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The Indian Institute of Science.

IN view of the impending appointment of the second Quinquennial Reviewing Committee, a brief survey of the development and activities of the Indian Institute of Science, Bangalore, during its life of twenty-five years, may assist in creating sympathetic and enlightened public opinion. This will provide a favourable background, rendering the task of the Committee perhaps less tedious and more congenial; it may even be found indispensable to the formulation of a definite policy for promoting schemes of reform and expansion, such as the Committee may deem desirable to recommend on the conclusion of their labours. The first Quinquennial Reviewing Committee have, in more than one section of their report, drawn attention to the prevailing public ignorance of the work and resources of the Institute, and have also adversely commented on the general misconception among members of the Court regarding the economic activities of the different departments. Such ignorance and misunderstanding, if allowed to persist, would favour the growth of public prejudice affecting the character and fair reputation of the Institute, although there is ample testimony of honourable work steadily pursued in a spirit of disinterested service to the country. It is true that the Pope Committee reported in 1921 abundant evidence that there existed in many quarters "a strong feeling of disappointment and dissatisfaction" with the then existing condition of the Institute; and if such a feeling still prevails in the public mind, it must be almost entirely due to general ignorance of the steps that have since been taken to remove partially or entirely the causes which led the Committee to record the adverse comment. If, however, there is still a source of dissatisfaction either within the precincts of the Institute or outside, we think it must arise from defects inherent in its organisation as well as from lack of a sound and definite policy, understood by all concerned, in regard to both the academic and the administrative spheres of this great foundation. In a short contribution on the Indian Institute of Science published in this *Journal* (October 1932), Alchymist observes that "with this provision (resources becoming available) the future, to which we now look for progress and expansion at least comparable with those of the last fifteen years, is hopeful". Manifestly the writer of the article is favourably

impressed by the advances made by the Institute during this period in the different branches of its activity. Sometime ago it was pointed out in an article in *Nature* (April 29, 1933) that "even if such an Institute were established in Great Britain, where the distances are not of the same continental order, it may be doubted if it would attract as many science graduates taking courses of advanced study and training for research as are now at Bangalore". This is a disinterested testimony to the increasing popularity and sound reputation of the Institute.

We have perused practically all the annual reports of the Council and have referred to almost all the volumes of the *Journal* of the Institute. They are probably the only authoritative documents which give information regarding the development of this institution, and when read in conjunction with the two Committee Reports reflecting the views and opinions of independent experts, we have all the materials necessary for forming a fairly correct judgment on the fundamental question of how far and in what manner the achievements of the Institute have fulfilled the aims and intentions of its founder, and also the intelligent expectations of the cultured public who look to the Institute for a lead in the economic and industrial life of the country. Judged by the ordinary academic standard, the Institute has a blameless record.

After briefly reviewing the administrative and financial matters of each year, Council Reports chronicle the departmental occupations of the Institute in a greatly abridged form, and their results are catalogued in the Appendices. To obtain a comprehensive and analytical view of the activities of the Institute, we propose to investigate the records for twenty years (1914-34), a period covered by the Pope and Sewell Committee Reports. During this period three departments, viz., General and Organic Chemistry, Electrical Technology and Biochemistry,—were operating—and in 1934 the Department of Physics was instituted. The total volume of laboratory investigations undertaken in all these departments is reflected in the number of preliminary reports communicated to the Indian Science Congress, and in the number of papers published in the *Journal* of the Institute and in foreign scientific periodicals. In estimating these results, account must be taken also of consultative work in which the members of the staff and research scholars were engaged.

Our analysis has yielded the following results. The Institute began to send its scientific papers to the Congress in 1916 and, up to 1934 has made 685 contributions. The *Journal* of the Institute first appeared in 1915 and so far 18 volumes containing 272 papers have been published. Information regarding the number of papers published in foreign journals is imperfect, but it is fair to assume that the number cannot be more than about a hundred, since until recently the policy has been to publish almost all the papers in the official organ of the Institute. We thus obtain a total exceeding 300 published papers. No indication is made in any of the official documents regarding the destiny of preliminary communications to annual sessions of the Indian Science Congress, but we have no doubt that all these researches were completed and their results published in the journals to which we have alluded.

