COLLOIDS IN BIOLOGY AND MEDICINE*

THE address deals with certain aspects of colloid chemistry with special reference to biological processes. Colloids offer a fruitful meeting ground for the different branches of Science; its manifold applications not only to industry but also to biology and medicine have made it of vital importance to the biologist and the physiologist. Colloid technique offers powerful tools to probe into the nature of isolated growing cells and tissues and leads to a better understanding of the types, the mechanism of sub-division, their movements and the factors affecting the nutrition of cells, muscle, and blood. A purely biological approach to the study of these problems is inadequate. A typical instance in point is the study of the protoplasm. Protoplasm has been defined as the material basis of life and it is only when the knowledge of the biologist on its behaviour, the results of the chemist regarding its constitution, investigations of the Colloid chemist on the state of dispersion and aggregation and the experience of the physicist regarding energy propagation in an essentially dynamic system are all woven together that a fabric giving a comprehensive picture can be obtained. Predominant colloid characteristics like electric charge, cataphoretic migration, iso-electric point, coagulation, peptization, adsorption, and membrane permeability have been shown to play a fundamental rôle in most vital processes. There is thus a clear indication that the future development of colloids will be mainly in its application to living matter and life processes.

An interesting aspect of the subject is the study of the formation of structures like musle fibres, bones, gall-stones, etc., in the living organism. These structures are closely related to periodic precipitation in gels. Similar physical conditions regarding diffusion, supersaturation, presence of a gel medium, formations in a colloidal state, are operative in both cases, and thus it becomes possible to explain the genesis of galt stones and other growths in the animal body in the same manner as in the formation of periodic precipitates. Thus, during inflammatory conditions, cholesterols in animal body separate along with calcium bilirubinate as a colloidal mass in the first instance. These change to a crystalline form by a process which is analogous to crystallization in a gel and thus concentric deposition, which is characteristic of reactions in a gel, is produced. The formation of shells, mother of pearl, and various types of concretions have many points of similarity with periodic precipitation. Synthetic elements produced by slow decomposition of calcium bicarbonate held in a gelatine gel give fine periodic layers of calcium carbonate with a spacing of about 4000—6000 per cm. and display the colours of natural mother of pearl. It may be considered that the alternate layers of aragonite and conchioniline in the mother of pearl are formed by a process of periodic precipitation.

Radiations act variously on colloids. They may lead to periodic deposition, photophoresis, and changes in the state of dispersion resulting both in a finer subdivision of the particles and in coagulation. Photoelectric affects may take place followed by secondary effects like increase in conductivity and decrease in viscosity but in many cases the behavious is better explained on the basis of photochemical changes which alter the conditions of the protecting layer and thereby reduce or neutralise the charge on the particle. These experiences from the study of colloids *in vitro* have their significance in the use of irradiations *in vivo* which affect colloidal materials of the living body.

The behaviour of colloids towards light is linked up with several branches of actino-therapy particularly in relation to deficiency and metabolic diseases. Though the emphasis in the therapeutic use of radiations has been more on the physiological side, a colloid-chemical approach to the subject is bound to prove profitable.

Adsorption offers another point of contact between colloid phenomenon and biological processes. There is no dearth of experience where the cells of the living body act as adsorbent. The role of adsorption is enhanced by the highly disperse nature of the body materials and

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the existence of minute capillary spaces. The catalytic activity to enzymes is intimately connected with adsorption. Experiments with inorganic adsorbents have shown that the molecules in the adsorbed layer are oriented in characteristic manner. A similar process is considered to be operative in the case of enzymes, where the peculiar frame work of the adsorbed molecules resulting from orientation will produce a factor of specificity in their action. There is a clear parallelism between toxicity and adsorption, which also lies at the basis of many biological phenomenon.

Peptisation and flocculation are essential properties of colloidal systems. These principles find their applications in the diagnosis of certain diseases and the pathological examination of body fluids. It has been found advantageous to use many medicines in a colloidal form rather than as ionogenic salts. Such a method of administration of a medicine secures a low osmotic activity and a large surface. Thus, medicine in all its aspects has made free use of colloid chemical methods.

There are many other spheres of biological activity where colloids play an important part. Again and again we find predominant colloidal characteristics like electric charge, cataphoretic migration, iso-electric point, coagulation, peptisation, adsorption, membrane permeability and many others, playing a fundamental rôle in most vital processes. Life is a continuance of the colloidal state and coagulation means death. As cytology marches onwards, many a chapter of the interplay of colloid behaviour and life processes will be revealed.

THE PATENT SYSTEM AND THE SCIENTIST*

IN the course of a thought-provoking article stressing the need for Scientists in India to pay greater attention to the Patent System than they have done hitherto, Sri. K. Rama Pai observes that Society looks up to the Scientists not only to expand the frontiers of knowledge, but also to solve numerous problems which face it, such as the economic problem of finding food and employment, the defence problem of maintaining an adequate war potential which would ensure freedom to the nation, and a thousand and one other problems which would assist men in passing through life with maximum comfort, and that the Scientist has a duty to concern himself with every factor which would be helpful to him for adapting his discoveries in the field of applied research, for utilitarian purposes.

Explaining the advantages of the Patent System, he remarks that it has been designed to encourage inventors to develop inventions from the laboratory stage to the industrial stage.

Commenting on the present attitude of the average Scientist in India to the System of Patents, he says that, as a rule, the Indian scientist either views the Patent System with positive disfavour or is supremely indifferent to it, as a result whereof many inventions of great merit which were known in the past have been lost to the country, or, the resources of research have been utilised unfortunately for re-inventing what has already been invented by others.

By way of breaking down the popular prejudice on the subject, Sri. Rama Pai argues that while it is true that the Patent system gives a formal recognition to the inventor of his exclusive right to his invention, this is done only in exchange for two privileges surrendered by the inventor, namely,

(i) The prompt disclosure of the invention o the public ; and

(ii) The unreserved dedication of the invention to the public on the expiry of the Patent.

What the Patent System actually does therefore is merely to restrict the period of exclusive right to a reasonable period of 16 years. There can be no doubt that in this transaction it is the public who get the better of the bargain in the long run.

* Abstract of an article on "Patent System and the Scientist" by Sri. Rama Pai, Secretary of the Patents' Enquiry Committee, constituted by the Government of India, to the symposium on Patent System arranged at the 36th Session of the Indian Science Congress.