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ASTRONOMICAL RESEARCH IN INDIA: II

IN *Current Science* for July 1943, a plea was entered for the promotion of astronomical study and research of the highest grade in our country. We require, in the first place, the establishment of observatories in different parts of India staffed by competent and enthusiastic astronomers and equipped with instruments capable of yielding results of real interest and importance. From Kashmir in the north to Trivandrum in the south, from Shillong in the east to Karachi in the west, the territories of the Indian Empire include a variety of latitudes, elevations, climates and observing conditions. A selection could be made of possible locations for a group of observatories which between them could cover the heavens in systematic programmes of exploration and study, all the year round. Then again, the Universities in India should take steps to give astronomical studies and research a proper place in their activities, instead of relegating them, as at present, to an unimportant and practically negligible status.* Astronomy can have no future in India, unless opportunities are given to talented young men to interest themselves in the subject at the Universities. It is necessary also to take steps to encourage and develop public interest in astronomy. Every city of any importance in India should maintain at public expense an observatory of reasonable dimensions which would be open to the public free of charge. Such an institution would be a cultural centre where even the humblest individual who desires to do so could acquaint himself at first hand with the facts of astronomy. There should also be societies and groups of amateur astronomers in every province to maintain and develop an active interest in the progress of astronomical science, by regular meetings, discussions and public lectures.

The programme outlined above presupposes many things—an enthusiasm for astronomy, a willingness to work for its progress, the desire and ability to find the money needed for its active promotion, and above all an atmosphere in which the pursuit of the science could flourish and not be regarded as a useless luxury. It might be urged that a poor country in which the vast majority of the people live at or below the marginal level of human existence, should not trouble itself about astronomy—a non-utilitarian pursuit, as some might be disposed to regard it. To convert those who hold this view to a different state of mind, it might be useful to point out clearly the enormously important part that astronomical studies have played and are playing in the development of both scientific knowledge and general culture. That astronomy occupies the premier position amongst the sciences will be evident if we recall its organic relationships with the other sciences. The basic idea of all science is the concept of law in Nature—the view which regards natural phenomena as an ordered sequence of events linked together by a chain of causation. This concept is an intellectual conviction which established itself in the first instance from the observational facts of astronomy, including especially the most familiar of them all, such as the daily rising and setting of the sun and the moon, the variation of the seasons, the predictability of eclipses and the like. The fundamental ideas which lie at the basis of all the sciences, *viz.*, the notions of time and space, matter and gravitation, light and darkness, heat and cold, all come to us as part of the astronomical environment in which we live. The deeper we delve into the various branches of natural knowledge, the more clearly do we perceive that everything on this earth and inside it, both in the remote past and in the immediate present, has been determined by the astronomical history of our planet. The

* The Osmania University at Hyderabad is an honourable exception in this respect.—C. V. R.

structure and functions of every living object on the face of the earth and the rhythm of its daily life bear the imprint of our astronomical environment and history in language which can be read very plainly.

The pursuit of astronomical studies in any country has an enormously stimulating influence on other branches of scientific investigation. Consider, for instance, that most abstract of all sciences, mathematics. A long roll of illustrious names in the history of science could be cited to indicate how the facts of astronomy and the attempt to interpret them furnish the motive power for the development of new kinds of mathematical thought. Just to mention, Archimedes, Bhaskaracharya, Kepler and Newton should be a sufficient lesson to us from the history of the past. The contents of Newton's immortal work, the *Principia* opened up a new world of thought alike in the regions of mathematics, astronomy and physics. Laplace and Einstein may be mentioned amongst the intellectual giants to whom the facts of astronomy were at once a challenge and an inspiration to develop new ways of mathematical thinking. An astronomical theorist has, of necessity, to be a first-rate mathematician, but his work benefits not only astronomy but all fields of science in which analogous methods could be applied. A striking illustration of this is the recent work of Chandrasekhar on the dynamical theory of stellar systems. As a published report by him reveals, the mathematical developments he has initiated are applicable also in the realms of molecular physics and of colloid chemistry!

