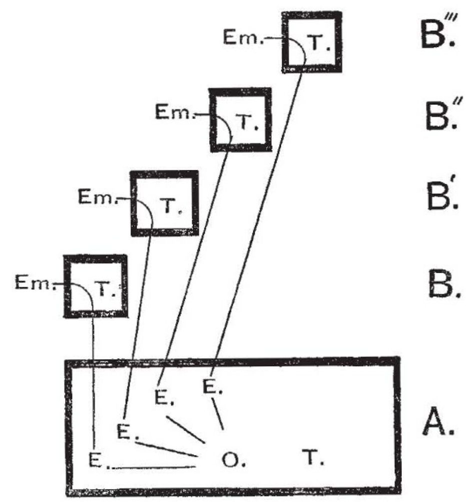

Fig. 3

A, produces a second, B, by budding, and during this process part of the "generative blastema" from the ovary of A passes into the body of B, and forms its ovary, O, which here produces one fully developed ovum, E, and a number of small ones. As B has a testis, T, it is a hermaphrodite like A.

The single mature ovum, E, of A, also passes into the body of B, where it is fertilised and gives rise to an embryo, EM, which undergoes development within, and finally escapes from, the body of B, although A is its mother, because the egg which has produced it was formed in the ovary of A before the body of B was formed by budding.

B then gives rise by budding to C, and the single mature egg of B passes into the body of C, where it is fertilised, and gives rise to an embryo.

Part of the "generative blastema" of B's ovary passes into the body of the bud C, and becomes an ovary, O, which again gives rise to one mature ovum, E; and C produces another bud, D, and discharges into it one ripe ovum and part of the ovary in the same way, and so on indefinitely. As C and D have testes like A and B, they are all hermaphrodite.

After the bud B has become independent of A, another ovum is matured in A's ovary, another hermaphrodite bud is produced, and so on indefinitely, and each hermaphrodite bud produces in succession an indefinite series of similar buds.

Now let us imagine a limit to this indefinite series of buds, and examine its effect.

Suppose that, while B retains its power to produce in succession an indefinite series of C's, the C's lose this power. As the function of the ovary of C is to provide the "generative blastema" for the ovaries of the series of D's, and to mature the eggs E, which are to be fertilised and developed within the bodies of the D's, it is plain that with the loss by the C's of the power to reproduce by

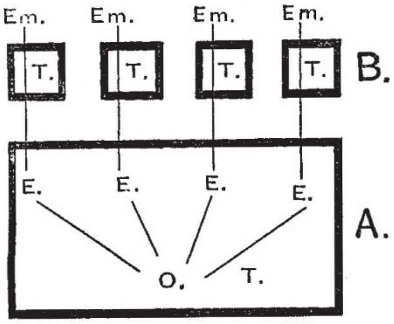

Fig. 4

budding, the ovary will be left without function, and we should therefore expect it to disappear. C would then become simply a male, but it would while young contain a single unfertilised egg, EM, derived from the ovary of B.

If the power to bud were lost by the first generation of buds, B, we should have the condition of things which is shown in Fig. 2, where the hermaphrodite A produces a male bud, B, and discharges the egg E into its body, there to be fertilised and developed into the embryo EM. A has, however, the power to repeat this process indefinitely, and to produce in succession a series of buds of the generation B, and the life-history is therefore now exactly shown in Fig. 3.

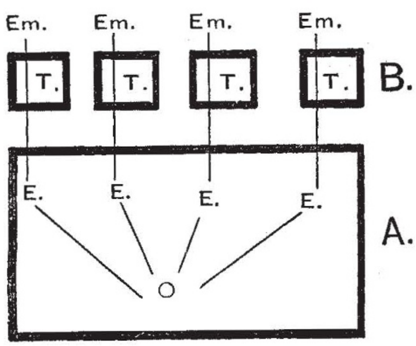

Fig. 5

Now suppose that, instead of appearing in succession, a number of buds of the generation B are formed at the same time, we shall then have the phenomena shown in Fig. 4, where a number of eggs, E, E, E, E, are matured simultaneously in the ovary, O, of the hermaphrodite A, and are discharged while still unfertilised into the bodies of the male buds, B, B, B, B, there to give rise to the embryos, EM, EM, EM, EM.

This is very nearly what we have in Salpa, where very many chain Salpæ are produced at one time. As these have no power to reproduce by budding, they have lost their ovaries, although each of them, when it is born, contains, like the buds of Pyrosoma, a single unfertilised egg, derived, according to my observations and those of Kowalevsky, and according to the analogy of Pyrosoma, from the ovary of the solitary Salpa A, Fig. 5.

