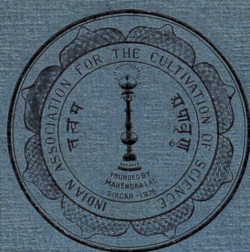


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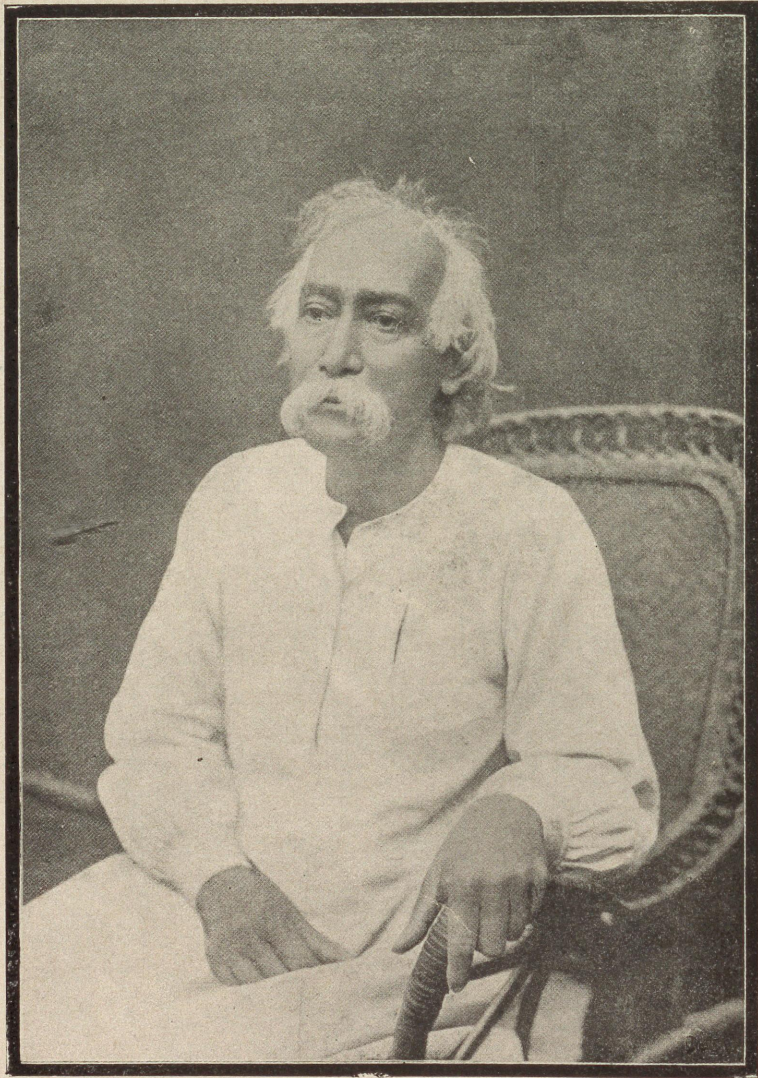
THE INDIAN ASSOCIATION
FOR THE CULTIVATION
OF SCIENCE
CALCUTTA

1948

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Dr. Mahendra Lal Sircar, M.D., D.L.

THE INDIAN ASSOCIATION FOR THE CULTIVATION OF SCIENCE

PART I

HISTORY

Science in the Seventies of the Last Century

In the progressive countries of the West, science has now entered into all avenues of human activity and has improved the life of man beyond all recognition. In India and other less fortunate countries, however, science has not yet effectively taken up its humanitarian mission and has scarcely been utilized for the establishment of a better social order and standard of life. But the teaching and pursuit of science has been developed on a scale wide enough to convince every body in this sub-continent, irrespective of his political creed or profession, that economic prosperity and national well-being depend entirely on intensive and large-scale application of science to all departments of human activity.

In India, this conviction is, however, of recent origin. Even three-quarters of a century ago, study of science was practically unknown in this country and the ultimate aim of education was to produce better and more efficient clerks for helping British rulers and trading companies. The universities and the educational institutions had hardly organized teaching in sciences and most of the colleges were not in a position, either for lack of interest or resources or for both, to offer any facilities for study in scientific subjects. The only institution which offered any such opportunity for a scientific career was the Calcutta Medical College founded in 1835, and similar colleges at Bombay and Madras, and for a long time the licenciates and the graduates from the Medical Colleges were the only scientific men to be produced in this country. "In none of the existing educational institutions with the exception to some extent only of the medical schools", wrote Dr. Mahendra Lal Sircar about 1870, "is any provision to be found for the thorough and practical teaching of science". How truly the same could be said of the whole of India!

As to research in science, it simply did not exist. The Asiatic Society of Bengal, founded by Sir William Jones in 1784 had now been in existence for over one hundred years and had carried on a series of useful researches in India's past history, literature, language, culture, archaeology, ethnology, geology and some other field sciences. But the Society by its tradition and resources, was more suited for historical and cultural researches than for

research in natural sciences. Whatever investigations in geology and field sciences the Society was credited for were carried out, almost without exception, by the European members in the service of the Government or by the various Surveys established in different lines on the suggestion of the Asiatic Society of Bengal.

It was at this time that Dr. Mahendra Lal Sircar, a private and leading medical practitioner of Calcutta, was dreaming of a day when the scientists of India should not only collaborate, on the same footing, with the scientists of European countries in furthering the bounds of knowledge, but should apply scientific knowledge for the betterment of human life. His conviction grew as he dreamt, and he set upon himself the arduous task of preaching the gospel of science to his countrymen.

The Movement for the Science Association

The idea of founding a research institution with libraries and laboratories, where young Indians could be offered facilities for research was first advocated by Dr. Sircar in an article "On the desirability of a National Institution for the Cultivation of Sciences by the Natives of India", published in August 1869, in the *Calcutta Journal of Medicine*. In this memorable article, Dr. Sircar tried to rouse his countrymen to a sense of national dignity and self-reliance in matters of positive thinking and cultivation of sciences in which ancient India had once led the world, and put forward the proposal for a Science Association with the following objective:—

".....We want an Institution which will combine the character, the scope and objects of the Royal Institution of London and of the British Association for the Advancement of Science. We want an Institution which shall be for the instruction of the masses, where lectures on scientific subjects will be systematically delivered and not only illustrative experiments performed by the lecturers, but the audience should be invited and taught to perform them themselves. And we wish that the Institution be entirely under native management and control.....".

The Royal Institution of Great Britain, whose example inspired Dr. Sircar to set up a similar scientific institution for India, was founded on March 7, 1799, by Benjamin Thomson, Count Rumford. As expressed in the words of its founder, the Institution had for its first object the "bettering the condition and increasing the comforts of the poor...." by "forming by subscription, in the metropolis of the British Empire, a Public Institution for diffusing the knowledge and facilitating the general introduction of useful mechanical inventions and improvements and for teaching by courses of philosophical lectures and experiments the application of science to the common purposes of life". It was subsequently developed into a research

institution, though its primary objective of popularizing science through organization of lectures and demonstrations always forms a prominent feature of its activities. With Thomas Young, the exponent of the wave theory of light, as its first professor and the young Cornish chemist, Humphrey Davy, as a lecturer, the Institution embarked on its brilliant career of scientific discoveries and achievements. Here worked and lectured Faraday, Tyndall, Dewar, and William Bragg. If the Institution had a few parallels as a home of original research, it had certainly none in its effort to popularize science among the British people. It is said that the whole of London used to flock to the famous lecture theatre of Albemarle Street to hear Davy, Faraday and Tyndall, each, in his own time, unrivalled demonstrator, lecturer and expositor in science.

Dr. Sircar's article in the *Calcutta Journal of Medicine* and the proposal for a science institution roused considerable interest among the enlightened section of the public, and he published the following prospectus for the Institution in the *Hindoo Patriot* of January 3, 1870:

"1. The cultivation of Sciences by the Natives of India being deemed particularly desirable, it is proposed to establish in Calcutta an Institution for the purpose, to be called the Indian Association for the Cultivation of Science. This is to be the parent Institution—branches will be established in different parts of India according as time, necessity, and other circumstances will suggest.

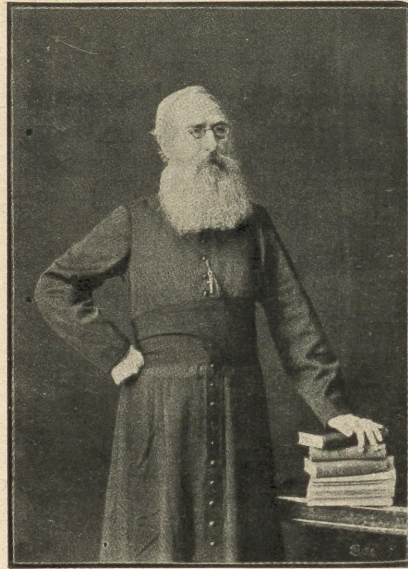
"2. The object of the Association will be, as its name indicates, to invite, encourage and enable the Natives of India to cultivate science in all its departments. A correlative object will be to rescue from oblivion whatever is connected with India, ancient or modern. Thus the Association will aim at editing and publishing the ancient records, so replete with interest and wisdom.

"3. The chief requisites to the formation of the Association being a local habitation, scientific works and instruments, and men able and willing to work, it is proposed to purchase a piece of land in Calcutta and to build a suitable house thereon; to purchase scientific instruments and standard works on the various branches of science; and to invite to join the Association men who are either already prosecuting their studies in especial departments, or who are just out from our educational institutions—ambitious, but unable from want of means, to prosecute scientific studies.

"For such and all these purposes money is the one thing needful. All well-wishers of Progress and of India are therefore solicited to contribute their quota in furtherance of the project which has been so feebly and imperfectly set forth".

Dr. Sircar devoted his whole energy in enlisting public support in favour of his proposal for the establishment of the research association and to the collection of funds for this purpose. The great cause

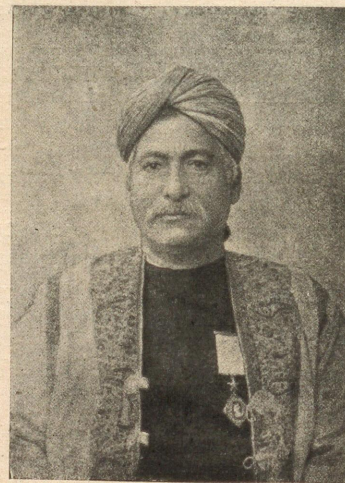
soon received strong support and encouragement from the leading educationists of Calcutta, including among others, Rev. Father E.