As every physicist knows, the study of the stars and the study of the atoms are only two different phases of the attack on the fundamental problems of his subject. In the July article, mention was made of the discovery of the finite velocity of light by Romer, of aberration by Bradley, of laws of planetary motion by Kepler, of the dark lines in stellar spectra by Fraunhofer, of helium in the sun by Lockyer, of the magnetic field in sunspots by Hale, and of the recession of the nebulæ by Hubble. These are typical examples of what might be called the purely observational discoveries of astronomy, which have exercised a profound influence on the orientation of physical thought. Such a list could be extended almost indefinitely. We may put the situation briefly by saying that the Universe is a physico-chemical laboratory of cosmic dimensions and that we are privileged to watch through our giant telescopes a never-ending succession of experiments made on a scale and under conditions which we could never hope to reproduce with our comparatively Lilliputian resources. What we see has much to teach us. It forces us to think deeply. With minds strengthened and refreshed by new ideas, we look again through the telescopes and understand better what we see. But that is not all. The facts of astronomy suggest new modes of attack on the problems of experimental and theoretical physics. When, for example, Niels Bohr set out in 1913 to solve the problem of atomic structure, he found his inspiration in the work of Copernicus, Kepler and Newton. His astronomical model of the hydrogen atom with the electron going round the nucleus in an elliptic orbit as the earth goes round the sun was a magnificent success. As every student of physics and chemistry knows, it opened up great new vistas of physical and chemical thought. To-day, the physicists are watching the skies to discover, if possible, the origin of the mysterious cosmic rays which have meant so much to them in every possible way!

Chemistry is a subject of vast practical importance, and to the uninitiated, it might seem that it could have nothing in common with the science of astronomy which lives with its head up amongst the stars! It is useful to dispel such an illusion if it exists in the minds of any. The vital link between chemistry and astronomy is to be found in the problems of the origin of the elements, of their abundance, and of their associations and segregations, all of which are of the utmost importance not only to the chemist, but also to the geologist, the mining engineer and the metallurgist. The spectroscope reveals that all or nearly all the elements present in the earth are also present in the stars. Even the mysterious nebulium proved to be nothing more mysterious than oxygen and nitrogen under somewhat unfamiliar conditions. The problem of the origin of the elements is, therefore, not so much a terrestrial problem as an astronomical one. The transmutations of the chemical elements successfully effected, though on a very minute scale, in the atom-smashing laboratories of the world suggest that such or other analogous transmutations are in progress in the cosmic crucibles which we call the stars. Indeed, the suggestion has been made (and is probably well-founded) that such transmutations are the origin of the tremendous outpouring of energy continually going on from the sun and the stars. Such extra-terrestrial knowledge cannot but prove ultimately of the highest value and importance to terrestrially-minded capitalists and *entrepreneurs* of industry!

The tremendous interest aroused at the time by the observations of Lowell at the Flagstaff observatory on the planet Mars may be cited as an indication of the possible or probable relations between astronomy and the as-yet-unsolved problems of the origin and distribution of organised life. There can be little doubt that the history of life on the earth as illustrated in the record of the rocks was to a great extent determined by the astronomical history of our planet. There is striking evidence in the record of notable climatic changes and asscciated with them also of the disappearance of some of the older forms and the appearance of newer forms of life from age to age. It cannot be assumed that the evolution of life on the earth has come to an end. Far from this being the case, man is now keenly interested in the process and is taking an active part in the creation or development of new plants and even new animals, which could be of service to him. Can it be assumed that the radiations of various kinds received by the earth from space play no part in biological evolution? Probably not. Be this as it may, no geologist or biologist afford to ignore what astronomy can tell him about the past, present and future of the earth.

