be cited of the value of science in a commercial and national point of view. A great industry was all but extinguished, and the impending catastrophe became a question for parliaments and statesmen. A scientific investigator was appealed to; he set to work in 1865, and after four years' continued application he had solved the problem, and delivered his country from the incubus on her industry. It has been well said that Jenner by his discovery of vaccination saved more lives than Napoleon ever destroyed; so Pasteur saved France in 1869 from a far greater tribute than the Prussian conqueror imposed on her in the following year.

This brilliant success, which could be neither concealed nor depreciated, led to the successful experimenter (barely recovered from an attack of paralysis, which ended his last laborious research) being called on to devise a means of checking the ravages of splenic fever (*anthrax*) among horses and cattle. Dr. Fleming gives an interest-account of this terrible scourge, and explains the methods adopted by Pasteur to investigate it. He discovered a method by which its virus may be "attenuated," and thus used for protective inoculation in the same way as vaccination protects against small-pox. This method, though often successful, has not proved uniformly so, and more must be done before its general efficiency is established. Dr. Fleming refers to the results in Algeria, in Prussia, and in Hungary, and to these he might have added those obtained by Dr. Roy in Buenos Ayres.

On the other hand, the treatment by inoculation of a contagious disease among poultry (ill-named *choléra des poules*), a method which was also discovered by Pasteur, appears to be uniformly successful.

The last investigation of the great French experimenter is that upon hydrophobia, which the world is still anxiously watching. This also is described by Dr. Fleming. We have kept our readers informed of the progress of this vast practical trial of a scientific mode of treatment on the victims of a hopeless malady. Every month brings fresh accumulation of evidence on the subject, and we hope soon to have the report of the Commission sent from this country to ascertain M. Pasteur's precise methods and their results. If he should be honoured to be an instrument in the hands of Providence for averting one of the most shocking and terrible diseases to which mankind is subject, the name of Pasteur will live as one of the greatest benefactors of our race. But in any case his work already achieved and its results established form an ample title to the admiration and the reverence of all who can estimate genius or value its conscientious devotion to the service of mankind.

LYCOPODS[1]

THE attention of the readers of NATURE has already been directed towards recent work on the Lycopodiaceæ by the publication of a *résumé* of the researches of Dr. M. Treub, Director of the Botanic Gardens of Buitenzorg, Java. He is the first botanist who has succeeded in giving a connected account of the prothallus, sexual organs, and development of the embryo of any species of Lycopodium, and now his first paper, which dealt with *L. cernuum*, has been rapidly followed by a still more complete and successful study of *L. Phlegmaria*, L. It might be expected that the second paper would be in great measure a repetition of the first, but this is not so; and it may be regarded as one of the most interesting results of this very suggestive and luminous investigation that it brings into prominence the greatness of the possible differences in development of two plants which have hitherto passed, and will continue to pass, under the same generic name. The observations detailed in this second paper are so important in their bearings on our views regarding other allied forms that it is desirable that at least the more striking points should be recorded here.

Attempts to germinate the spores of *Lycopodium Phlegmaria* were at first unsuccessful, but after more than a year young plants were found on one of the tree trunks on which spores had been sown, and subsequently similar young seedlings were found in large numbers in the forest. The germination of the spores appears to be slow, and Dr. Treub is of opinion that the culture of prothalli from spores will never be easy, a view which is supported by the fact that the oophore is capable of various modes of asexual multiplication; indeed it appears that the majority of the prothalli found owed their origin to this source, and not directly to the germination of spores. An autonomous existence of the prothallus, independent of the formation of sexual organs, has been demonstrated by Goebel in the case of *Gymnogramme leptophylla*, and a similar, but still more pronounced condition is found in this Lycopod. The prothallus grows in the dead external layers of the bark of trees; it is as a rule devoid of chlorophyll, and consists of cylindrical branches, covered with absorbing hairs. These cylindrical organs branch monopodially, the branches being usually formed in acropetal order; they have a terminal growth with two initial cells, each of which gives rise to half of the cylindrical organ. It is worthy of note that there is a great similarity between the structure of this apical meristem and that of the stem of the sporophore. In the fully-differentiated parts of the prothallus a peripheral tissue one layer of cells in thickness may be distinguished; this gives rise to the rhizoids. The mass of tissue inclosed by this superficial layer, though it shows some slight varieties according to the mode of development of the branch, never attains any high state of differentiation.