Rev. Fr. E. Lafont, S. J.

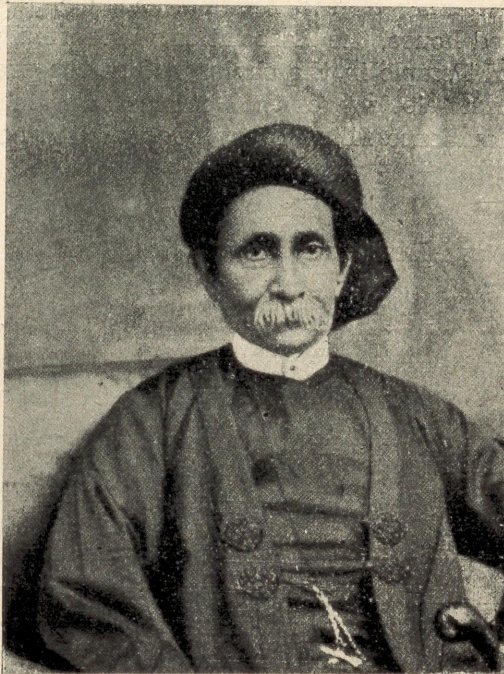
Lafont, Rector of St. Xavier's College, Pandit Iswar Chandra Vidyasagar, Raja Rajendralal Mitra, Rai Kristodas Pal Bahadur, Acharya Keshab Chandra Sen, Maharaja Sir Joteendra Mohan Tagore Bahadur, Moulvi Abdul Latif Khan Bahadur, Babu Joy Kissen Mookerjee and his son Raja Peary Mohan Mookerjee, Hon'ble Sir Ramesh Chandra Mitra, Justice Gcoroo Das Banerjee, Rai Kanailal Dey Bahadur and many others far too numerous to mention. Babu Joy Kissen Mookerjee was the first to have come forward with a donation of Rs. 1,000 which was soon followed by those from others.

Among the early subscribers to the general fund mention should be made of H. H. Maharaja of Patiala (Rs. 5,000), Maharani Swarnamayee (Rs. 8,000), Rai Annadaprosad Roy Bahadur of Kashimbazar (Rs. 4,500), Raja Kali Kissen Tagore (Rs. 2,500; he also contributed to the building fund, his total donation amounting to Rs. 32,750), Maharaja Joteendra Mohan Tagore Bahadur (Rs. 2,500), Raja Kamal Krishna Deb Bahadur (Rs. 2,000, in addition to Rs. 1,000 which he contributed for the Lecture Hall), Maharani Shyam Mohini (Rs. 2,000), Hon'ble Sir Ramesh Chandra Mitra, Kumar Purna Chandra Singh Bahadur and Kumar Kanti Chandra Singh Bahadur (Rs. 2,000 each). Besides rendering financial assistance, many of them took active interest in the Association and continued to do so as long as they lived. Raja Peary Mohan Mookerjee very actively associated himself with Dr. Sircar in the various phases of development of the Association and in pulling it through



Raja Peary Mohan Mookerjee

all its financial and other stresses. Later he served as its first non-official President when the Lieutenant-Governor of Bengal declined in 1912 to serve as its President, which was the earlier convention. Before this he served the Association as a Vice-President for a quarter of a century since its very foundation. He continued to conduct very efficiently the affairs of the Association as its President



Sir Gooroodas Banerjee

till death removed him from this world in 1923. Another very enthusiastic associate of Dr. Sircar was Sir Gooroodas Banerjee. He also was the Vice-President of the Association since its foundation until the last day of his life and took very lively interest in all its activities.

With the co-operation of such leading educationists and public-minded Rajas and Maharajas of India, Dr. Sircar was able to raise about Rs. 80,000 by the end of 1875 for his projected Association. The Government of the Province

also became convinced of the importance of such a research institution and thought fit to lend their support and encouragement to the cause. In his Minutes dated January 21, 1876, published in the *Calcutta Gazette* of February 23, Sir Richard Temple, then Lieutenant-Governor of Bengal, placed on record the deep appreciation by his Government of this effort to establish an Association for the Cultivation of Science and provided for the following aid:

“I propose, therefore, to take up an eligible building, with its premises, situated at the junction of College Street and Bowbazar, and to make it over unfinished to the Association for occupation free of all charge for a term of years, which would be settled separately in consultation with the Committee for the purposes as set forth on condition that at least Rs. 70,000 be actually obtained by donations of which at least Rs. 50,000 must be invested by the Committee in Government Securities and that a monthly subscription of at least Rs. 100 per mensem be promised for two years.....”.

Following this announcement, the Government purchased the premises No. 210, Bowbazar Street and made it over to the Committee of the Association. Unfortunately, the building was old and dilapidated and not very satisfactory for purposes of scientific lectures, and much less for carrying on scientific researches. But even then this Government aid, however inadequate for such great a cause as the sponsor had in view, came as a profound relief and led to the early establishment and functioning of the Association. On July 29, 1876, in the newly acquired house, the Association was formally inaugurated, with Sir Richard Temple in the chair, 'before the presence of the elite of the Calcutta Society, of the votaries of science in this town and a crowded audience filling every nook and corner of the house'.*

The New Building and Research Laboratories

Thus established, the Association immediately set to organize classes in sciences and purchased books and demonstration apparatus for lecture work. From the very beginning, the Association had the privilege of honorary services of such renowned teachers as Rev. Father E. Lafont and Rev. A. de Peneranda, both of St. Xavier's College, Babu Taraprasanna Roy, and of course Dr. Mahendra Lal Sircar,—all very ardent exponents of science. The lectures were attended by students of the Calcutta colleges, members of the Association, and by general public in increasing numbers. The small lecture room soon proved inadequate for the growing audience and the Committee of Management keenly felt the need of a large lecture hall spacious enough to accommodate about 500 men. Meanwhile a small nucleus of a laboratory in physics and chemistry was formed with the aid of the munificent donation of Rs. 25,000 by Raja Kali Kissen Tagore. From modern standards the laboratory may seem modest enough, but still it was perhaps the largest and richest of its kind then in India, as in the seventies and eighties of the last century even such a laboratory was quite unknown in an educational institution.

In spite of these developments, the need for a new lecture hall and building for the laboratories grew and became insistent. A representation was made to the Government for permanent possession of the house and on Government approval the house was purchased for Rs. 30,000. Fresh appeals were issued for a building fund, to which the generous public responded, and before long a sum of Rs. 30,000 was promised. The principal donors were H.H. the Maharaja of Durbhanga (Rs. 5,000), Kumar Indra Chandra Singh

* Hindoo Patriot.

Bahadur of Paikpara (Rs. 5,000), Raja Kali Kissen Tagore (Rs. 5,000), Maharaja of Bettiah (Rs. 3,617 and odd), H. H. the Maharaja of Kashmere (Rs. 3,000), Babu Akshoy Kumar Dutt (Rs. 3,050) and Kumar Sarat Chandra Singh Bahadur (Rs. 2,000).

New donations also poured in, and the Gaikwar of Baroda and several others contributed to the fund. Special mention, however,



H.H. Maharaja of Vizianagram

should be made of the munificent donation of Rs. 40,000 from H.H. the late Maharaja of Vizianagram for laboratory buildings. The donation from the Maharaja of Vizianagram has an interesting history. Dr. Mahendra Lal Sircar cured the Maharaja of some painful disease and instead of accepting a large fee running into nearly five figures, asked him to give a suitable endowment to his favourite Association, whereupon the donation followed. The hall of the Association is named *Vizianagram Hall* in grateful acknowledgment of this gift.

Thus, public munificence, Government patronage, and above all, the unsparing efforts of Dr. Mahendra Lal

Sircar combined to bring into existence seventy-two years ago the oldest scientific research institution in India. Firmly secured in its new buildings, the Association now rightly looked forward to a future of great scientific activity. But even at this stage the Founder had the foresight to realize that his efforts to see the Association function as a full-fledged research institution were doomed to failure until he had succeeded in creating endowed professorships and paid posts for research workers. He strongly believed that sustained work in research could not be expected from anybody, however enthusiastic he might be, if he was not freed from worries and his basic wants. From the very beginning of the Science Association movement, he had seized every opportunity to bring home to his countrymen the urgent need for the creation of paid posts for research workers. But

in spite of his repeated appeals, the funds of the Association continued to remain insufficient for any such purposes.

Now that the building problem was solved and the good work of the Association in respect of teaching and popularization of science was widely recognized, Dr. Sircar turned his whole attention to collecting funds for endowed chairs and paid research posts, and succeeded, after hard persuasions, in establishing three endowment funds, each for instituting a professorship.* Among the principal donors to these funds may be mentioned the names of Sir Gooroodas Banerjee, Babu Ganesh Chunder Chunder, H.H. Maharaja Shivajee Rao Ho'kar, and Maharaja Benoy Krishna Deb Bahadur. A notable contribution was that of the Maharaja of Coochbehar who came



H.H. Maharaja of Cooch Behar

forward with a donation of Rs. 100/- a month, starting from April 1890, and the subscriptions were continued till the death of the Maharaja in April 1923. The donation was utilized at the beginning for paying the remunerations of the Coochbehar Lecturers in Chemistry; later, the donations were funded as the Coochbehar Professorship Fund. But the positions of these funds, even at the time of the Founder's death in 1904, were so deplorable that, taken together, they did not permit the creation of a single professorship. Dr. Sircar deeply regretted the inability of his countrymen to endow, within his life time, a single professorship in his favourite Association for which he lived, worked and died. At the Annual Meeting of the Association held on September 4, 1902, he observed:

* Ripon Professorship Fund (started in 1884), Hare Professorship Fund (1896), and Victoria Professorship Fund (1901). The total income for these Professorships is only Rs. 840/-per annum.

"I can only give expression to one feeling that has taken over-powering possession of me, and that is a feeling of regret at having wasted a life. I have failed in fulfilling a task which I had imposed upon myself, and for which I had solicited your co-operation . . .

"The co-operation that you have accorded me has not enabled me to endow a single professorship, though three have been started in succession . . .

