A BIOLOGICAL OUTLOOK

ON

LIFE AND ITS PROBLEMS

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ISSUED

BY

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FOREWORD.

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HOW A BIOLOGICAL OUTLOOK ON LIFE AND ITS PROBLEMS CAN BE DEVELOPED BY EDUCATION THROUGH UNIVERSITIES

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Our problem is how the biological outlook on human life may be developed in the course of University education.

By the biological outlook on human life is meant thinking of of ourselves as evolved and evolving organisms, struggling, and co-operating multiplying and developing in an evolved and evolving environment. Evolving may be of course in a minus as well as in a plus direction, or even between the two.

The biological outlook implies a full recognition of the fact that the social co-ordinates: FOLK, WORK, PLACE, and also in reverse order, PLACE, WORK, FOLK, correspond to the biological co-ordinates; ORGANISMS, FUNCTIONINGS, ENVIRONMENTS: or, again, ENVIRONMENTS, FUNCTIONINGS, ORGANISMS.

It is plain enough that the biological outlook cannot be rapidly acquired, for it is the outcome not of direct instruction, but of a sympathetic attitude to life and an intellectual discipline in its ways. It implies a mental habit, the result of successful observation, experience and reflection, which leave the inquirer impressed with the value of looking at human life in the light of biological principles. Not that this discloses all the facts, for it requires to be complemented by Psychology, Sociology, Ethics and even Religion.

Except in the mentally resolute, a vivid biological outlook is rarely gained apart from some tradition. In most cases the student comes to look at life biologically, because his teachers, parents and associates look at life in that way.

The meaning of the biological outlook may be clearer if we contrast it with the non-biological way of looking at human life—not that any one can be entirely non-biological. The biological outlook implies a recognition of

man as a living organism, the highest of the mammals, with all the vital processes of other animals, with harmonious functioning that spells health, with liabilities to dis-harmony that lead to disease, and with a very important regulative system whose hormones are essential to the welfare of body and mind. The psychical aspect is as supreme as the protoplasm is fundamental, but while the body may be thrilled by the mind, it is not less true that the mind is thrilled by the body. The unity of the organisms is a basal biological truth.

Secondly, the human organism lives in an environment which must fulfil certain minimal requirements of food, fresh air, space, beauty, change and so forth. Generous environment helps to make the most of a man; deficient environment may depress, inhibit, starve and kill. To an extent unsuspected before Biology came of age, Man is modifiable by his Enviornment and stimulated by his Environment for better or for worse. Yet man, when he gets a chance, is increasingly master of his environmental Fate.

Thirdly, the biological view of man sees him as a developing organism, which means more than the universal recognition of his infancy, childhood, adolescence and so forth—a recognition obviously older than any biology though aided by it. It means that every human organism realises a complex inheritance in a complex environment and that every character is a resultant of two components—the hereditary nature and the environing nurture. It means that the degree of development—whether all-round or lop-sided, varies with the nurture, whether generous or niggardly. Moreover the shape of the life-curve—the individual trajectory—is both variable and modifiable; thus childhood may be short and strained, or long and joyous; adolescence may be the successful adventure of an argosy, or a miserable shipwreck; and ageing may be, as Shakespeare said, a ripening or a rotting. The nurtural factor in development has potencies far from being fully estimated; and these affecting mind as well as body, through and through. In Whitman's unforgettable lines: "There was a child went forth every day, and what that child saw became part of him—for a day, or for a year, or for stretching cycles of years." No doubt the study of heredity confirms something of the old fatalism; yet it has to be corrected by a fuller biology which does some justice to the modifying power of nurture, and to the continual emergence of the new.