The solitary Salpa is therefore a true female, and as it has lost the testis which, according to the analogy of Pyrosoma, its ancestors must have possessed, it is a true female and not a hermaphrodite.

We therefore have in place of the indefinite series of hermaphrodite buds of Pyrosoma, a single generation of male buds, each of which receives, like the buds of Pyrosoma, a single mature ovum from the ovary of its gemmiparous ancestor.

While the series of stages which are here described may not correspond exactly to the actual phylogeny of Salpa, it certainly shows that our knowledge of Pyrosoma cannot be quoted as an "indirect negation" of my view; for it shows that the analogy of Pyrosoma would lead us to look to the ovary of the solitary Salpa for the origin of the egg which is fertilised and developed within the body of the chain Salpa.

All observers agree that the so-called "ovary" of the chain Salpa consists of a single egg, which is fertilised while the animal which carries it is very young and almost embryonic, and all agree that normally no more eggs are produced by the chain Salpa. A "rudiment of an ovary, which only consists of one fully developed ovum" is certainly not an *ovary* at all, but an *ovum*, for the origin of which we must search elsewhere, and Kowalevsky's observation as well as my own show that it originates in the ovary of the solitary Salpa.

As all observers agree that the chain Salpa has a testis, and that it normally contains only one egg, it is certainly a male; and as all observers agree that the solitary Salpa has no testis, while Kowalevsky and I agree that it has an ovary, we must regard it as a female, and we therefore have, instead of an instance of alternation, a very remarkable example of sexual difference.

There seems to be only one way to escape this conclusion;—that is, by denying that the structure which Kowalevsky and I have described as an ovary is an ovary at all.

Salensky is an advocate of this view, and claims that my so-called ovary is simply a mass of embryonic cells destined to give rise to the branchial sacs, as well as the ovaries of the chain Salpæ, but I have shown in a recent paper in the *Zoologischer Anzeiger* that the branchial sacs of the chain Salpa originate from quite a different part of the stolon, and that the ovary contains cells which are in no sense embryonic or unspecialised, since they have all the characteristics of ova. In a paper which is now ready for publication, I shall give photographs of sections which prove this point beyond question.

R. N. G. gives, as another reason for rejecting my view, the fact that Salensky has found a second ovary in a chain Salpa.

This is clearly exceptional, for all observers agree that no such second ovary normally occurs, nor has Salensky given conclusive proof that the cells which he observed were ova at all, as he has not observed their development. Out of many thousand sections which I have examined, I have found three chain Salpæ which had received two ova from the ovary of the solitary Salpa instead of one, and if Salpa is descended from a form like Pyrosoma, it is quite possible that a chain Salpa may occasionally receive with its ovum part of the ovary, and that this may give rise to other ova, but the discovery of such an abnormal Salpa would not prove that the normal chain Salpa is hermaphrodite, even if it could be shown that these eggs completed their development and became embryos.

In conclusion, I wish to point out to R. N. G. that, inasmuch as the writer who attempts to generalise from the observed phenomena of science for the benefit of the public should use every precaution to insure accuracy in the statement of facts, he will do well to examine his authority for his statements that I have called the *solitary* Salpa a *nurse;* that I have described a Cunina in which the "hydroid produces medusæ by gemmation;" and that I believe "that the solitary Salpa is hermaphrodite."

Baltimore, July 14 W. K. BROOKS

COLONIAL AND FOREIGN REPORTS

THE annual reports of colonial botanical gardens, Government plantations, museums, &c., form at the present day no inconsiderable item of the literature of scientific progress in different parts of the world which constantly crowd an editor's table. These records become, year after year, of increasing importance as well as of increasing bulk, and it is right that their contents should be better known, so that they may become useful, and this can only be done by a wide distribution of the reports themselves, and attention drawn to them by other publications.

Taking a few of these reports, which have recently come to hand, in the order of their issue, we first find one from Wellington, New Zealand, under the following title, "Eighteenth Annual Report on the Colonial Museum and Laboratory," together with the "Fourteenth Annual Report on the Colonial Botanic Garden, 1882-83." This Report treats of various branches of science, and, as might be expected, geology has its full share. In the observatory the principal work is said to have been the observation of the transit of Venus, Dr. Hector's account of his observation, which, he says, was written out within an hour after the transit, being given as an appendix. Under the head of Botanic Garden, after describing some successful experiments in planting wattles (species of *Acacia*), Dr. Hector refers to experiments in the cultivation of *Sorghum*, which, however, are said not to have been continued in the garden, but in the northern part of the colony, the results were very favourable, proving that quite as large a percentage of crystallisable sugar can be obtained in New Zealand as in America. "Recent improvements," it is said, "have been made in the machinery, and by the use of a vacuum evaporating pan all the causes of the former miscarriage in the production of the sugar appear to have been removed, so that there is every prospect of the growth of the *Sorghum* becoming an important industry in the north of New Zealand." A most interesting and important feature of the year is said to be the sudden expansion of the cultivation of hops in the colony. In Nelson it is shown that the cultivation has been most successful, and in the neighbourhood of Wellington the hop also grows well. The plants are subject more or less to attacks from the red spider and what is known as the plant louse, but they have not yet committed any great damage.