"...If I had rigorously applied myself to the practice of my profession, I am sure I could have left as a legacy an amount of money equal to that I have succeeded in collecting over 30 years..... But the Institution thus founded after my death would not have been of a national character and would have been a belated Institution."

But the posterity knows that the life of the great Founder who was much ahead of his time could not have been better spent. He laid the foundation of science and of spirit of scientific research in India. A young generation was already rising before him, as he lay dying, to bear, and keep burning more resplendently, the torch of science he had kindled in the country he loved. Not long after his death (on the 23rd February 1904) his favourite Association was destined to become a foremost research institution, humming with life and research activity and attracting the attention and respect of the whole scientific world.



Dr. Amrita Lal Sircar

After his death, his son Dr. Amrita Lal Sircar succeeded him as the Honorary Secretary and carried on the work of the Association with great ability upto 1919. Great credit goes to him for allowing all the facilities of the laboratory of the Association, keeping it open at all hours, to Sir (then Mr.) C. V. Raman and thus making it possible for him to carry on original investigations in the midst of his duties in a Government post.

The necessity for creation of an endowed professorship,—which



Rai Bahadur Vehary Lal Mitra

the Founder had strived hard to meet—was more and more keenly felt as the research activities of the Association grew. It was in 1934 that one such professorship, named after the Founder as the 'Mahendra Lal Sircar Professorship', could be established with the accumulated funds of the Association, the collections of the Mahendra Lal Sircar Memorial Fund, and a munificent donation of Rs. 1,00,000 from Rai Bahadur Vehary Lal Mitra. A cherished dream of the Founder was thus realized.

PART II

TEACHING, RESEARCH AND SCIENTIFIC PUBLICATIONS

Early Teaching Activities

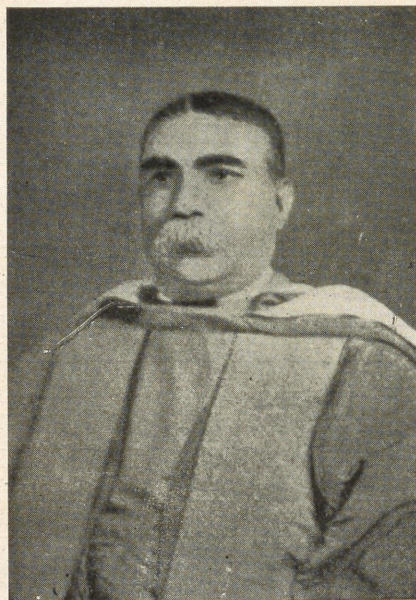
During the early days, the activities of the Association were mainly confined to the dissemination of scientific knowledge through popular lectures arranged with the co-operation of well-known local scientists. A programme of research could not be initiated right from the beginning, owing partly to the inadequacy of funds for necessary equipments and partly to the scarcity of trained and able people for research work. It was, therefore, thought more advisable—and rightly too—to take up the task of educating the people in the latest developments of science and making them familiar with the methods of experimentations.

Dr. Sircar himself first started delivering regularly illustrated popular lectures on physics, and soon Father Lafont joined him in this selfless task. Later Dr. Taraprasanna Roy began to deliver similar lectures on chemistry. These lectures attracted a fairly large audience which gradually grew in size and numbered 300 in 1886, including some ladies. It was then possible to secure the co-operation of a few more well-known scientists and the number of honorary lecturers was thus increased. With their help it was possible to arrange for popular lectures on topics not only in physics and chemistry, but also in geology, applied mathematics, biology and botany. Among these honorary lecturers who spared their valuable time for this noble cause were included Sir Jagadish Chandra Bose,



Sir Jagadish Chandra Bose

Sir Asutosh Mookerjee and Sir Nilratan Sircar. Names of others deserving special mention are Mr. Chuni Lal Bose, Chemical Examiner, Government of Bengal, Dr. Rajani Kanta Sen and Mr. Ram Chandra Datta in chemistry, Mr. Mahendra Nath Ray and Mr. Syamadas Mukherjee in applied mathematics, Mr. Pramath Nath Bose, discoverer of the Gorumahisani iron deposits and indirect promoter of the great Tata Iron and Steel Works, in geology, Mr. B. L. Choudhury in biology, Dr. Amrita Lal Sircar in physics and Mr. Giris Chandra Bose in botany. A few years later the Association arranged for regular classes in botany, physics and chemistry for the I. Sc. students.



Sir Asutosh Mookerjee

The ultimate aim of developing the Association into a research institution was, however, never lost sight of. So, when by 1904, the Calcutta University introduced separate science degrees and the various colleges undertook conducting practical classes in science, the Association gradually discontinued its programme of regular science teaching and devoted more and more to research. Periodical public lectures on popular scientific subjects, however, still continued to be delivered by eminent scientists, and this feature has persisted even to this day. Great scientists from different parts of the world have been occasionally invited to deliver courses of lectures on the latest developments in the subjects of their special interest. These lectures are generally published and made available to a much wider range of students of science.

Beginnings of Research Activities

We have already referred to the difficulties in undertaking research programme during the early stage of the Association. Failure to secure the services of whole-time research workers for want of paid posts and the limited resources of the laboratory long prevented the Association from developing into a research institution, and during the first thirty years of its existence the Association had indeed very little record of original scientific investigations carried out in its laboratories. With the turn of the century, the spirit of research began to be gradually visible among those con-

nected with the Association. In 1902, Dr. Sarasilal Sircar, then Assistant Chemical Examiner to the Government of Bengal, carried out some interesting investigations on crystalline copper ferrocyanide. In 1906, the Association undertook another important programme; it started recording meteorological observations twice daily and published them in the daily newspapers. This practice was continued for a long time. Another early scientific activity was the routine chemical analysis of foodstuffs and other articles, under the guidance of late Dr. Chunilal Bose. Some chemical problems were also investigated by Dr. Rasik Lal Dutta and two research scholars of the Association, Mr. Manindra Nath Banerjee and Mr. Jagadindra Nath Lahiri.

Prof. Raman and his pupils

In 1907, the course of events in the Association took a momentous turn. Mr. (now Sir) C. V. Raman, then an officer in the Finance Department of the Government of India, was attracted by the activities of the Association and started some experimental investigations in acoustics in its laboratories. Under the inspiration of Raman, the Association entered into a new period of continued and intensive research activities and developed into an active and leading research institution in the East, in fulfilment of the long cherished dream of its departed Founder.

Chandrasekhar Venkata Raman (born 1887) had been a student of physics of the University of Madras, where he had a uniformly brilliant academic career. While still a student he gave promise of originality in thinking and investigation, and is known to have carried out some researches in acoustics. The Government of his Province, however, did not consider him suitable for any post higher than one in the Subordinate Educational Service, and he was actually offered one in the said department. Raman refused



Prof. C. V. Raman

this and like many other brilliant students, successfully competed for the Indian Finance Examination. He was stationed in Calcutta, but soon developed a great dislike for the dull routine work of his department. He planned to carry on in his spare time the researches he had begun in his early life and decided to join the Association.

In 1907, Raman was elected a member of the Association (next year a life member) and was permitted to carry on his investigations as a regular part-time honorary research worker. Although he could devote very little time to his investigations after attending to his duties in the office, and the facilities available in the laboratory of the Association were far from satisfactory, he was able, in course of a few years, to publish a fairly large number of original papers on acoustical problems in foreign scientific journals. These papers attracted the attention of the physicists of Europe and America, and students and young research workers began to flock to the Association to work under him.

The acoustical problems investigated by Raman during the early years (1912-1920) of his research at the Association include maintenance of vibration by variable spring, maintenance of combinational vibrations, motion in a periodic field of force, motion of bowed strings, vibration on bowed stringed instruments of violin family, partial tones in bowed strings, 'Wolfnote' in violin and other stringed instruments, alteration of tone by violin-'mute', 'wolfnote' in pizzicate playing, whispering gallery, Indian stringed instruments, mechanically played violin and forced vibrations of strings. Investigations dealing with discontinuous wave motion and the nature of aerial wave generated by impact were also undertaken. Among his early collaborators in acoustical problems may be mentioned the names of Mr. A. Dey, Dr. B. N. Banerjee, Dr. S. K. Banerji who rose to be Director General of Observatories, Dr. R. N. Ghosh, the late Dr. P. Das, and Mr. M. N. Mitra.

Joint Research Activity of the Association and the newly established University College of Science

The research activities of the Association received further impetus in 1917, when Mr. C. V. Raman, on the invitation of Sir Asutosh Mookerjee joined the Calcutta University as Palit Professor of Physics. The Palit Professorship was created through the munificence of Sir Tarak Nath Palit, a leading barrister of Calcutta, who gave his life's saving amounting to nearly 3 million rupees to the cause of science. But the College of Science at 92 Upper Circular Road had no laboratory yet, and the authorities of the Calcutta University were far-sighted enough not only to permit

Prof. Raman to continue his researches at the Association, but also to allow him to borrow apparatus bought with the grants of the University and set them up at the laboratories of the Association.

Prof. Raman was thus provided with the combined facilities and resources of the Palit Laboratory and of the Laboratories of the Association. Even some of the Palit research scholars carried out their investigations at the Association in order that Prof. Raman could supervise more conveniently the work carried out by them as well as that of the research scholars of the Association. By this time, owing to the munificence of Kumar Sri Panchanan Mookerjee of Uttarpara, grandson of Raja Peary Mohan Mookerjee, two research scholars could be appointed by the Association to assist Prof. Raman in his investigations. Thus the number of whole-time research workers increased and the Association developed into a great centre of research in Physics.

In 1921, Prof. Raman undertook a research tour in Europe and America, and in recognition of his services in founding a research school in physics, he was elected to the Fellowship of the Royal Society of London in 1924. At this stage, the Government of India also realized the importance of the work done at the Association and sanctioned an annual grant of Rs. 10,000 as contribution towards the research expenses in 1926, which was increased to Rs. 20,000 in 1927 partly through the influence of Sir R. N. Mookerjee, who was then the President of the Association.

With such increased resources and facilities of research, Prof. Raman now extended his sphere of investigations into the field of optics, X-rays and magnetism. Thus problems relating to (1) Interference and Diffraction of light, (2) Rayleigh-scattering, (3) Birefringence due to electric and magnetic fields, viscous flow and stress, (4) Magnetic susceptibilities of gases, liquids and solids, and (5) X-ray diffraction in liquids and solids were all investigated about this time. His investigations on light-scattering led in 1928 to the discovery of a new phenomenon known after him as the **Raman Effect**. A brief account of these investigation for which the fame of the Association spread far and wide appears in what follows.