During this period the total number of scholars who have undergone training or have conducted research in all the departments, including the recently instituted section of Physics, is 836 which includes about 250 students who qualified for certificates and diplomas in Electrical Technology. Of those who were engaged in research, only four students were elected to the Fellowship of the Institute, which is equivalent to the D.Sc. Degree of the Universities, and about 139 received the Associateship which represents the M.Sc. standard. The qualifying test for tangible recognition of work is obviously high, and it is in keeping with the character and reputation of the Institute. More than 30 per cent. of the scholars trained in various departments have been absorbed in industrial occupations and scientific professions, and the demand for such highly trained candidates must grow in the future with the industrial expansion in the country. During the period to which we have restricted our survey, the total income amounted roughly to Rs 109,84,902 and the expenditure to Rs. 103,88,233, nearly 50 per cent. of which was utilised in equipping the laboratories. According to the opinions expressed by the Pope and Sewell Committees, the scientific equipment of the laboratories for every description of research in the relevant subjects is perhaps unrivalled in India.

The evolutionary history of the Institute may conveniently be divided into three natural stages which we may characterise

as the periods of exploration, consolidation and action. Between the years 1911 and 1921, the Institute was practically engaged in equipping itself for the duties of a "new Institution entirely novel to the country and therefore without a fund of experience on which to draw"—a factor which must impose a serious handicap on its emergence at once as a foundation rich in traditions and in spectacular achievements. The Council was engaged during these ten years in a very full and thorough discussion of the numerous administrative and academic problems arising from the resignation of Dr. M. W. Travers and of Professor Rudolf at the end of the session 1913-14; the schemes prepared by the special Committee of the Council involving considerable expenditure for equipping the new department of Applied Chemistry and for extending other existing laboratories; the refusal of the Government of India to grant extra financial assistance owing to the War and the failure of the efforts of the Council to secure a Director who could also assume the duties of a professor of applied chemistry. In 1915, when the affairs of the Institute were passing through a critical phase, the Indian Industrial Commission was appointed, and when Sir Thomas Holland and Sir Dorabji Tata met Sir Alfred Bourne in the year 1916, a memorandum was presented to the Commission suggesting that the Institute should form a nucleus for the development on a large scale of an Indian Institute of Chemistry. This proposal was not in consonance with the resolution of the Government of India (May 1909) that "they were of opinion that the idea of combining in one Institution and entrusting to a single staff of professors, both the teaching of science and the experimental development of new industries, was open to the obvious criticism that these two objects were in no way connected." The Holland Commission accepted the Memorandum of the Council because they discovered that the Institute had departed from the resolution of the Government of India and from the aims and objects of the founder of the Institute, and in a significant paragraph they wrote that, originally projected by the late Mr. J. N. Tata with the object of encouraging post-graduate study and training for research in pure physical science, the Institute has, in the course of a comparatively short career, developed a distinct tendency towards the study of problems which are

likely to lead to results of immediate economic value, rather than towards the pursuit of investigations of purely scientific interest. As a result of this bias towards chemical industry, the Institute was invited to co-operate with the Indian Munitions Board in the work which that Board had undertaken towards utilising local resources for war, and such assistance necessarily implied the temporary suspension of normal work in the departments. This co-operation finally led the Council to the conviction that "the Institute should concentrate effort on industrial chemistry and endeavour to secure further funds towards that end" and owing largely to the influence of this conviction great progress was made in the years 1916-18 towards associating the work of the Institute with that of the industrial departments of Government. The progress made in the applied branches of chemistry is reported in detail in a monograph issued by the Institute on the ceremonial occasion of unveiling the statue of Mr. J. N. Tata, and led the Council and Government to reconsider the future policy and lines of development. The Pope Committee was appointed in 1921 and their report introduced the second phase in the life-history of the Institute which we call the period of consolidation.