Mr. Morris's "Annual Report of the Public Gardens and Plantations for the year ended September 30, 1883," shows that the usual operations of the department have been fully maintained, while the "chief scientific work of the year has been connected with the collection and determination of numerous native plants of the island which have been added to the Department Herbarium, and the large addition of others to the growing collections." Referring to the attacks by insects on the sugar cane, Mr. Morris points out that the spasmodic or intermittent character of the attack is in accordance with their general habit in all parts of the world; "but," he says, "it is well for us to note their appearance and disappearance with great care, in order that we may thereby be prepared for their attacks, and reduce the amount of damage they do to our crops to a minimum."

The indiscriminate destruction of small birds in the island has attracted some attention, and measures have been suggested whereby it may be checked or perhaps stopped.

The mungoose, which has been imported from India to destroy rats on sugar estates, is stated to be increasing very rapidly, not only on sugar estates, but on the highest mountains along the shore, and even amidst swamps and lagoons. The sugar planters have greatly benefited by its introduction, rat-eaten canes being now scarcely known. The negro settlers and persons not connected with sugar estates complain of its ravages amongst their poultry, fruit, and vegetables. Mr. Morris says, however, that poultry is still fairly plentiful in country districts, and from his experience of the mungoose in confinement, the creature is not likely to eat either sugar cane, banana, or field vegetables, except under the influence of extreme hunger, which would not occur so long as there are rats, mice, lizards, and other small animals to feed on. "The mungoose is, however," Mr. Morris says, "disturbing greatly the distribution of animal life in the island; and the harmless yellow and other snakes, lizards, ground-hatching birds, the interesting cony, and many members of our indigenous fauna, are likely to become extinct at no distant period."

Under the head of cultivation and distribution of economic plants Mr. Morris reports progress in many new products. It is not encouraging, however, to find that the cultivation of ginger in Jamaica appears to be dying out, due "to the smaller yield of plants cultivated so persistently on the same land, to the uncertain nature of the crop, no less than the difficulty experienced in many districts in curing it properly." Jamaica ginger has hitherto held a prominent position in the market as to quality, and it is a pity that its reputation should become a thing of the past.

The next report before us is that of Dr. Schomburgk, and treats of the "Progress and condition of the Botanic Garden and Government plantations" at Adelaide, South Australia. A similar work seems to be going on here as at most other colonial gardens at the present time, namely, the distribution of native, and the acclimatisation of foreign plants, chiefly of economic value. The Gardens seem to be very popular, as well as the Museum of Economic Botany, which is a comparatively new institution to Adelaide. Two appendices are added to Dr. Schomburgk's report, one consisting of a "Catalogue of Plants added during 1883 to those under cultivation in the Botanic Garden," arranged according to their natural orders, and the other a "List of Palmæ, Bromeliaceæ, Filices, and Lycopodiaceæ, cultivated in the Botanic Garden." The report is illustrated by eight views in the Gardens.

A Report of the Committee of Management for 1883 of the Technological Industrial and Sanitary Museum of New South Wales shows that a great deal of progress has been made in extending the utility of the Museum during the year. The Museum, which seems to have been opened so recently as December last, bids fair to become of very great service to the colony. One paragraph in the Report says, "Special endeavours are being made to collect the raw products and samples illustrative of the industries and manufactures of the Australian colonies, and the Committee have already secured a considerable number of native vegetable and mineral products and a comprehensive series of specimens of wool."

The "Annual Report of the Royal Botanic Garden, Calcutta, for the year 1883-84," and that of the Government Cinchona Plantations in Bengal for the same period, are, as usual, very creditable to Dr. King as superintendent. Dr. King's reports are always concise and interesting records of admirable work both at the Botanic Garden and at the cinchona plantations, and those before us show that in the former a good deal of consideration has been paid during the year to the extension of plants of real commercial value, such, for instance, as paper materials, including the sabai grass (*Pollinia eriopoda*, Hance), and the