Interference and diffraction of light

In optics, Prof. Raman and his collaborators including Drs. N. M. Basu (now Professor of Mathematics, Dacca University), P. N. Ghosh, B. N. Banerjee, N. K. Sethi, K. S. Rao and B. B. Ray undertook a series of investigations on interference and diffraction of light. Some of the important problems under this head include the

diffraction of light by cylinders of large radius, diffraction figures due to an elliptic aperture, diffraction by straight metallic edges, colours of striations in mica plates, lamellar diffraction in mica, Powell's and Talbot's bands, Quetelet's rings, scattering of light by liquid droplets, the problems of coronas, glories and iridescent clouds and similar other interference phenomena.

Rayleigh scattering

Sir C. V. Raman's first work on light-scattering was a note in *Nature* on the Doppler effect in the molecular scattering of light. Subsequently he published several such notes dealing respectively with smoky quartz, colour of the sea, molecular scattering of light in crystals, molecular scattering in liquids, opalescence phenomena in liquid mixtures, thermal opalescence in crystals and the ice glaciers, the scattering of light by anisotropic molecules, by liquid and solid surfaces and structures of molecules in relation to their optical anisotropy and other topics. He also published a few papers dealing with scattering of light in the refractive medium of the eye, light scattering in water and its bearing on the colour of the sea, and light-scattering in amorphous solids and binary liquid mixtures.

Under his guidance Dr. B. B. Ray investigated the scattering of light by sulphur suspensions. A theory of light-scattering taking into account the anisotropy of the polarizing field of neighbouring molecules, was developed by Prof. Raman and Dr. K. S. Krishnan. They also made important contributions to the understanding of various optical and electrical properties of liquids. Dr. L. A. Ramdas working under Sir C. V. Raman investigated very extensively the scattering of light by liquid and solid surfaces and by gaseous mixtures at high pressures. Prof. Raman and Mr. K. S. Rao studied the problem of extinction of light in liquids and determination of the Avogadro constant. These two authors also studied the polarization of light scattered by gases and vapours.

Special mention should be made of the work of Dr. K. R. Ramanathan who investigated light-scattering in liquid mixtures, polarization of light scattered by some organic vapours and the structure of molecules in relation to their anisotropy. He investigated the electro-magnetic theory of scattering of light in fluids and discussed the problem of fluctuation of dielectric constant in liquids in the theories of scattering of light. Dr. I. Ramakrishna Rao investigated into the optical anisotropy of molecules from the experimental studies of the polarization of scattered light.

There were also other important workers in this branch of physics. The investigations of Dr. N. K. Sur on the light-scattering

by smoky quartz, of Dr. A. S. Ganesan in oblique scattering of light in gases and liquids and the polarization of light scattered by organic vapours, of Dr. S. Venkateswaran on the molecular scattering of light in aqueous solutions and polarization of light-scattering in liquids, and of Dr. C. M. Sogani on the optical properties of chromatic emulsions, contributed significantly to our knowledge about the scattering of light and allied phenomena.

This list is far from complete, but is sufficient to indicate the thoroughness with which Prof. Raman and his Calcutta School organized research in the various aspects of scattering of light and related problems. As a matter of fact, the Association had at that time very few rivals even outside India, in the matter of research in optical scattering and was acknowledged to be one of the best centres of research in this subject in the whole world.

Messrs. Rama Chandra Rao, M. N. Mitra, A. N. Banerjee, Kameswar Rao and D. Banerjee also carried out useful work and published papers on light scattering.

Birefringence due to Electric and Magnetic fields, Viscous flow and Stress

In collaboration with Dr. K. S. Krishnan, Sir C. V. Raman discussed the theory of electric double refraction (Kerr effect) in liquids with special reference to the relative contributions of electric polarity and optical anisotropy to this effect and also the theory of mechanical birefringence in liquids. They started experimental investigation on magnetic double refraction with the help of a large electromagnet constructed in the workshop of the Association and studied the phenomenon in benzene and its derivatives and calculated the magnetic anisotropy of benzene molecule from its structure. Sir C. V. Raman and Dr. I. R. Rao and later Dr. Chinchalkar observed magnetic birefringence in aliphatic hydrocarbons, water, alcohols and a number of other compounds.

Dr. K. Banerjee studied the double refraction produced by stress in isotropic solids in relation to their internal atomic arrangements.

Magnetic susceptibilities of gases, liquids and solids.

Dr. V. I. Vaidyanathan developed a sensitive apparatus for the measurement of magnetic susceptibilities of gases with which he investigated the diamagnetic susceptibilities of a few gases and vapours.

Dr. S. Bhagavantam studied the magnetic susceptibility of naphthalene and anthracene crystals and pointed out definitely that the structure of these crystals, determined previously by Sir William Bragg from results of X-ray analysis, could not explain the results of magnetic investigations obtained by him. Mr. Paramasivan discovered a remarkable anisotropy in magnetic susceptibilities of graphite and Dr. Ramachandra Rao found that the susceptibilities depended on the particle size.

In collaboration with Dr. K. R. Ramanathan he put forward a theory of diffraction of X-rays in liquids and amorphous solids. The experimental investigations to verify the theory were first carried out by Dr. C. M. Sogani. Dr. Krishnamurti found a correlation between the diffraction due to some powdered crystalline organic compounds and by those of the same substances in the liquid state.

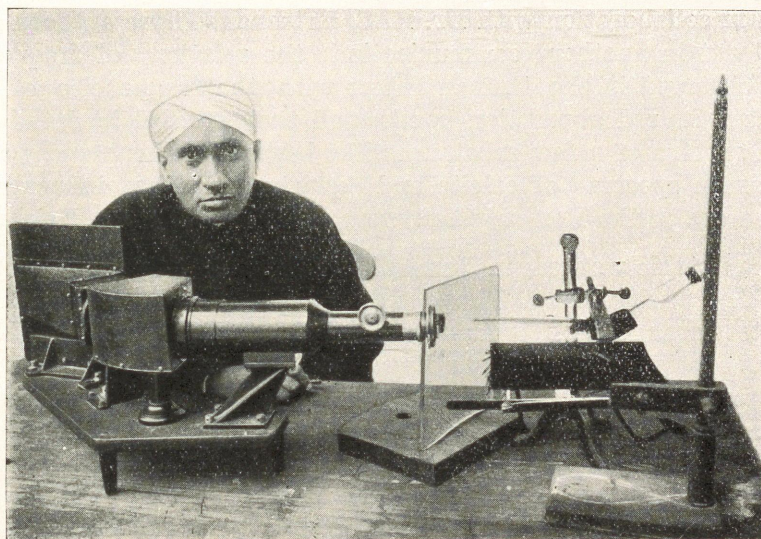
The theory of Raman and Ramanathan was extended by Dr. K. Banerjee by taking into consideration the intermolecular forces; thus the correlation between the liquid and solid patterns observed by Dr. Krishnamurti could be explained. The phase diagram of the liquid alloy of sodium and potassium was also studied by Dr. Banerjee by means of X-ray diffraction.

Important investigations on the structure of solids by X-rays have also been carried out in this laboratory. Of particular interest are the structures of naphthalene and anthracene determined by Dr. Banerjee. These structures were different from those found previously by Sir William Bragg who later accepted the structures determined by Dr. Banerjee as correct ones and thus removed the difficulties of explaining the results obtained by Dr. Bhagavantam in his investigations on magnetic susceptibilities of these crystals. Mr. J. Dhar also completely analysed the structures of diphenyl and dibenzyl. Dr. C. Mahadevan did pioneering work in applying X-rays to the study of coal.

Discovery of Raman Effect and Subsequent Work

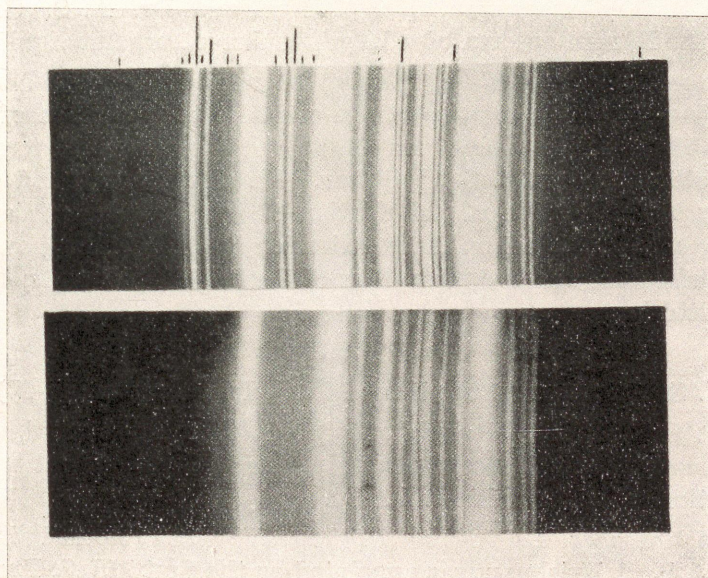
Prof. Raman's work in the scattering of light culminated in the discovery in 1928 of what is now universally known as the *Raman Effect* for which he was awarded the Nobel Prize in Physics for 1930. An account of the discovery of the Raman Effect was first published by Sir C. V. Raman in the *Indian Journal of Physics* in 1928. It was pointed out how the "weak fluorescence", which had been observed previously by the workers of the Association to persist even after careful distillation of the liquids, turned out to be

a scattered radiation with changed wave-length. The universality of the phenomenon was tested with complementary filters, but the



Prof. C. V. Raman with his Apparatus

spectral analysis of the light scattered by benzene was also made with the help of a very small Hilger quartz spectrograph. The first spectogram obtained by Sir C. V. Raman is reproduced below:



Discovery of Raman Effect
(from *Indian Journal of Physics*)

In the paper mentioned above, Sir C. V. Raman announced only the observed degradation of frequency in light scattering. The enhancement of the frequency in light scattering was later observed by him in collaboration with Dr. K. S. Krishnan. These authors also pointed out in another communication the relation of frequency shifts observed in the Raman Effect with the frequencies of the extreme infra red absorption bands, and they studied in detail the Raman spectra of a few substances like benzene, toluene and water. The Raman spectra of calcite and quartz and the influence of temperature on the Raman effect, were also studied by Dr. Krishnan.