The lateral branches, which are not very numerous, take their origin from the peripheral layer, several cells taking part in the formation of each. The growth of these branches may be long-continued, and it is not arrested on the formation of an embryo on another branch. By progressive rotting of the older parts branches may be separated from one another, and this constitutes the simplest mode of increase in number of individuals But, besides this, two other modes of vegetative propagation are known—(*a*) by ordinary propagating organs: these are small ovoid multicellular bodies, which originate from single superficial cells, and are set free by rupture of their pedicels; (*b*) by thick-walled organs, smaller than the above, which only appear on weakly prothalli: these may undergo a period of rest. Among the vascular Cryptogams the only organs hitherto known of a similar nature to these are those described by Cramer; Dr. Treub is, however, of opinion that a truer comparison may be be made to the gemmæ of the Hepaticæ, and especially of *Blasia*, while in many of their general characters, which may be recognised on inspection of the twenty beautiful plates, the prothalli of *L. Phlegmaria* show points in common with the oophore of certain of the Muscineæ.

The sexual organs of *L. Phlegmaria* are produced on the upper surface of the prothallus, and are always accompanied by paraphyses, structures which are absent in other Vascular Cryptogams, but frequently present in the Muscineæ. The position of the antheridia is variable; sometimes they are scattered singly on the vegetative branches, sometimes they are associated in groups, and are then often borne on the considerably thickened extremities of branches. Their development is similar to those of *L. cernuum*, while the antherozoids have two cilia, and resemble those of *Selaginella*. The archegonia have a more definite position, and they appear subsequently to the antheridia, on those thickened extremities of branches which have already borne antheridia: they project from the surface of the prothallus, and have three to five canal cells, while the highest number hitherto recognised

[1] "Études sur les Lycopodiacées," par M. Treub. Part II. *Annales du Jardin Botanique de Buitenzorg*, vol. v. 2ième partie.

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among Vascular Cryptogams is three; this is again a point in common with certain Muscineæ.

This would not be the place to enter upon those details of the mode of development of the embryo, which Dr. Treub has worked out with such signal success It must suffice, while referring those who are specially interested in the subject to the original paper, to state merely the most prominent facts. In the first place there is a considerable difference between the development of the embryo in *L. cernuum*, and that of *L. Phlegmaria*, while in certain points the latter corresponds to *Selaginella Martensii*. Thus the ovum in *L. Phlegmaria* divides first by a wall perpendicular to the axis of the archegonium into two: of these, the cell next the neck becomes the suspensor, the other is the mother-cell of the embryo; the latter develops ultimately into a multicellular mass arranged in two tiers: the lower tier forms only the massive "foot," while from the upper (*i.e.* that further from the neck of the archegonium) are derived the stem and single cotyledon, and ultimately also the first root. The mode of origin of the root is interesting in connection with my own recent observations of the exogenous origin of the root in Phylloglossum. According to Dr. Treub's observations, the first root of *L. Phlegmaria* is at first covered by an envelope a single layer of cells in thickness, which cannot rightly be regarded as the outermost layer of the root-cap; accordingly we have the barest possible example of endogenous formation, only a step removed from the exogenous. These and other results of the investigation of the development of the embryo of *L. Phlegmaria* afford fresh material of the greatest value for comparison, not only with other groups of the Vascular Cryptogams and with the Muscineæ, but also with other species of the genus Lycopodium. Further, the full account given of the prothallus provokes a comparison which Dr. Treub has embodied as follows (p. 88):—"As far as it is possible to judge at present, we find in the sexual generation of the Lycopods, more clearly than elsewhere, transitional terms between the great series of the Muscineæ and that of the Vascular Cryptogams." Some readers will doubtless call to mind, in connection with this, a striking passage by a well-known botanist, Prof. Goebel, written a few years ago (Schenck's *Handbuch der Botanik*, Bd. ii. p. 401), which runs thus:—"We must then satisfy ourselves by asserting that the gulf between the Mosses and Pteridophyta is the deepest that we know in the vegetable kingdom, and bridging it over by hypotheses and explanations does not make it one whit the less."

