# The Architecture of Life

SECTION I (Physiology) of the British Association arranged a discussion at Blackpool under this title, in which Sections A (Mathematical and Physical Sciences) and B (Chemistry) took part. This discussion was concerned with some of the evidence bearing on the problem of the fundamental structure of the cells of animal organisms. In a wide and imperfectly explored field such as this, papers dealing with experimental data tend to appear rather unrelated and miscellaneous. What follows is not so much a summary of the papers as an impression of the main features of general interest.

Introducing the subject, Mr. A. D. Ritchie said that the advance of knowledge in the biological sciences depends upon an understanding of structure. In the history of science, the first stage was the development of anatomy, which revealed the relations and functions of those parts and organs of the body that are visible to the naked eye. The second stage was the development of microscopical technique which revealed the cellular structure of tissues, the functional relations of cells to one another, and, to some extent at least, the structure of the cells themselves. These methods have now accomplished most of their work. The third and the last advance will be the elucidation of the molecular architecture of the living cell. No possible improvement in microscopic technique can make structures so small as $10^{-5}$ cm. directly visible. The range of molecular magnitudes lies below this, say $10^{-6}$ cm.–$10^{-8}$ cm. No one method of attack is going to reveal structures of this order, but only the co-operation of many different methods making use of all the resources of physics and chemistry.

Dr. D. M. Wrinch dealt with what is perhaps the central problem, that of the structure of proteins. The foundations of our knowledge have been laid by the labours of the organic chemists using the classical conception of Fischer, that proteins are built up of α-amino acids joined by the peptide linkage. Their results can now be extended by means of two new physical methods. By Svedberg's centrifuge method the size and shape of molecules of proteins in solution can be determined. By the X-ray method Astbury has obtained information about the molecular structures of keratin fibres and the protein of muscle, and Bernal about soluble crystalline proteins The chief difficulty has been to understand the transition in structure from the globular form of the soluble crystalline state to the long chain structure of the denatured state and the fibres. The 'cyclol' scheme put forward by Dr. Wrinch gives promise of a solution. According to this conception the amino acids are linked in patterns of condensed six-atom rings. The possible patterns of this type are limited in number and their configurations can be worked out geometrically. The tautomeric change from the cyclol arrangement to the fully extended straight chain through the intermediary of folded chains becomes intelligible. There can be little doubt that all the ordinary proteins have the same kind of skeleton holding them together, so that a general solution of the structural problem is possible.

There is, however, a very different kind of protein-like material, the nucleo-proteins, the main structural constituents of the chromosomes of the cell nucleus. Geneticists have shown that the carriers of the hereditary characters are to be found here, and that they are specific and definitely localized. Fortunately, some chromosomes are so large that details of their structure are visible under the microscope. The molecular basis of the chromosome, Dr. Wrinch suggested, consists of bundles of straight chains of mainly basic amino acids bound together by combination with transverse bands of nucleic acid molecules—a suggestion that the most recent work tends to confirm.

Attached to the central structural skeleton shared by proteins in common are the side chains of the amino acids, which confer on each one its peculiar and specific properties. The importance of these specific properties comes to light in investigations of quite a different type. Dr. J. H. Quastel pointed out that for the catalysis of the chemical reactions brought about by living organisms, it is necessary to assume definite spatial arrangements of the enzyme systems concerned. Destruction of the normal cell structure stops some of the chemical reactions but not others. Experiments with bacteria have shown that while one chemical reaction can be blocked by the presence of an inactive substance on the active surface, another can proceed normally, so that the two must occur in different places and each place is specific for catalyzing one type of reaction. In the active cell there are simultaneous and successive reactions linked together in a way that implies not only definite patterns of reactive groups in the cell structure, but also some means for separating and restricting the diffusion of the soluble substances that undergo chemical change.

Dr. P. Eggleton's paper dealt with some aspects of this very difficult subject.