The notable workers in Raman Effect at the Association include Dr. L. A. Ramdas, Dr. S. Bhagavantam, Dr. P. Krishnamurti, Dr. S. Venkateswaran, Dr. A. S. Ganesan and Dr. S. C. Sirkar. Dr. L. A. Ramdas observed some Raman lines in the case of ether vapour. Dr. Bhagavantam studied the Raman spectra of a number of elements and simple molecules in the liquid and solid states and the polarization of the Raman lines due to some of the liquids. He next turned his attention to gases and studied the Raman spectra of hydrogen, oxygen, nitrogen, carbon dioxide, hydrogen sulphide, etc., at high pressures and the polarization and intensities of the Raman lines in some of these cases.

Dr. P. Krishnamurti studied the Raman Effect in crystal powders. He also studied the hydrolytic dissociation and formation of hydrates by Raman Effect.

Dr. S. Venkateswaran, Mr. A. Karl and Dr. A. S. Ganesan studied the Raman spectra of a large number of organic liquids.

The measurement of the relative intensities of Stokes and anti-Stokes lines in the Raman spectrum and also the influence of ultra-violet absorption frequency on these relative intensities received special attention by Dr. S. C. Sirkar. He also investigated experimentally the dispersion of polarization of the Raman lines and the influence of electric field on the polarization of the Raman lines. Mr. J. Dhar studied the relative intensities of Rayleigh and Raman lines in light-scattering.

K. S. Krishnan as the First M.L.S. Professor (1934-42)

In 1933, Sir C. V. Raman accepted the Directorship of the Indian Institute of Science, Bangalore, but he kept contact with the Association as its President till 1934.

The *Mahendra Lal Sircar Professorship* was founded in 1934 and Prof. K. S. Krishnan was appointed as the first M.L.S. Professor. As a scholar at the Association he had collaborated with Prof. C. V. Raman in the discovery of the Raman Effect. In 1928 he accepted

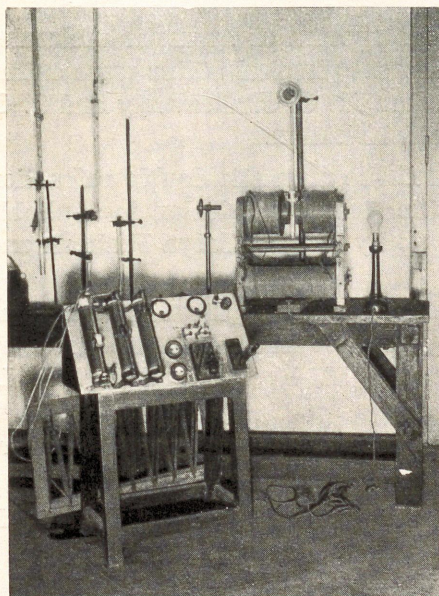
the post of Reader in Physics at the Dacca University and developed there a method for studying magne-crystalline action. After joining the Association as M.L.S. Professor, he continued this work in collaboration with his students. His own method of determination of the magnetic susceptibilities along different directions in the crystals, originally developed at Dacca, was improved at the Association, in collaboration with Dr. S. Banerjee and Dr. A. Bose. Jointly with these two authors and also with Mr. A. Mookherji he measured the magnetic susceptibilities and magnetic anisotropy of a large number of organic and inorganic crystals. These investigations guided many workers in their X-ray analysis of structures of some of these crystals, and soon attracted widespread attention.



Prof. K. S. Krishnan

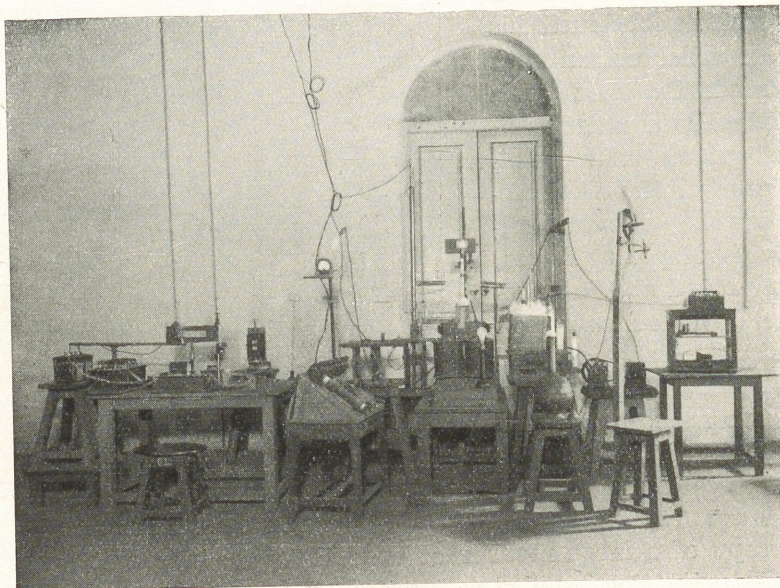
Their magnetic studies of paramagnetic crystals threw considerable light on the nature of the crystalline fields. Dr. A. Bose, Mr. A. Mookerji and Dr. B. C. Guha undertook extensive studies on salts of the iron group of elements and rare earths beginning from room temperature to that of liquid oxygen with the help of an ingenious cryostat devised by Dr. A. Bose.

Prof. Krishnan in collaboration with Mr. N. Ganguly carried out an investigation into the remarkable magnetic properties of graphite. They found that graphite possesses an extremely high anisotropy which



Prof. Krishnan's Apparatus for study of magne-crystalline action

is temperature-sensitive. The results yielded very clear conceptions regarding the electronic structures of semi-conductors. The investi-



Cryostat for Magnetic Studies at Low Temperatures

gations were extended to bismuth and antimony crystals by Mr. W. J. John, working in this laboratory.

The absorption and fluorescence spectra of aromatic molecules of special structural interest in different physical states were extensively studied by Messrs. P. K. Seshan, D. C. Chakravarty and S. C. Ganguly under the guidance of Prof. Krishnan.

Dr. S. W. Chinchalkar measured the magnetic double refraction of many organic compounds in the state of solution in suitable solvents. The work was followed up by Messrs. Satya Prakash and L. D. Mahajan.

Investigations for the determination of the structure of some organic and inorganic crystals by X-ray methods were made by Messrs J. Dhar and A. C. Guha, Dr. H. K. Pal and Mr. S. L. Chorghade.

The principal refractive indices of various organic crystals were determined by Messrs Sundararajan and Chorghade.

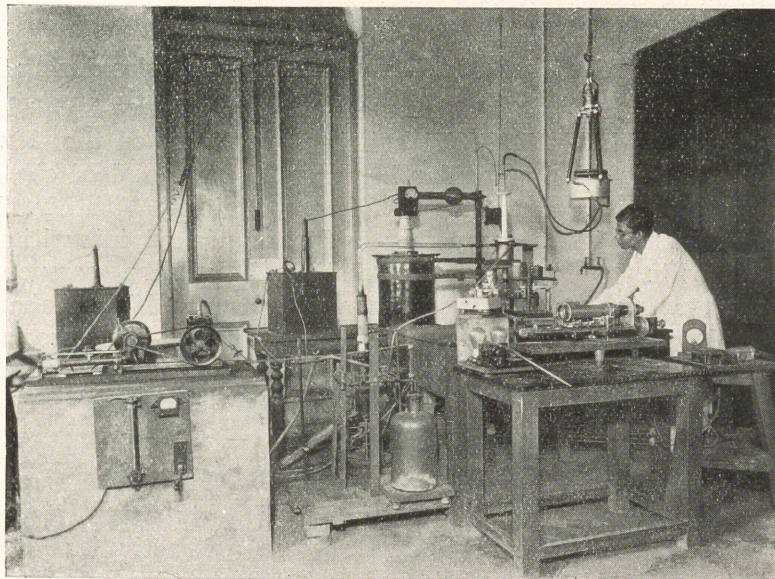
Raman effect of organic, inorganic and organo-metallic compounds were studied in detail by Mr. N. Gopal Pai.

In recognition of his work on magnetic anisotropy and crystalline structure, Prof. Krishnan was elected a Fellow of the Royal Society in 1940.

Prof. K. S. Krishnan left the services of the Association in 1942 on receiving a call to the Professorship of Physics at the Allahabad University. Even after he left the Association, Prof. Krishnan continued to be associated with it as a member of its Committee of Management (now known as its Council).

Research Work Under Prof. K. Banerjee as M. L. S. Professor during the period 1943-48

Before joining the Association as M. L. S. Professor, Dr. Banerjee had been carrying on X-ray analysis of crystal structure.



Apparatus for X-ray Analysis of Crystal Structure

The X-ray equipment of the Association has been considerably improved by him during this period, so that it has developed into a modern X-ray laboratory. During this period, owing to war-conditions most of the equipments required by him could not be purchased, and they had to be constructed in the workshop of the Association under his directions.

Very interesting results have been found from the investigations of Messrs. R. K. Sen and M. N. Datta, carried out under his guidance on the extra reflections from phloroglucine dihydrate and benzil crystals. The explanation of these phenomena offered by Dr. Banerjee resolves some of the difficulties in crystal dynamics. Investigations on the extra reflections from a number of other crystals have also been carried out by these workers. Messrs. B. K. Banerjee and B. S. Basak have obtained interesting results in their studies on glass and organic fibres with the help of X-rays.

Mr. S. C. Ganguly has investigated the fluorescence of a few aromatic compounds both in the solid state and in solutions. He has investigated the influence of the frequency of the exciting radiation as well as of the temperature on the fluorescence spectrum. He has also investigated the absorption spectra of these substances.

Mr. A. Dutta has studied the magnetic properties, electrical conductivity and Hall effect of semi-conductors in different crystallographic directions at various temperatures ranging from -180° C to 200° C and has obtained results which have been very useful in understanding the nature of semi-conductors.

Research work under Dr. S. C. Sirkar, Reader in Physics during 1943

Dr. S. C. Sirkar was appointed a Reader in Physics in 1943 and carried out with Mr. B. M. Bishui investigations on the Raman spectra of a few alkyl sulphides in the solid state and of ethylene dibromide and dichloroethylene in different states. With Mr. S. B. Sanyal he studied the temperature dependence of intensities of Raman lines in the case of a few substituted benzene compounds. He further carried out in collaboration with Messrs. N. N. Saha and R. M. Rudra an X-ray analysis of jute fibre. He left the Association by the end of 1943 and joined the War Department and has recently been appointed Professor of Optics in this Association.