In this treatise of Dr. Treub we are put in possession of those positive observations which, beyond their intrinsic and independent interest, acquire the highest possible value from the fact that they fit into this wide and deep gulf, and materially help to fill it up. Such observations, and the theoretical considerations which follow them, are sure of a hearty welcome among the fellow-countrymen of Charles Darwin.

I cannot close this article without a brief reference to the peculiar case of symbiosis found in the prothalli of *L. Phlegmaria*. Endophytic Fungi have already been described in prothalli of other species, and here Dr. Treub finds the tissues constantly infested by a fungus, apparently one of the Peronosporeæ. Its thin filaments inhabit the interior of the cells themselves, but without killing them, the nuclei of the cells remaining normal, while the growth of the prothallus does not appear to be visibly hindered by its presence. It would appear that we have here a case of "commensal" symbiosis, in the strictly literal sense; unfortunately it is impossible as yet to follow out the subject thoroughly into its details, but we may hope that Dr. Treub may be able shortly to give us some more general insight into the economic relations of the two organisms thus amicably associated together.

F. O. BOWER

THE UNITED STATES FISHERIES[1]

THESE two volumes, with the familiar black cloth binding, shiny paper, and plates of photo-engravings, characteristic of American official publications, are the first instalment of a series, which is to contain the results of an exhaustive survey of the United States fisheries from all possible points of view. The purpose and method of the survey, and the history of its origin and progress, are sketched in a prefatory note by Mr. Spencer F. Baird. In 1879 it was arranged that the Tenth Census, which is under the direction of General Francis A. Walker, should co-operate with the Commission of Fish and Fisheries in carrying out an historical and statistical investigation of the fishery industries. The direction of the whole survey was intrusted to Mr. G. Brown Goode, Assistant Director of the National Museum, who had for some years previously devoted a large portion of his time and energies to the study of the fisheries. The work to be carried out was divided by Mr. Brown Goode into seven departments:—(1) Natural history of aquatic products; (2) the fishing grounds; (3) the fishermen and fishing towns; (4) apparatus and methods of capture; (5) products of fisheries; (6) preparation and manufacture of fishery products; (7) economy of the fisheries. The co-operation of every person who had any special knowledge of the subjects under consideration was secured. The field-work was so divided that each portion could be assigned to men who were most competent from their previous experience to undertake it. The shad and alewife fisheries, for example, were assigned to Colonel Marshall MacDonald, the Alaska fisheries to Dr. T. H. Bean.

It was understood from the beginning that the results obtained should be set forth in a series of finished reports, of which those referring principally to the exploited organisms, namely, fish and aquatic animals, should be presented to and published by the Fish Commission, while those dealing with the exploiting organisms, the fishermen and manufacturers, should be the property of the Census Office. The expenses of the work have been shared between the Commission and the Census. The reports prepared for the Fish Commission being too bulky for publication in the annual reports, permission was obtained from the Senate and House of Representatives to publish them separately. The series will be as follows:—Section i. natural history of useful aquatic animals (the two volumes now before us); ii. the fishing grounds; iii. the fishing towns; iv. the fishermen; v. the apparatus of the fisheries and the fishing vessels and boats; vi. the fishery industries; vii. the preparation of fishery products; viii. fish culture and fishery legislation; ix. statistics of production, exportation, and importation; x. the whale fishery; xi. a catalogue of the useful and injurious aquatic animals and plants of North America: xii. a list of books and papers relating to the fisheries of the United States; xiiii. a general review of the fisheries, with a statistical summary.

The statistical reports prepared for the Census Office are ten in number. The results they contain have been already partially published in Census bulletins and in statistical tables scattered here and there in various volumes. The prefatory note concludes with a brief summary of the statistics of the fisheries. In 1880 the number of persons employed in fishery industries was 132,426, of whom 101,684 were fishermen. The total value of the capital invested was $37,955,349.

After the prefatory note we find the letter of transmittal from Mr. Brown Goode to Prof. Baird. In this it is stated that the work is intended especially for the use of the reading public, and technical zoological discussions

[1] "The Natural History of Useful Aquatic Animals of the United States," forming Section i. of "Fisheries and Fishery Industries of the United States." 1 vol. Text; 1 vol Plates. 4to. (Washington, Government Printing Office, 1884.)

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