If a dead muscle is suspended in Ringer's solution, dissolved substances can diffuse freely into the whole of the water of the tissue. When the muscle is alive, most electrolytes can diffuse into one third only of the water it contains; the remaining two thirds are inaccessible to them. Glucose also has access to one third only, but urea can diffuse freely throughout. Histidine can diffuse throughout, but not its derivative carnosine. It is impossible at present to understand the partitioning mechanism underlying these facts, but some mechanism there must be.

The electrical potentials that are developed at cell surfaces are generally believed to be due to unequal concentrations of electrolytes on the two sides. The frog's skin develops such a potential between its two surfaces, but only so long as oxidative chemical reactions are going on, presumably to provide energy for maintaining a concentration gradient. Mr. O. Gatty has found that specific types of chemical reaction are necessary for this purpose, and is endeavouring to work out their course in detail.

Mr. J. S. Mitchell's experiments have been concerned with a rather special problem, the chemical changes in proteins brought about by ultra-violet light; but the method used is one of very general interest and great importance. It is to study the process in monomolecular films spread on a water surface. In such films the molecules can be definitely orientated and molecular structures and transformations may be studied directly. Many important cell constituents and other substances of biological interest can form monomolecular films, so that this very powerful method can be applied to them. A. D. R.

# Obituary

## Dr. J. B. Charcot

THE wreck of the polar yacht *Pourquoi Pas?* in a furious gale on the coast of Iceland on September 16, with the loss of all on board but one, was a tragic but not an inglorious end to a famous ship and to the life of the brilliant explorer whose career was so closely bound up with her for nearly thirty years.

Jean Baptiste Charcot was born in 1867, the son of a famous physician and neurologist, Prof. J. M. Charcot. He studied medicine in Paris and was for a time an assistant in the Pasteur Institute. Although he published several papers on medical subjects which were not without merit, circumstances determined that his reputation was to rest not on his professional achievements but on the outcome of his devotion to the sport of yachting.

Charcot's love of the sea brought him under the influence of the revival of polar exploration at the beginning of the present century and fired him to take a part. He raised funds for the purchase and equipment of a small ship, renamed the *Français*, for an arctic voyage, but changed the scene of his exploration to the Antarctic and sailed in 1903 with the intention of searching for the missing expedition of Otto Nordenskjöld in the Weddell Sea. When in South America he heard of Nordenskjöld's relief, and took the *Français* to the west side of Graham Land, there to continue the work begun by Gerlache in the *Belgica*. He reported the existence of Loubet Land south of Graham Land, and pushed on within sight of Alexander I Land; but the main value of the expedition lay in the physical observations and natural history collections made with the aid of his efficient scientific staff during two years.

On his return, Charcot secured Government support for a second expedition, and after a close study of the British, German and Norwegian polar ships, he had the *Pourquoi Pas?* designed to unite the best features of them all. In her he cruised for two years, 1908–10, to the west and south of Graham Land, giving precision to the somewhat nebulous lands seen from the *Français*. He explored the coast of a large island south of the Antarctic Circle to which he gave the name of Adelaide Island, believing it to be an extension of the small island so named by Biscoe in 1832. South of Adelaide Island he discovered a large inlet which he named Marguerite Bay and a new land south of Alexander I Land to which he gave the name of his father. These lands he could not approach, and he believed them to be islands lying off the Antarctic continent. As on the previous expedition, the main value of the researches on the *Pourquoi Pas?* came from the very extensive series of magnetic, meteorological and oceanographical observations and the collections of geological and zoological specimens.

After completing the publication of his results, Charcot continued to make oceanographical summer cruises in the *Pourquoi Pas?*, especially in the Greenland Sea and along the west of Scotland. He was one of the very small number of sailors to effect a landing on the remote islet of Rockall, 185 miles west of St. Kilda, and he acquired an intimate knowledge of the complex coasts of the Outer Hebrides. At the beginning of the Great War his Government insisted on placing him in the Army medical service, but he succeeded in proving that he was a better sailor than a surgeon, and received a commission in the French Navy. Later he was given command of