Scientific Publications

The Association published Annual Reports from its very foundation. The early reports are records of activities of the Association and of lectures delivered by Dr. Mahendra Lal Sirkar as Secretary and by other members of the Committee of Management. These records are full of interest and information as to the state of scientific education and research then obtaining in India and will constitute an invaluable source for a history of scientific education and developments in India, if and when it comes to be written.

From 1906 the Association undertook to publish, as appendices to the Annual Reports, the records of meteorological observations and reports of the chemical analysis of the articles of general importance. In this way much useful scientific data received publicity at that time and have been preserved for future reference.

As research activities developed in the Association, the authorities keenly felt the need of a local scientific journal for prompt publication of the results of this work. At that time in India there was no medium for publication of original scientific papers of a general nature. The bulletins or reports of the Government scientific departments generally published survey types of work and were

very specialized in scope. So the scientific workers had to send their results to foreign journals for publication, which meant unnecessary delay apart from other inconveniences.

These considerations led the Association in 1909 to start publication of a series of special research bulletins containing results of investigations carried out at the Association. The first five bulletins were only reprints of publications in such important journals as *Philosophical Magazine*, *Physical Review* and *Nature*. From 1912, however, original papers and contributions, not published elsewhere, appeared in these bulletins. Before long these bulletins received widespread appreciation for the high standard of their communications, and their publication became a regular feature of the Association.

In 1914, a separate section designated as *Transactions of the Science Convention* was introduced in the Annual Reports. In this section were published proceedings of the scientific meetings at which original papers were read and discussed. At first, these meetings were few and the numbers of papers limited, so that a small separate section at the end of the Annual Reports proved quite sufficient for recording such activities. But with the increase in the volume of research work, the scientific meetings of the Association were organized more frequently, and larger number of papers came to be read and presented for discussion. The little space devoted to the "Transactions of the Science Convention" in the Annual Report now failed to cope with such increasingly large number of papers accumulating throughout the year, and necessity arose for a separate journal to be published at more frequent intervals. The **Proceedings of the Indian Association for the Cultivation of Science** thus came into publication. It is of interest to note that the first issue of the **Proceedings** appeared with a paper by Sir P. C. Ray, read at one of the scientific meetings of the Association, held on February 6, 1915.

Initially, most of the papers published in the **Proceedings** were local contributions, but its high standard soon appealed to scientific workers all over India, and it became the only scientific medium in the country for publication of research papers in all branches of sciences. As the research activities of the Association, under Prof. C. V. Raman, became more and more concentrated on physics, contributions on other sciences received for publication fell off rapidly, and the **Proceedings** turned out to all intents and purposes to be a journal of physical researches. In 1926, it was, therefore, decided to change the title of the journal to **Indian Journal of Physics and Proceedings of the Indian Association for the Cultivation of Science**.

The Indian Journal of Physics has so long been published bi-monthly; it has been converted into a monthly journal this year. It is recognised throughout the scientific world for its high standard and quality. Its present popularity is largely due to the unsparing efforts of the authorities of the Association and of thousands of scientific workers who have preferred this journal to foreign scientific periodicals as a medium of publication of their investigations. In this connection mention should be made of the very active co-operation and assistance of the Calcutta University which offered to publish the journal free of cost. Recently, the Journal received a grant from the Rockefeller Foundation, through the National Institute of Sciences of India. Despite such voluntary co-operation and help, the financial position of the journal has never been very happy, and more funds are needed for its further improvement.

PART III

DEVELOPMENT PLANS

The remarkable and striking achievements of science in recent years have completely revolutionized the traditional technique of scientific research. Until recently the development of science centred round individual workers each cloistered in his own laboratory and pursuing his favourite line of work. But scientific knowledge has grown to such an extent and the different methods of tackling a problem are so inter-related that though solitary workers can still be expected to make notable contributions to the cause of science, there are certain types of scientific investigations which require well-directed team work.

The Committee of Management of the IACS during the war-years of 1943-1946 realized the supreme need of re-organizing the activities of the Association so that it might play an increasingly important part in the domain of fundamental researches in Molecular Physics, a branch of science in which it has made a name and has a tradition to cherish. The Committee very rightly felt that it must not be satisfied with any plan of mere re-building and extension of the laboratory or of improvement of its equipment, but that the planning must recognise the new trends and tendencies of scientific research. The plan ultimately formulated by the Committee early in 1946 envisaged the creation of an active Research School where the problem of Molecular Structures would be investigated by the concerted team work of a band of physicists and chemists. The entire resources of the Association for fundamental researches in X-rays, Optics, Raman Effect and Magnetism would be fully utilized and the works in these fields would be supplemented, co-ordinated and blended with the works of a Theoretical Physicist, a Physical Chemist and a specialist in Optics, and with the researches of an Organic and an Inorganic Chemist in the field of Structural Chemistry. In fact, the plan is for a more intensive and unified study of problems which the Association has set as its goal almost from its inception, and this is sought to be done by starting the five new Departments referred to above.

Our statesmen and scientists have begun to realize that if India is to take her rightful place in the Assembly of Nations it is highly necessary for her to undertake an intensive programme of simul-

taneous and co-ordinated development of both fundamental and applied research. It is now recognised that such researches alone can ensure the security of a country in war and its prosperity in peace. It is hoped that India will inaugurate a new era where fundamental and industrial researches will be harnessed for the service of her people.

The Committee of Management of the IACS has kept it in view that the future programme of work of the Association must necessarily be planned in consonance with the general plan of research enterprise in India, and the scope and functions of its line of researches should be such that the results achieved would find application in the study of subjects of technical importance. For the present the Committee has chosen to concentrate on investigations in the physics and chemistry of High Polymers.

This subject has attained enormous scientific and industrial importance during the last 25 years. Next to Atomic Energy this is to-day receiving the greatest attention of chemists and physicists of Europe and America, but unfortunately it has not yet attracted sufficient attention in our country. High polymers include such diverse substances like Rayon and Nylon; synthetic rubber and gutta percha; nitro-cellulose lacquers, varnishes and adhesives; and Plastics. Synthetic products like Nylon bid fair to eclipse all old established fibre industries; synthetic rubber has already become a major war and peace-time material; and plastics have found such wide applications that it is truly said that from the age of steel we are fast passing into an age of plastics. Industrial India of the future will have to develop these industries on her own.

The IACS with its equipments and resources, and its proposed personnel and experience, will be one of the Institutes best fitted to undertake pure and applied researches in this subject. The studies of its Departments of Chemistry would be helpful in understanding the chemistry of polycondensation and polymerisation in all its aspects and in utilizing this knowledge for industrial application in our country; while the researches of the different Departments of Physics would supply data regarding the optical, electrical and thermal properties of the products, and help to throw light on the internal structure and valence forces responsible for polymer formation.

ADMINISTRATION, STAFF, BUILDING AND EQUIPMENT **Administration**

The general administration of the Association, according to the new Rules which have been approved by the Government of India, is

vested in the Life Members, Ordinary Members, and Members of other categories, whose general direction and advice is sought through a General Meeting of the Association which is usually summoned once a year, but may be summoned at any time for specified, extraordinary reasons.

Under the new regulations, the scope of membership has been widened, enabling provincial governments, city corporations, and industrial firms to be associated actively with the development and administration of the Association.* It is hoped that these new avenues will be exploited by the parties concerned.

The actual administration is vested in a Council of 22-28 members, of whom 12 are elected by the general body of members, 4 are nominated by the Government of India (Ministry of Education) including two nominees of the National Institute of Sciences of India, and up to 5 members are elected by Donors and Subscribers. 10 members of the Council must retire every year. The Office-bearers of the Association are the President and 2 Vice-Presidents.

Between the meetings of the Council, the administration will be carried on—in special cases, in consultation with the President—by the Director who will generally be a whole-time, salaried officer of the Association.

The financial affairs of the Association are looked after by the Finance Committee of the Council, and by a body of 5 Trustees, elected for life by the Association.

Personnel of the Staff.

The Research Departments proposed are:

- (1) X-Rays & Magnetism
- (2) Optics
- (3) Theoretical Physics
- (4) Physical Chemistry
- (5) Organic Chemistry
- (6) Inorganic Chemistry—each under a Professor or Reader.

To assist the Professor or Reader in each department there would initially be:

one Research Officer, one Laboratory Technician, one Senior Research Scholar and two Junior Research Scholars;

but the personnel will have to be increased in near future. In addition to these, necessary technical staff would be provided for the

*Any association or corporate body will, on payment of a sum of not less than Rs. 2,500/., enjoy the rights of Life Membership. And further, each association or corporate body or person making a donation of Rs. 2 lakhs, or subscribing a sum of not less than Rs. 10,000 annually, shall have the further right of electing one nominee to the Council of the Association; provided that—in the event of the number of members so eligible exceeding five, a Donors' Constituency shall be formed with all such donors to elect five nominees to the Council.

laboratories, workshop, glass-blowing, gas production, and auxiliary services of the laboratory, details of which have been worked out by the Council.

In order to ensure co-ordination of work of the different departments, the Professors will be required to meet at least once every month, under the chairmanship of the Director.

To meet the growing needs of the newly-created Departments, the library will also have to be expanded with a larger range of periodicals and standard books of reference.

The administrative work will increase to a considerable extent, and a Registrar has been appointed to look after routine administrative work under the supervision of the Director. Under the new Constitution, he is the *ex-officio* Secretary of the Association, its Council and all its committees.