Let us leave science now and consider for

a moment the cultural aspects of astronomical study. Can it be denied that astronomy is the noblest and the grandest of the sciences, that it takes us away, if only for a while, from the noise and the dust of terrestrial conflicts and leads us to a better comprehension of the universe we live in and its eternal verities? Our politicians and philosophers are constantly reminding us of India's great spiritual heritage. Should they not raise their voice also to remind us of India's intellectual heritage as reflected in our age-old interest in astronomy, and help to build up a renewed and active interest in its study? C. V. RAMAN.

POST-WAR ORGANISATION OF SCIENTIFIC RESEARCH IN INDIA

A SYMPOSIUM on Post-War Organisation of Scientific Research in India was held under the auspices of the National Institute of Sciences of India on the 27th and 28th September 1943, in the hall of the Royal Asiatic Society of Bengal, Calcutta.

As a result of the discussion the following tentative proposals regarding the formation of a National Research Council were adopted. It was decided further that these proposals be circulated to the Government Scientific Departments, Universities, learned societies and unattached institutions for expression of their views, and discussed, with a view to their being given effect to, at another symposium meeting to be held at Delhi towards the end of the year at which representatives of the relevant organisations would be invited to be present.

I. The Council of the National Institute of Sciences of India be authorised to take necessary steps for the organisation of a National Research Council constituted under the statutory authority of the Government of India. The National Research Council shall be directly responsible to the Government and have the following functions:—

(*a*) To plan the main lines of scientific work in accordance with national needs, to formulate schemes for the above purpose, to review and modify the same whenever necessary and to recommend ways and means for implementing the results of accomplished researches.

(*b*) To ensure balanced development of all branches of science, and minimise overlapping.

(*c*) To advise and help relevant authorities regarding the training and supply of scientific personnel for pure and applied research.

CONSTITUTION

National Research Council.—The National Research Council shall consist of scientific and technical experts not exceeding sixty in number, the majority of whom shall be elected by non-official scientific organisations, including Universities and institutions of University rank, the remaining number being nominated by the Government of India from among the scientific and technical experts. The President of the National Research Council shall be nominated by the Government of India from among the members. A Vice-President shall be elected by the National Research Council from among its members. A whole-time salaried Secretary shall be appointed by the National Research Council for carrying on its work, who will not be a member of the Council.

Governing Body of the National Research Council.—There shall be a Governing Body of the National Research Council which shall consist of the following: The President and Vice-President of the National Research Council, and the Chairman and Vice-Chairman of each of the Boards.

Boards of Research.—For the performance of its functions the National Research Council shall constitute the following Boards of Research from among its own members, each of which will be responsible, within its own particular sphere, for giving effect to the policy of the National Research Council:—

(1) Board of Scientific Research,
(2) Board of Agricultural Research (Soils, Crops and Animal Husbandry),
(3) Board of Medical and Public Health Research,
(4) Board of Engineering Research, and such other Boards as may be considered to be necessary.

The maximum number of members of each of the Boards of Research shall be fifty. The National Research Council shall appoint the Chairman and Vice-Chairman for each Board and shall co-opt eminent scientific workers in different branches in consultation with non-official scientific organisations, Universities and institutions of University rank, scientific departments of the Government, and Federations of Chambers of Commerce.

Research Committees.—For the performance of its work, each Board will be authorised to constitute Research Committees for all important subjects, to settle the objectives of research, indicate the individuals or organisations which could undertake the several component parts of the enquiry, receive, and co-ordinate the resulting information, make it available to those who will turn it to advantage and to form a national plan into which all who are in a position to contribute information can fit the particular lines of research. Governing Bodies of National Research laboratories, when established, shall be constituted in consultation with the relevant Research Committees.

II. The Government of India be requested to form development corporations for the performance of functions analogous to those performed by the Research Enterprises Ltd., in Canada. The National Research Council shall be represented on the Governing Bodies of the development corporations.

III. To enable effect being given to the policy of scientific development determined by the National Research Council, the Government of India should make grant of five crores of rupees per annum.