"The Origins of Life"

N. W. Pirie's characteristic and entertaining account of the symposium in Moscow on the origin of life mainly consists of an exposition of his views on the subject and a metaphysical criticism of a minor part of my own contribution to the discussion.

The scientific value of the symposium lay, it seemed to me, in the fact that so many distinguished and active scientists in fields ranging from astrophysics to genetics, with a strong central weighting in biochemistry, had come together to discuss a subject of such wide scope and importance as the origin of life on the Earth. It is true that most of the prepared contributions had only an incidental bearing on the subject, but taken together they began to build up a picture which can be the basis for further directed research. They also brought out by their weaknesses the nature of the major gaps in the story that still need to be filled.

On the whole, the original Oparin–Haldane hypothesis of evolution of life on this Earth in a primary reducing atmosphere was supported by the later contributions.

Urey, who could not be present himself, summed up in favour of a primitive atmosphere containing mainly nitrogen and hydrocarbons with ammonia mostly dissolved in sea water. Miller reported further work on the synthesis of amino- and vegetable-acids from such simple molecules, which has been largely confirmed and extended by Terenin, Pavlovskaya and Passynsky, who also used ultra-violet light. Asymmetric syntheses on quartz catalysts were also reported by Klabunowski.

On the next and critical stage of polymer formation, there was an interesting paper by Akabori on the polymerization of amino-acetonitrite on clay to form polyglycine and the subsequent introduction of other amino-acid side-chains. This was about as far as the synthetic approach from simple molecules had progressed, though the work of Oparin and his school on reactions in coacervate drops is suggestive of the conditions of the next stage of Pirie's 'eobionts'.

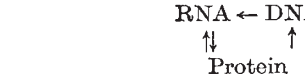
The rest of the discussions turned on the reverse approach, by analysis of existing biochemical processes in a variety of organisms. Despite Pirie's criticisms of the limitation this implies to the more successful mechanisms, it is unfortunately the only way open to us until we get to other planets. We had, on the most general question of the evolution of metabolism, an important paper by Prigogine on the thermodynamics of cyclic biochemical systems and of their evolution from simpler forms. Other ideas on the open character of organic metabolism were furnished by Broda and Mitchell.

I put forward a suggestion of how the apparent improbability of the enormous complexity of biological structures could be understood in terms of the formation of a sequence of structural units, such as macro-molecules, fibres and membranes, determined by the nature of their progressively weaker ultimate binding forces, each including all the smaller and more tightly bound lower structures. The functions of such structures in cell metabolism was well brought cut in the paper by Sissakian.

In the field of biochemical evolution, Calvin brought forward a general hypothesis for the production of catalytic activity from progressively more complicated substances up to the present-day protein enzymes. Nicolaev provided some experimental evidence for this from the catalase-like activity of certain copper complexes.

On the evolution of proteins and enzymes, we had interesting papers from Šorm and Hoffmann-Osterhof showing the persistence of common features pointing to an earlier peptide stage. Straub provided further evidence in experiments that seemed to show that the synthesis of proteins in liver cells proceeds in two stages, first that of a common basic protein and then the addition of a specific terminal grouping conferring on it specific—enzymic or antibody—character.

The two other major biochemical activities, those of energy transfer and control of reproduction, seem to be carried out by the same groups—the nucleotides as coenzymes, and the polynucleotides or nucleic acids as basic genetic material. There was naturally much discussion of the nucleic acids, and their role in stabilizing biochemical reaction patterns, at the symposium, particularly in the contributions of Chargaff on the relations of proteins and nucleic acids, and in those of Fraenkel-Conrat and Schramm on specific protein synthesis by viruses, which I did not find as irrelevant to the subject as did Pirie. At the moment we have to consider the triad of mutual synthesis :



but this cannot have been the original state, and it is one of the major problems of biopœsis to find what were its antecedents.

On biochemical evolution there was general agreement that the Pasteur effect implied, as Oparin had first suggested, the priority of fermentative over oxidative cycles in the evolution of life, a point well brought out in Aubel's paper. It was also dealt with in an impressive paper by Braunstein on the evolution of nitrogen metabolism.

Closely connected with this is the question of photosynthesis, which was the means of liberating the molecular oxygen necessary for oxidative cycles. Here a series of interesting papers, especially those of Reid, Oda, Krasnovski, Sorokin and Sabozhnikow, indicated that before the chlorophyll-operated oxygen-liberating photosynthesis, there was one operating photocatalytically through simpler porphyrins and producing mainly molecular sulphur or sulphur compounds as some bacteria do to-day. Here Pirie is not quite fair in his claim that really primitive types were not studied, though it is now clear that there is much more to be learned in this field.

Nearly all the papers presented belonged or fitted in with the now almost orthodox scheme of biopœsis, including those as far removed as Pauling's on the relation of blood-group mutations by minor protein molecule changes. However, one interesting heresy appeared in the paper by Fox on the hydrothermal production of many enzymic reactions, suggesting that life had originated not in a cold but a nearly boiling ocean, to-day represented only by hot springs.

I hope these remarks may do something to enlarge Pirie's view of the symposium, but they still are far from doing justice to the wealth of information presented and the interesting discussions that ensued. However, in some months time scientists will have the opportunity to judge for themselves by the publication in several languages of the Proceedings of the Symposium.

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