Dr. M. O. Forster (now Sir Martin Forster) was appointed Director of the Institute in 1922 soon after the publication of the Pope Committee Report. In less than three years of his assumption of duties, three professors retired on reaching the age-limit; Dr. Alfred Hay in December 1922, Dr. Gilbert J. Fowler in 1924 and Dr. J. J. Sudborough in June 1925, the vacancies being filled by Mr. J. K. Catterson-Smith, Dr. R. V. Norris and Dr. J. L. Simonsen, respectively. Dr. Forster's time and energies were devoted to examining the administrative and departmental problems adumbrated by the Pope Committee and to exploring the means of implementing, in so far as might be possible, their recommendations. In the department of Biochemistry, Dr. Fowler had established a distinguished school of research in several applied branches, and Dr. Norris proceeded to found new ones. Relieved from the influence exerted by war-conditions, practically all the departments resumed the pursuit of investigations in pure science, maintaining, however, such *liaison* with industrial problems as opportunity offered. Dr. Forster's administration will be remembered chiefly as a period of consolidation of the

moral and material resources of the Institute, in accordance with the proposal of expansion outlined in the Pope Committee report. It was also the period which witnessed the rapid evolution of departmental activities which created a suitable atmosphere for the next phase of development. Before Dr. Forster relinquished his office in March 1933, the Sewell Committee had reported.

Sir Venkata Raman, the new Director, assumed charge of his duties almost immediately. It must be remembered that Sir Venkata Raman was a member of the Pope Committee and had sat in the Council of the Institute for over seven years. In this respect the new Director had an advantage over his predecessors, *viz.*, that he entered upon his duties with a complete knowledge of the work of the Institute such as few could claim to possess. But they were not confronted with the difficulties which Sir Venkata Raman had to encounter. He had soon to face a deficit budget. The Physics Department had to be constructed and equipped. The proposals of the Sewell Committee had to be considered. In the meantime Dr. H. E. Watson and Professor F. N. Mowdawalla proceeded to other appointments. Dr. Watson, who was the senior member of the Institute Staff, had by his energy and character elevated the Department of General Chemistry to an honourable position, and some of his researches had led to the establishment of industries. His departure from the Institute is undoubtedly a great loss. Professor Mowdawalla was a former scholar of the Institute where he had conducted several investigations in the Department of Electrical Technology, and his place is to be filled by Mr. Kenneth Aston. In the Council Report for 1934-35 the Department of Physics organised by Sir Venkata Raman is shown as having produced 39 papers, General Chemistry 9, Organic Chemistry 14, Biochemistry 49 and Electrical Technology 15, in other words the total output of research during this one year was 127 papers. We had almost a paper for every three days emanating from the Institute. This is research in full action.

The Pope Committee deplored that "the Institute has lost in efficiency by reason of the fact that its policy and lines of development have never been defined with sufficient precision," and an examination of the Council Reports since 1922 does not disclose any comprehensive and clearly de-

fined policy directed to the promotion of the welfare and progress of the Institute and of its relation to the economic and industrial life of the country. Perhaps the most important question which the Institute will be called upon to settle is whether it will continue to provide preliminary training in scientific methods and knowledge in its departments and also to hold certificate and diploma courses in Electrical Technology, particularly in view of the fact that almost all the Indian universities have instituted research departments both in theoretical and applied branches of science, in which work of a very high order is conducted, manifest from the number of papers published in India and abroad. In most of the universities, post-graduate work involves a considerable amount of training in research methods, and the M.Sc. Degree is awarded on the submission of a thesis on an original problem. In view of the rapid strides that universities and government research departments are making in the field of research, the Indian Institute of Science has to shape its academic policy to suit the altered conditions in the country.

The essence of this policy, as we conceive it, is that the Institute must find facts, while the public and government must find out how to use them. One of the main articles of such a policy would be to launch a campaign to convince the new legislatures and other bodies who control finance, that research is wealth, and that the greatest tributaries to it are chemistry and physics, through their contributions to agriculture, medicine, metallurgy and the entire range of manufacturing occupations. The second factor in this policy is to insist upon public recognition of the fact that the prosperity of a country in a competitive civilisation depends not so much upon the control of natural resources as upon the control of scientific processes. The work of the Institute in the field of fundamental research and industrial research should no longer be permitted to remain an inscrutable mystery to statesmen and administrators whose position in public life and whose influence in the legislative councils would be a material agent in establishing new research laboratories. The Institute is essentially a single organism, whose health and functional efficiency depend upon the harmonious co-operation of its different members, and in order to secure such co-ordinated effort and infuse a sense of collective responsibility,

the different departments must develop mutual interests and remove the spirit of exclusiveness. This is best done by the establishment of borderland branches of science, which would bind the several units into a single corporate body with common aims and purpose.

The question of the status of the Institute is discussed by the Sewell Committee. They have stated "that the Institute ought always to be in a position to provide such opportunities as cannot be obtained anywhere else in India; that it should do what no other institution can do; that it should maintain a position of pre-eminence; that it should acquire even a world reputation and that it should become a place of reference." The path to attaining this ideal is also indicated in the report, *viz.*, the personnel of the directorate, professoriate and staff, to which we would add finance. These admirable sentiments, however, are not in consonance with the theory elaborated by the Committee regarding the sources of revenue to be explored by the Institute. It seems to us that the preservation of the All-India or international character of the Institute depends upon the regional origin of its finances, its staff and students; and any suggestion of contribution by the provinces in proportion to the benefits received by their scholars must militate against the All-Indian status of the institution. On the other hand, contributions based on the financial capacity of each province irrespective of other considerations will invest the policy and outlook of the Institute with a national character. Each British Province

and each major Indian State might endow a chair and support the laboratory attached. The late Mr. J. N. Tata never contemplated personal or communal benefit from the Institute which his munificence founded. The Institute is the cultural rallying point of the Indian Nation, and its structure is an indivisible unit. If the provinces, the Indian States and the industrial magnates consider it their patriotic duty, rendered in a spirit of pure altruism, to create and support associate professorships, readerships and lecturerships in appropriate branches of science, then it may be possible to release the funds of the Institute more freely for developing its international reputation, by inviting scientists of outstanding eminence such as the Sewell Committee contemplate, to associate themselves with the life and work of the institution. If it were only possible to induce such men to come to India—and it may not be difficult provided we have the resources—the universities, the government scientific departments and the industries would be glad to secure their co-operation and only then would the Institute be in "a position to do what no other Institution could do". It is gratifying that, with the limited funds at his disposal, Sir Venkata Raman has already taken the first step in this direction by inducing the Council to invite Professor G. Hevesy and Dr. Max Born to stimulate the work of the Institute; further development of this great institution must depend upon the financial support of provincial governments and of the Indian States.

Academy of the Natural Sciences of Philadelphia.

MUSEUM workers all over the world are familiar with the high standard of publications issued by the Academy of Natural Sciences of Philadelphia, which is maintained wholly by private endowments and contributions from members and friends. This Academy was founded in 1812 and has done great service in stimulating research in natural sciences in almost a century and a quarter of its existence. The 86th volume of its *Proceedings* for 1934 has been recently issued. It contains 17 contributions from well-known workers. Of these 15 are on zoological subjects dealing with Mammals, Birds, Reptiles, Amphibians, Fishes and Molluscs, and two small ones on botanical subjects. The interesting feature of this

volume is that it contains contributions about the Zoological Results of the Third De Schauensee Siamese Expedition, of the Matto Grosso Expedition to Brazil in 1931, and Dolan West China Expedition of 1931. These expeditions account for 7 papers out of 15. Another remarkable feature of the series is that separate of the contributions presented in its *Proceedings* can be purchased at a small cost. There is a good index to the genera and species described and referred to in the volume. The full volume comprises 589 pages and 23 plates, mostly of molluscs. It is further illustrated with numerous drawings in the text. The price of the full volume is \$5.00 to subscribers and \$6.25 to others.