Fourthly, the biological outlook on human life implies a recognition of man as the long result of time, solidary with the rest of creation. His fabric is shot through and through with partially humanised threads from his mammalian ancestry. The past re-asserts itself in his present, often inconveniently. Yet he is the outcome of a progressive evolution. It is an ascent, not a descent, that he has behind him. His flesh is heir to many ills, but there is an organic momentum within him that is stronger for integration than for the opposite. Moreover his evolution is going on; the fountain of the new is unexhausted. The Darwinian factors, of variability and heredity, selection

and isolation, continue to operate changing and entailing, sifting and singling. The world is new every day, for better or for worse ; but the trend towards betterment is normally the stronger.

Moreover while man is biologically a scion of a mammalian stock, it is also biologically sound to recognise his apartness. For he is a creature of rational discourse, guiding his conduct in the light of ideas, more or less conscious of his past, and more or less ready to control his future, building up a social heritage on a quite different plane from natural inheritance transmitted by his much mingled germ-plasm.

Finally it is characteristic of the biological outlook that it sees man as an organism quivering in the web of life. Many circles of life intersect the human circle, and man's doings reverberate through Animate Nature. As Darwin continually showed, there is cumulative momentum in minutiae, and the consequences of actions spread like ripples on the surface of a pool. No one has begun to have the biological outlook till he can see man and even each man in his intricate web of interrelations.

In regard to the development of this biological outlook in its various aspects, which we have sought to outline, it must be clearly understood that this way of looking at things cannot be acquired by swallowing "principles of biology", or by any other short and easy method. It is the outcome of sojourning with living creatures ; it is based on a multitude of carefully garnered experiences ; it means hard work with masses of fact ; it grows out of observation and reflection. There is no short cut to the biological outlook, save when some vivid experience, or some teacher or fellow-student, may effect a veritable scientific conversion.

This preamble is already long, but one other introductory remark seems necessary. The biological outlook is much more than an intellectual gain ; it is of incalculable practical value. Science is for Life, not life for Science ; and the corollary of the biological way of looking at things is the biological control of life. Pasteur is to Darwin as works to faith. Savoir, prevoir, pourvoir ; knowledge gives foresight, and foresight gives power. In Bacon's phrase the biological outlook is not only luminiferous, it is also fructiferous. It is not only "for the glory of the Creator", it is also "for the relief of man's estate."

The biological view of human life turns a hundred vague and perplexing puzzles into tangible flesh-and-blood difficulties that can be scientifically tackled. Man becomes more intelligible, and therefore more masterable. How many many diseases have been more or less conquered ; how many factors making for positive health are now being used as levers to lift the weight of "life-harming heaviness" ; what success there has been in ameliorating both surroundings and work ! The days of folded hands and submission are over ;

every year man enters, and may enter more fully, into the possession of his kingdom of enlarging life.

In regard to biological teaching in the Universities of the British Empire, it is to be feared that there is relatively little Biology, in the strict sense, being taught anywhere, and that some of that little is not very good. Insurgent zoology no doubt, efflorescent botany, biochemistry like a Hercules in the cradle but what else? We see embryology shrinking under the aegis of Anatomy; here and there a course of biometry struggling for existence; almost like a duriosity is a course on comparative psychology; perhaps an extramural vindication of comparative physiology; comparative pathology hardly known, even as an idea; in a few green trees a vigorous branch of Genetics, preserved from the frost by the label Agricultural; and so we might savagely, and no doubt in some measure unjustly, continue. But where does Biology come in? We mean by Biology *the general science of organisms—the study of nature, persistence, continuance, development and evolution of life.*

It seems to us a sad fact that there is relatively little education in Biology in the Universities of the Empire!—There is abundance of first-class zoology and first-class Botany, but there is relatively little General Biology. No one can seriously pretend that a little Zoology plus a little Botany makes a course of Biology. One might as well say that a whiff of oxygen and a whiff of hydrogen will serve as a drink of water. A distinguished Professor from the North was being shown round one of the greatest of the Southern Universities by a delightful and delighted student-guide. "Yes" he said, "here is Botany, which I understand; and there is Zoology, which I also understand; but what is "Biology" which I see engraved over that portal". The student was taken aback and stood silent; but suddenly a smile of enlightenment spread over his face, and he gave the reply: "Oh, yes, I remember now; Biology is the dog-fish and the bean plant."

The reason for the paucity of biological education is that University teachers try to put too much into one short course, with the result that the more synthetic part of the programme is crowded out. No doubt it is a little difficult to teach Zoology or Botany except in the light of the great biological concepts of growth, development, correlation, variability, heredity, evolution, and so forth; yet it can be done and often is; and all science suffers for it.

Let us take Zoology for a moment. It is so far being excellently taught, and yet there is no rapid diffusion of the biological outlook; and the credit for what little there is must be shared with the Press and the Publishers. Doubtless there has been a sprinkling of biological information widespread throughout the community. A considerable proportion of the public may be said to know that most diseases are microbic rather than mysterious, and that the individual life begins in a fertilised egg-cell; but this fragmentary knowledge is not quite enough for the biological outlook, is it?

Our frank reproach is that the Universities fall short of their just ambition as regards Biological Education ; and a large part of the reason for this is that the hands of the teachers are too full. Keeping still to Zoology, it is plain that every year in every college should see at least *four* main courses going on. *First* there is the prolonged course, for those who are going to be teachers or investigators in Zoology. This must be comprehensive, introductory to all the various aspects of zoology, and continued for several years. *Secondly*, there must be the introductory course for Medical Students, orientated with a view to their subsequent medical studies, giving prominence to the Cell, the Germ-Cells, the Early Stages of Development, Heredity, the Principles of Morphology and Physiology, Parasites, and all that sort of thing. This is naturally to a considerable extent a biological course, but the medical orientation indicated is often conspicuous by its absence, too much general Zoology being usually insisted on. *Thirdly*, there should be a cultural course for "Arts" students, in which the main emphasis should be on ecology, the old-fashioned Natural History, in other words the study of habits and inter-relations ; and, of course, also on Evolution. *Fourthly*, in our judgment, there should be a short course on the Principles of Biology, with obvious, yet not-stressed, applications to the problems of human life. We submit several sample programmes of courses :

(*a*)

ZOOLOGY.

Course for Medical Students.

A Course of about 100 Meetings. Lectures and Practical Work intermingled.

A.—General or Introductory Part.

1. Introductory discussion of various problems of animal life, *e.g.*, different ways of moving, different ways of feeding, animal behaviour at various grades, animal life throughout the year, animal life in different haunts, inter-relations of organisms—to bring out what organisms are, and what they busy themselves with, and how animals differ from plants.

2. A bird's-eye view of the animal kingdom. The basis of classification. What is meant by species and varieties. The great lines of animal evolution *e.g.*, Vertebrate, Arthropod, Annelid.

3. Several illustrations of Protozoa, *e.g.*, Amoeba, Paramecium, Malaria-organism, Sleeping-sickness organism. Disease-causing Protozoa and their vehicles. Detailed analysis of the Animal Cell and Cell-division.

4. A number of Invertebrate types selected to illustrate particular points, *e.g.*, the beginnings and evolution of tissues ; the division of labour

in the body and the establishment of organs ; the evolution of the nervous system and the succession of steps in a reflex action ; the various ways of solving the same problem, *e.g.*, respiration.

5. Introductory study of early stages of development, *e.g.*, in sea-urchin. The egg-cells and sperm-cells. Maturation, fertilisation, and segmentation. The significance of larvae. Comparison of a number of life-histories, *e.g.*, jellyfish, earthworm, crab, butterfly, sea-urchin, and pond-snail. Alternation of generations.

6. A number of Vertebrate types selected to illustrate particular points *e.g.*, homologies, based on a thorough comparison of such skeletons as those of birds and mammals ; the differentiation of the food-canal and its outgrowth ; the everyday functions of the body : the regulatory system and the evolution of the ductless glands ; different modes of reproduction leading up to mammalian viviparity. The evolution of sense-organs and brain.

7. The fact of evolution. The evolving organisms and the evolving system of inter-relations. Practical illustrations.

B.—Special Part.

8. The Study of important parasites and their life-histories, *e.g.*, Trematodes, Tapeworms, and Nemotodes, with particular emphasis on forms like the species of Bilharzia and Hookworm. Insects and Acarines as carriers as well as parasites. Return to Protozoon parasites. Illustrations on the Web of Life and man's share in it.

9. History of the germ-cells. The principles of Genetics. Mendelian Inheritance. Reversions. The concept of Unit-characters. Heredity and disease. Hormones and Heredity.

10. Experimental Embryology. Influence of Nurture on the development of hereditary nature, modern experiments bearing on this. Influence of changes in habits and surroundings ; how far of racial significance. Question of the transmission of "acquired characters" or somatic modifications.

11. Brief comparative study of sex and reproduction. Sex dimorphism at various levels in the animal kingdom. Modern work on hormones. Darwin's theory of sex-selection and its modern form.

12. The factors in evolution brought together. Fluctuations and Mutations, Selection and Isolation.

The practical work of three kinds : (*a*) Manipulative exercises in dissection and microscopic technique ; (*b*) as a discipline in precision—a very thorough study of particular things, *e.g.*, dog's skull, bird's skeleton, brain of skate, eye of ox, appendages of crustacean and insect ; and (*c*) direct illustrations of what has been discussed in the lectures.

(*b*) INTRODUCTORY.

COURSE FOR ARTS AND SCIENCE STUDENTS.

A Course of 100 hours, of which 50 are devoted to practical work.

1. General Survey of the Animal Kingdom. The characteristics of the great classes. Structure, functions, habits, life-histories, and inter-relations of a series of types and groups, *e.g.*, Amoeba, Paramoecium, Sponge, Hydra and the Hydroids, Medusæ, Sea-Anemones and Cora's, Unsegmented Worms, Earthworm, and other Annelids, Starfish and Sea-Urchin, Crayfish and other Crustaceans, Peripatus, Centipedes, Millipedes, Insects, Spiders and other Arachnids, Snails and other Molluscs, Primitive Vertebrates, Skate and other Fishes, Frog and other Amphibians, Reptiles, Birds, and Mammals. Special studies of selected British animals.

2. The Problems which the Animal has to solve : Nutrition, Movement, Self-preservation, Race-continuance, etc. Illustrations of the variety of solutions. The everyday functions of the body—contractility, irritability, digestion, circulation, respiration, excretion, integration—introduction to comparative physiology. The study of Animal Behaviour.

3. Introduction to the study of structure. The form of the body ; the organs ; the tissues ; the cells and their protoplasm. Some general ideas of morphology illustrated, e.g. homology differentiation, substitution of organs.

4. Introduction to the study of development. Early chapters in development, e.g., of Sea-urchin and Nematode. Types of embryos and larvæ. The recapitulation doctrine. Introduction to the study of heredity.

5. Inter-relations of animals with one another and with plants. Commensalism, symbiosis, partnerships, social animals.

6. The Haunts of Life and how animals are adapted to their peculiarities : littoral, pelagic, abyssal, fresh water, terrestrial, aerial. The peopling of land and sea. Introduction to the study of the Pas (palæontology) and the factors in Evolution.

7. The Biology of the Seasons. The life of animals considered in relation to external periodicities.

PRACTICAL WORK: The macroscopic and microscopic study of a series of types.

Or

(*c*) SHORT NATURAL HISTORY COURSE FOR GENERAL STUDENTS.

Forty meetings in all, with demonstrations.

A. A General Survey of the Animal Kingdom.

B. The problems that animals have to solve, such as nutrition, movement, self-preservation, and race continuance. The everyday functions of the body and the various forms of animal behaviour.

C. The General Structure of a higher animal and the adaptation of its parts for special uses.

D. Different kinds of Life Histories; introduction to the study of Heredity.

E. Inter-relations of animals with one another and with plants.

F. The life of animals throughout the year.

G. The Haunts of Life; the Peopling of Land and Sea; the Evolution of Animals.

(*d*) PRINCIPLES OF BIOLOGY.

A course of forty meetings devoted to a study of Biology with relevant Practical Work.

1. The Distinctiveness of "Organisms," or the Criteria of Livingness.

2. "Function" and "Behaviour" or the everyday life of the Organism.

3. The System of Animate Nature.

4. The Individual and the Race.

5. Originative Factors in Evolution; Variation etc.

6. Directive Factors in Evolution; Selection etc.

It is significant that at a recent congress of University teachers met in London to discuss the teaching of Biology in the Universities, there was only a single reference to Eugenics. While we are personally convinced that indirect instruction in regard to the biology of human life is in most cases of greatest value, leaving the outlook to develop in each mind, we are also convinced that the continuance of such detached aloofness in biological education is not only unprogressive, but unscientific.

In conclusion, we wish to plead for a form of biological discipline which has never been tried as much as it deserves—the study of living animals. In many Universities and colleges it is part of the routine that students should study living amœbæ, various animalcules, Hydra and so forth; but the study of the living soon comes to an end. In all marine laboratories the student has, however, opportunities of extending this study of the living in very delightful ways, and no one can forget the revelation afforded by the first watching of, say, a vigorous starfish. Our plea is for an extension of this kind of study, for it is rewarding and promiseful. For small groups of students it is sometimes realised by means of excursions.

In a well-known educational institution for the Training of Teachers, there is no dissection at all unless a student particularly wishes it in order to solve some problem. Yet the teaching and learning of Zoology in this institution reach an unusually high level, Institution un-named. Its main practice is worth following, to the extent of having much study of the living creature. For this study gives impressions that dissection can never give; it illumines the concepts of growth, development, struggle, variation and so on; it induces the biological outlook.

To watch a transparent egg developing, to follow the life-history of a dragonfly or a tadpole, to watch an ant-lion in its ways, to scrutinise a bee-hive or a formicarium, to measure and plot out the rapid growth of a caterpillar in size and weight, to study day after day the progressive behaviour of a starfish in learning to right itself when turned upside down, to keep the hermit-crab's diary for him, to discover the succession of populations in a jar of pond water, to make a careful record of the differences between the members of a large family, say of chickens, and so on as opportunities arise—*that* is the line best of all worth following. Our proposition is; the biological outlook arises more from the study of the living than from the indispensable analytic studies which need no defence.

Everyone who has tried knows that the study of living animals is peculiarly difficult; and many creatures have an exasperating way of dying just when we particularly wish them to be alive. For a large class the study of living animals above microscopic dimensions may seem almost utopian. Yet it can be done; and it is well worth while.

It must not be supposed for a moment that we are proposing all this a **a** *substitute* for dissection and other analytic methods, which have their own values and rewards. We are simply pleading for a fairer trial of a fundamental discipline.

Nor let anyone suppose that the study of a life-history, or of an animal's everyday behaviour, or of its relations with its environment animate and inanimate, need fail to be brain-stretching. Resolutely pursued, the study of the living animal will not fail to discipline the scientific mood.

Our plea may be received more sympathetically when it is remembered that in India, so large and clamant a part of the Empire, there is a widespread repulsion to our predominantly necrological methods; and our own students often feel the same, women specially and poets too. Now when the taking of life is abhorrent, and the handling of the dead animal is repugnant, surely, in the name of education, the natural and promiseful way out is to get the teachers in Indian Universities, Colleges and Schools, to think out a carefully-planned study of living animals, such that it will illustrate biological principles, and engender the biological way of looking at life. Moreover it is familiar commonsense that the result of instruction depends on the degree in which those concerned teach and learn *gladly*. That the glad way of teaching and learning biological science in India is through the study of the living, we are convinced; and more of this will do us good in Britain.