Site

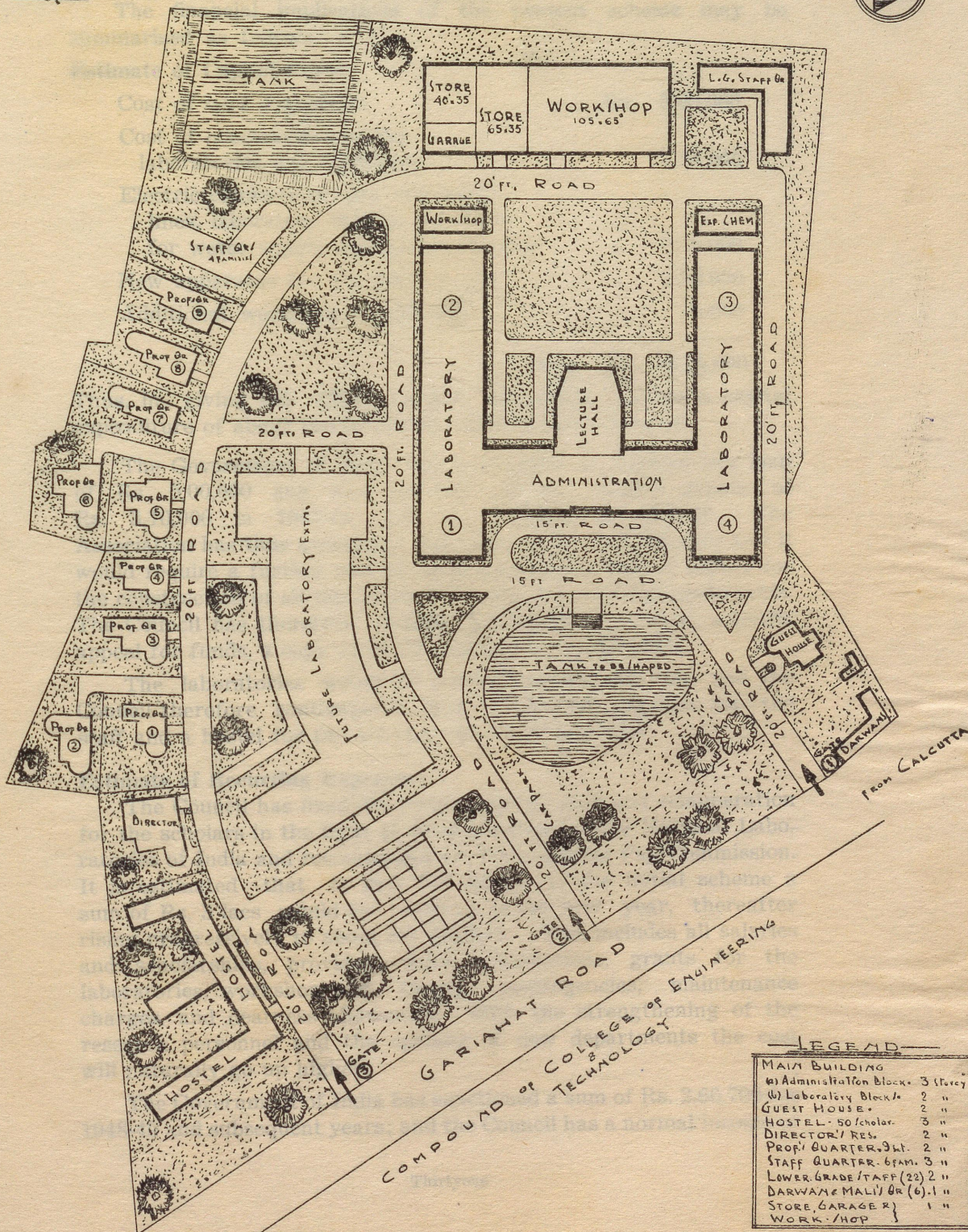
The Association being at present housed in a crowded locality in Calcutta, schemes of expansion are difficult to carry out. It is therefore contemplated to sell out the present land and building and to shift to a quieter part where land sufficient for the full development of the Association is available for a modest price. The Council has been able to acquire, through the good offices of the Bengal Government, a plot of land covering nearly 29 bighas at Jadavpur. The land adjoins the buildings of the College of Engineering and Technology, Bengal, and that of the Central Glass and Ceramic Research Institute (under C.S.I.R.). The Association will thus have neighbours most intimately interested in researches of an applied type.

The lay-out map of our new home attached to this brochure shows the tentative plans for all the buildings. The completion of the project will take a long time, but for the present the Council is taking up the construction of the main laboratory building which is to be a partly three-storied and partly two-storied structure with a total built-up area of 80,000 sq. ft. It is being so planned that there will be ample scope for future extensions without impairing the architectural harmony of the structure. The building will incorporate recent ideas of laboratory construction and laboratory services, and will provide accommodation for all the laboratories, library and meeting halls, and for an athenæum.

PROPOSED RESEARCH LABORATORY AT JADAVPUR

FOR INDIAN ASSOCIATION FOR THE CULTIVATION OF SCIENCE

SCALE 0 50 100 150 200 250 FT.



LEGEND

MAIN BUILDING	
(a) Administration Block	3 Storey
(b) Laboratory Block	2 "
GUEST HOUSE - 2 "	
HOSTEL - 50 Scholar - 3 "	
DIRECTOR'S RES. - 2 "	
PROF. QUARTER - 9 hts. - 2 "	
STAFF QUARTER - 6 fam. - 3 "	
LOWER GRADE STAFF (23) - 2 "	
DARWANG MALI'S QRS (6) - 1 "	
STORE, GARAGE } 1 "	
WORKSHOP }	

DRAWN BY: B.M.C.
DATE: 22.48

DRAWING NO: 21-45-1

- LAY-OUT PLAN -

CHAUDHURI & GUHA
CIVIL ENGINEER - ARCHITECT

FINANCIAL IMPLICATIONS OF THE SCHEME

The financial implications of the present scheme may be summarised as follows:—

Estimate of Capital Costs:

Cost of land acquisition	..	Rs. 5,00,000
Cost of construction of the laboratories and workshop	..	„ 17,00,000
Electric connections, gas and water lines, laboratory fittings, provision for water supply and gas production	..	„ 5,00,000
New apparatus for the laboratories	..	„ 2,50,000
Additional workshop equipments	..	„ 75,000
		<hr/>
	Total	Rs. 30,25,000

Thus, in giving full effect to the immediate scheme a capital expenditure of about thirty lacs of rupees will be involved.

The Government of India has sanctioned an interest-free loan of Rs. 5,00,000 and has provided further capital grants of Rs. 3,10,000 in 1947-48 and Rs. 1,22,000 in 1948-49. The Association has thus available a total sum of Rs. 9,32,000 only and it would require a further sum of about twenty-one lacs of rupees for the construction of all the laboratories and for their full equipments. The Council has therefore thought it necessary to issue a public appeal for funds, a copy of which is given in the appendix.

The laboratories would be located outside the city and the Council therefore contemplates that residential quarters for the staff and a hostel for the scholars should be provided.

Estimate of Recurring Expenses:

The Council has fixed the salaries of the staff and remuneration for the scholars in the light of those adopted for the National Laboratories of India and recommendation of the Central Pay Commission. It is estimated that to give full effect to the initial scheme a sum of Rs. 3 lacs would be required in the first year, thereafter rising progressively to about Rs. 4.3 lacs. This includes all salaries and scholarships, provident fund contributions, grants for the laboratories, workshop and library, contingencies, maintenance charges, and dearness allowances. With the strengthening of the research personnel and the opening of new departments the cost will naturally go up higher.

The Government of India has sanctioned a sum of Rs. 2,66,700 for 1948-49 and subsequent years; and the Council has a normal income of

about Rs. 17,000 only per annum from endowments etc., which can be utilised for the establishment. Thus the amount available to the Association falls far below its requirements, and the Council appeals to the Government and the generous public for funds to meet the deficit in the capital expenditure, and for adequate endowments or annual grants on a permanent basis.

Research departments in the Universities and Research Institutes like the IACS are national assets, and as such, they have a legitimate claim on the national income. In fact, research expenditure has already assumed a significant proportion of the national expenditure in western countries. It is encouraging to note that the Government of India has recognised the utility of such expenditures in starting and maintaining several National Research Institutes and subsidizing Research Associations. It is high time that our industrialists should also utilize these Research Associations to their advantage. The Indian industrialists will now have to face a ruthlessly competitive world and it would be a mistaken policy to depend for their success upon tariff protection, abundance of raw materials, cheapness of labour and other similar factors. They must move forward and find out ways and means for increasing application of the results of pure research in a constant endeavour to improve their products. Not every commercial concern can, however, maintain adequately equipped and properly staffed research laboratories; and Research Associations could be of immense benefit to them.

The Council of the IACS has planned that the Association would also undertake both short-time and long-range research problems on the Industrial Fellowship basis. Such Fellowships can be created by individual industrial concerns or by associations of manufacturers. The Mellon Institute of Industrial Research in the U.S.A. provides a parallel of a private organization of research workers where this system of Industrial Fellowship has worked very satisfactorily. The following excerpt from an annual report of the Institute will convey an idea as to how the system works:—

“The Institute provides laboratory, library, and consultative facilities, the use of its permanent research equipment, direction to the progress of the work, and an atmosphere which is conducive to productive investigation. Each Industrial Fellowship is a case of trust, and knowledge concerning its progress and subject matter is withheld from the public, if the donor so desires..... Further, the knowledge gained by one Industrial Fellow along one investigational line becomes available to another research man, provided that such co-operation violates no trust.

Reports are placed in the archives of the Institute to be released for publication at such a time as will not injure the interests of the donor. No

scientific or technical papers are prepared for publication without the consent and approval of the donor concerned.....”

“The donor, on his part, provides a foundation sum which is adequate to cover the annual cost of maintenance of the Industrial Fellowship, which includes operating charges, the purchase of all necessary special apparatus or other equipment, and the salary of the research man or men selected to work on the particular problem.....”

In 1911-12 the number of such Fellowships in this single Institute was 11, the number of Fellows 24, and research expenditure £39,700; whereas, in 1946-47 the corresponding figures were 80, 295, and £6,67,817,—which reflects the growth, popularity and serviceability of the system. The Council of the IACS hopes that our industrialists will also adopt this system with benefit to themselves and to the cause of a healthy growth of science in our country. Calcutta being the biggest industrial centre in India, the institution of Industrial Fellowships is expected to meet with large response.

RESUME

The history of the Indian Association for the Cultivation of Science is the story of a group of persons whose visions were far in advance of their times and who dedicated their lives for the scientific advancement of their country. At a time when there was no arrangement for scientific instruction anywhere in India, they founded the Association to spread scientific knowledge among the people and to train up scientists who later disseminated far and wide the knowledge acquired by them. The Association demonstrated that high class scientific discoveries of international importance are possible in India as well. Under great difficulties of every description the Association inspired, nourished and fostered this spirit of research and thus led the way to the establishment of other research institutions and research centres under the Science Faculties of the Universities. By publishing a scientific journal of a high standard it encouraged further research activities. It has produced two Fellows of the Royal Society and the only Nobel Laureate in scientific subjects in the East and thereby raised the status of India in the world of Science.

The Association is at present faced with a difficulty that was not so formidable in the past. Within the last two decades research techniques have changed enormously. High traditions and collection of a batch of industrious, selfless and talented workers can no longer be of much avail in a laboratory with weak finances and consequently poor equipments. The Association with its long and glorious record of solid achievements is a national asset. It is, therefore, up to the nation to find the finances for strengthening the research personnel and improving its equipments so that the country may reap the fullest benefit from its activities.

APPENDIX I

Presidents and Honorary Secretaries of the Association

For the first 35 years of its existence the Association used to have the Lieutenant-Governor of Bengal as its President. But since 1912, it has been the practice to elect non-official presidents.

The invaluable services rendered to the Association by its Founder-Secretary Dr. Mahendra Lal Sircar (1876-1904), by Raja Peary Mohan Mookerjee as Vice-President (1876-1911) and then as President (1912-25), by Dr. Amrita Lal Sircar as Secretary (1904-1919), by Sir C. V. Raman as Secretary (1919-33) and then as President (1934), and by Sir K. S. Krishnan as Secretary (1934), have already been mentioned in detail in the body of this report. The efforts of some of the presidents and secretaries who took particularly great interest in advancing the cause of the Association within recent years, deserve special mention here.

PRESIDENTS: Sir R. N. Mookerjee, the great industrialist of Calcutta, helped Sir C. V. Raman in securing a grant of Rs. 20,000 per annum from the Government of India in 1927-28, and thus to maintain the large and increasing number of scholars which gathered round him. Sir U. N. Brahmachari (1942-46), great as a medical practitioner and greater still as an investigator whose discovery of Urea Stibamine saved millions of lives in India, took very great interest in the affairs of the Association in spite of failing health, and scarcely missed any single meeting. He was responsible for enlisting a large number of life members and ordinary members, and he had other larger plans in the making when he was snatched away by the cruel hand of Death. We hope that his sons would give practical shape to his wishes which are well-known to them.

Professor Meghnad Saha, the present President, has been connected with the Association since 1926, when he became a life-member. So long as he was at Allahabad he could not take much active interest in the affairs of the Association. Since his return to Calcutta in 1938, he has been actively associated with the administration of the Association as a member of the Committee of Management, as Vice-President, and since 1945, during the long-illness of Sir U. N. Brahmachari, as acting President, and afterwards as President. After the reorganisation of the Association, he has been unanimously re-elected as its President.

The new plans for reorganisation and active measures to give effect to the schemes were evolved during the regime of Prof. Saha as President, and Prof. P. Ray as Secretary. We have to thank above all, for the successful negotiation with the Government of India, Dr. D. M. Sen, Deputy Secretary of the Ministry of Education, Sir S. S. Bhatnagar, Director, Council of Scientific and Industrial Research, Sir J. C. Ghosh, Prof. J. N. Mukherjee and others.

SECRETARIES: The Association has been fortunate to have very eminent scientific men as Secretaries, whose services have been recorded in the body of the report. Profs. S. K. Mitra and J. N. Mukherjee were Secretaries from 1934-1935, and 1935-1944, and with their usual energy and devotion piloted the Association skilfully through a period of great unrest and difficulties.

The Association has thus been able to receive devoted honorary services of many public-spirited citizens and scientists of the country as Presidents, Secretaries, and members of the Committee of management (now Council) during the first seventy-two years of its existence; and if, as it hopes, the future citizens and scientists of India continue to come forward with the same spirit of service, its future is assured.

Past Presidents.

- 1876—The Hon'ble Sir Richard Temple.
1877—Sir Ashley Eden.
1882—Sir Rivers Thompson.
1887—Sir Steuart Bayley.
1890—Sir Charles Elliot.
1895—Sir Alexander Mackenzie.
1898—Sir John Woodburn.
1903—Sir Andrew Henderson Leith Fraser.
1909—Sir Edward Norman Baker.
1912—Raja Peary Mohan Mookerjee.
1925—Sir B. C. Mahtab, The Maharájádhiraja Bahadur of
Burdwan.
1927—Sir R. N. Mookerjee.
1934—(Jan.-June)—Sir C. V. Raman.
1934—Sir Nil Ratan Sircar.
1942—Sir U. N. Brahmachari.
1946—Prof. M. N. Saha (re-elected, Dec. 1947, under the new
Constitution).

Past Honorary Secretaries.

- 1876—Dr. Mahendra Lal Sircar.
1904—Dr. Amrita Lal Sircar.
1919—Sir C. V. Raman.
1934—Sir K. S. Krishnan.
1934—Prof. S. K. Mitra.
1935—Dr. J. N. Mukherjee.
1944—Prof. M. N. Saha.
1944—Prof. P. Ray.
(The office has been discontinued under the new Constitution).

Director.

- 1947—Prof. P. Ray (Honorary).

Trustees

- Hon'ble Mr. Justice C. C. Biswas.
Mr. Nirmal Chunder Chunder.
Dr. Bimala Churn Law.
Mr. Ramaprasad Mookerjee.

APPENDIX II

Who is who among the past Research Workers of the Association

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| Banerjee, A. N. | | Professor of Physics, Surendra Nath College, Calcutta, and Assistant Editor, Indian Journal of Physics. |
| Banerjee, B. N. | .... | Formerly Meteorologist, Government of India. Retired from service a few years ago. |
| Banerjee, D. | .... | Lecturer in Physics, Calcutta University. |
| Banerjee, K. | .... | Reader in Physics, Dacca University, (1933-43); joined this Association as Mahendra Lal Sircar Professor of Physics in March, 1943. F.N.I.; President, Physics Section of Indian Science Congress, 1947. |
| Banerjee, S. | .... | Formerly Senior Research Assistant, Inspectorate of Stores at Cawnpore. Has just come from America after specialising in Geophysics. |
| Banerji, S. K. | .... | Director-General of Observatories; F.N.I. President, Physics Section of Science Congress, 1923; past President, Indian Physical Society. |
| Basu, N. M. | .... | Professor and Head of the Department of Mathematics, University of Dacca. |
| Bhagavantam, S. | .... | Principal, Science College, Andhra University, President, Physics Section of Indian Science Congress, 1946. |
| Bhattacharyya, D. K. | .... | Professor, Patna University. Since retired. |
| Bose, A. | .... | Professor, Jagannath College, Dacca; now Research Officer, Indian Association for the Cultivation of Science in the Department of X-rays and Magnetism. |
| Chakravarty, D. C. | .... | Lately, Registrar, Bose Research Institute, Calcutta. |
| Chinchalkar, S. W. | .... | Professor of Physics at King Edward College, Amraoti (Berar). |
| Choreghade, S. L. | .... | Assistant Meteorologist. |
| Das, P. | .... | Was part-time Lecturer in Applied Mathematics, Calcutta University. Since deceased. |
| Deb, S. C. | .... | Assistant Director of Industries, Government of West Bengal. |
| Dey, A. | .... | Was Prof. Raman's Laboratory Assistant, but did some research work. |
| Dhar, J. | .... | Head of the Department of Physics, Indian School of Mines, Dhanbad. |
| Ganesan, A. S. | .... | Professor of Physics, Science College, Nagpur. |
| Ganguly, N. | .... | Professor of Physics at St. Edmund's College, Shillong. |
| Ganguly, S. C. | .... | Professor of Physics at Bangabasi College, Calcutta. |
| Ghosh, P. N. | .... | Was Sir Rash Behari Ghosh Professor and Head of the Applied Physics Department, Calcutta University; F.N.I.; President of Physics Section, Indian Science Congress, 1941. Died on the 23rd December, 1946. |
| Ghosh, R. N. | .... | Reader in Physics at the Allahabad University. F.N.I. |
| Guha, A. C. | .... | Professor of Physics at K. N. College, Berhampore, Bengal. |
| Guha, B. C. | .... | Lecturer, Presidency College, Calcutta. |
| Krishnamurti, P. | .... | Joined the Indian Institute of Science, Bangalore, as Personal Assistant to the Director. Now Officer, Gas Mantle Co., Bangalore. |

- Krishnan, K. S. Reader in Physics, Dacca University (1928-33); M.L.S. Professor at the Association (1934-42); Professor of Physics, Allahabad University (1942-47); now Director, National Physical Laboratory. F.N.I.; F.R.S. President, Physics Section (1941) and elected General President (1949), Indian Science Congress.
- Mahadevan, C. Joined the Geological Department, Hyderabad and is now a Professor of Geology and Head of the Department, Andhra University. Elected President, Geology Section, Indian Science Congress, 1949; F.N.I.
- Mahajan, L. D. Professor of Physics at the Maharaja's College, Patiala.
- Mitra, M. N. Joined the Bengal Education Service; since retired from service.
- Mookherji, A. Professor of Physics, Birla College, Pilani.
- Mukherjee, B. N. P.A. to Director, Lac Research Institute, Nankum, Ranchi.
- Pai, N. Gopal Now in the Institute of Hygiene and Health, Calcutta.
- Pal, H. K. Prof. of Physics, A. M. College, Mymensingh.
- Parthasarathy, S. Assistant Director, B.S.I.R.
- Rai Chaudhuri, D. P. Senior Professor of Physics, Scottish Church College, Calcutta.
- Raman, C. V. Worked in the Association, 1907 to 1933: was its Secretary (1919-33) and President (1934). Palit Professor of Physics, Calcutta University (1916-33); Director (1933-35) and then Professor of Physics, Indian Institute of Science. Fellow of the Royal Society; Nobel Laureate; President, Physics Section (1924), and General President (1929), Indian Science Congress.
- Ramanathan, K. R. Superintending Meteorologist, Meteorological Office, Poona. F.N.I.; President, Physics Section, Indian Science Congress, 1939.
- Ramdas, L. A. Agricultural Meteorologist at Poona. F.N.I.; President, Physics Section, Indian Science Congress, 1948.
- Rameswaram, C. Meteorologist, Government of India.
- Rao, I. R. Formerly Reader in Physics, Andhra University, now Director of Research, