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News from the International Union for Pure and Applied Biophysics

IUPAB President's Speech at the Opening Ceremony of the Third International Congress on Biophysics Cambridge, Mass., 29 August 1969

1. Introductory remarks

1.1. It is my privilege to thank, on behalf of the International Union of Pure and Applied Biophysics, our gracious hosts, the administration of MIT, and our distinguished guests for their whole-hearted help and collaboration in organizing this magnificent congress. A special expression of gratitude is due to the organizing committee and its energetic chairman—Professor Walter Rosenblith—who have devoted their attention for many months to preparing the general programme and to the minutae and details of this great event, thus making possible the smooth running of the Congress from both the scientific and organizational point of view.

Only eight years have passed since at the first General Assembly, the International Organization of Biophysics constituted itself as an independent and self-supporting body and adopted its statutes. Today it is a recognized institution which has organized several congresses and numerous scientific symposia, which publishes its own journal—the *Quarterly Reviews of Biophysics*—and is an active member of the roof organization of all scientific unions—the ICSU. The rapid growth of our Union is due to a large extent to the fine work of the Council and its Executive Committee, and above all the devotion and efficiency of the Secretary-General, Professor A. K. Solomon.

1.2. The name 'Biophysics' stems from a tradition which goes back to the middle of the nineteenth century. It seems that the term Biophysics was coined by du Bois Raymond and was used freely by von Helmholtz. Until recently, however, the meaning of the term was dis-

puted both by individual scientists and scientific organizations. The founding father of our Union—Sir Gordon Sutherland—wrote that 'probably no two scientists would agree on the definition of the word "biophysics...".' He hastened to add however that 'during the past 50 years there has been a growing consciousness that in this ill-defined borderland where physics, physical chemistry and medicine overlap—revolutionary advances are likely to be made in the near future...'. In other words, Sir Gordon was not greatly concerned about the precise definition of biophysics so long as the field was active and creative and researchers could identify themselves with the rapidly growing discipline.*

In reality there is a wide gap between the biophysics of the nineteenth century and the discipline as it is today. In the earlier era biophysics encompassed the grafting of some physical methods on to biology and the solution of physiological problems with the aid of physico-chemical tools. Modern biophysics was born with Schroedinger's 'What is Life', in which the new recognition was clearly stated: namely, that the phenomenon of life can be interpreted in molecular or physical terms. It is this revolutionary approach which attracts a growing proportion of physicists and physical chemists to the study of biophysical phenomena.

2. Physics versus biology

2.1. In a recent symposium on the philosophical foundations of biological explanations, the biophysical approach was severely criticized by several biologists and philosophers of science. The well-known evolutionist E. Mayr challenged the physical biologists on their attachment to beautiful theories which are not ready to yield to ugly facts. He said that 'the enthusiastic but poorly informed physical scientists have lately tried very hard to squeeze all biology into the straightjacket of a reductionist physico-chemical explanation...'. According to Mayr, biology requires a holistic, organismic approach which is incompatible with the reductionist attempt to derive the phenomena of life from molecular structures and interactions. For the only question posed by the reductionist relates to how—what is the organization of systems and what are the mechanisms of their operation? The biologists, on the other hand, ask such taboo questions as what for—what is the purpose of organs and social elements?—as well as non-physical questions such as those

* As has been said of other broad definitions in science: 'Biophysics is like my wife—I can recognize it, but I cannot define it!...'

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relating to the history of the organisms, their evolution and how they have come to be what they are today.

2.2. Although the biophysicists are ready to accept with due humility the criticism of the philosophers, their humility does not go too far. The humble attitude of the scientists can best be characterized by the story of the great teacher who was lying on his death-bed surrounded by a group of admiring students, who were reciting the wise statements of their beloved master, and praising his wide knowledge and profound understanding of man and Nature. Suddenly they observed that the lips of the dying man were moving, in an attempt to utter a few last words. And this was the final statement of the great scientist: 'While enumerating my achievements and personal qualities you have forgotten to mention one property: I am extremely humble too...'.

There is some justification in a lack of humility in this group of young and vigorous scientists, intoxicated by the striking achievements of their discipline. For the 'reductionist' approach has secured unexpected victories for the interpretative advancement of science in domains which only a short time ago seemed to be beyond the reach of a physical-molecular approach. This is demonstrated by the well-known history of the cracking of the genetic code: Already in the thirties of this century some workers expressed the opinion that both personal and genetic memory is encoded in molecular structures. The materialistic reductionist approach was however criticized violently by J. S. Haldane who wrote, at the end of the thirties, that such a theory 'has evidently all the defects of a mechanistic explanation of development. How such an amazingly complicated system of sign posts could function by itself—as a physico-chemical process—and reproduce itself indefinitely often—is inconceivable.' Only twelve years later Avery and his co-workers discovered the genetic transmission by DNA and a few years after this the physical structure of DNA was elucidated and its relation to the genetic code translated into molecular terms.

2.3. The main objection to the criticism of the philosophers and holistic biologists is, however, their misinterpretation of the modern biophysical attitude. Both the new physics and biophysics have ceased to adhere to the classical notion that all physical concepts are based on centimetre, gram and second. The way is open to geometrical and informational ideas without which the very notion of a 'code' could not be adopted by the biophysicists. The treatment of the cybernetic organization of the cell and the communication systems of the organism demon-

strate clearly that the distinction between the reductionist and holistic approach has little justification in the biophysical praxis. The biophysicists—as well as scientists in other disciplines—are trying hard to integrate biological phenomena into unified intellectual structures. Their attempt is however not biased by the classical, mechanistic, pictures; there is an honest effort to learn from living systems and to forge suitable models for the physical interpretation of the phenomena of life.

The essential humility of the new biophysics lies in its readiness to learn from biological experience and to adopt its 'Weltanschau' to the dictum of living nature, without trying to impose preconceived ideas on newly discovered phenomena. To be sure, the fact-finding by physical methods continues, but the facts are united into more open-minded theories which transgress the confines of specialized disciplines. This was stressed in one of the fine essays of Peter Medawar, who says that 'the ballast of factual information is growing daily less... In all sciences we are being progressively relieved of the burden of single instances, of the tyranny of the particular...one of the distinguishing marks of modern science is the disappearance of sectarian loyalties. Isolation is over—we all depend on each other.'

Within this framework, biophysics is not only mature enough to deal with problems of living nature, but is free to deal also with human affairs related to the impact of science on modern society.

3. Certain social problems

3.1. The satisfaction which the advancement of science provides to its devotees seems to lose its appeal for the younger generation which expects from science more than the abstract pleasure of *sub spaecie eternitates*. Neither is the attraction of the intellectual control of natural phenomena sufficiently strong as to provide a substitute for the search after moral values and dicta for meaningful behaviour. Many years ago, the great sociologist Durkheim pointed out that the more men become capable of controlling the external conditions of life, the less interested they become in living...'Although the application of the sciences have abolished or controlled an astonishingly large number of obvious causes of sorrow and tragedy it is not obvious—he wrote several decades ago—the the majority of men feel life to be any less sad or tragic than before.'

In addition to the disillusionment regarding science felt by the younger generation, based on lack of the guidance which the understand-

ing and mastery of natural phenomena might have been expected to provide, and its failure to bring about human enlightenment, there are numerous social factors which alienate the younger generation from embracing scientific careers. It is well known that in the present period of the second industrial revolution, brains have become a more influential form of capital than material property; science has become sufficiently important that administrators are taking interest in it—and administrators believe that they know how to run things. Moreover, they also think that scientists do not—and hence bureaucratic procedures, which nobody would have bothered to enforce a decade ago, are now being rigorously enforced, to destructive effect. It is therefore not surprising that many young students prefer to engage in social studies which promise to find a new way of life without administrative intervention.

And last but not least, there are the academic factors related to the scientification of society. The frightening growth of the academic institutions to mega-universities having a student population which is numbered in the tens of thousands presents the scientific teachers with educational problems which did not exist previously. The rather conservative structure of academic bodies makes it even more difficult for them to come to grips with the unfamiliar situation, and brings many a scientist to escape into the old ivory tower instead of facing the human problems raised by the new science-dominated society. Dr Mehta stated adequately the educational difficulties of modern universities: 'In former times—the teacher could provide his students with a *map* to guide them through life; now the best thing he can give them is a *compass*...'

3.2. It is the hope of the organizers of this congress that a solution to these problems exists and that the concerted efforts of open-minded scientists and teachers can help in developing new approaches which will provide an adequate educational system for a large student body which represents a major fraction of the younger population in the advanced countries.

The adaptation of the structure and methods of universities to the urgent needs of our time could not be carried out by the self-conscious professors of the classical type. Indeed, it is known from the history of science that some of the greatest scientific ventures were destroyed not by external forces but by the rigidity of the high academic ranks. My friend Prof. S. Sambursky analysed in some detail the 'decline and fall' of Greek science, which developed continuously for over a millenium,

and vanished rather suddenly many centuries before the advent of the Middle Ages. The conventional explanation is that the conquest of Alexandria in Egypt by Omar II during the eighth century put an end to the schools of Archimedes, Euclid, Aristarchos and Hero the Alexandrian. Sambursky's study elucidated, however, that the Alexandrian School died 200 years before the Arabic conquest and the famous library which was burnt with the entry of the conquerors was empty before it took fire. What the investigation demonstrated was that already in the sixth century, Alexandrian science had deviated from the free peripatetic method of the Athenian school. The universities had become formal and traditional, departments were established and a fixed curriculum imposed on the students. A short time before the death of scientific creation the system of chairs was introduced, for teaching *ex cathedra*, and the professorial rank named and sanctified....

To avoid the ancient catastrophy, it is up to the new, dynamic and free sciences like biophysics to make a major effort for a renovation of the educational system and for the introduction of humane and enlightened methods. It is gratifying that on the programme of this congress we find a symposium on education in biophysics, which signifies an awareness on the part of the organizers of the responsibility of the IUPAB towards the young and frustrated students.

4. Concluding note

4.1. After the opening session, the Congress will begin its regular activity. Before this starts, I would like to conclude my opening remarks with a few words of advice *pro domo sua* which I learnt from a Prayer published in a little publication of a Kibbutz. The prayer might help the participants and the chairman in the working sessions. It is as follows:

1. Please help me not to indulge in petty details and endow me with the ability to recognize the essential issues under consideration.
2. I don't dare to ask your grace to enable me to take pleasure in what the others have to say, but please help me in listening to their presentation.
3. I am convinced of the breadth of my own wisdom and I know that it would be a pity to keep silent...but, dear God, I would also like to have some friends.
4. Endow me with the ability of seeing important achievements in unexpected places and to discern the capability of other people, and above all grant me the courage to tell them about the value of their findings....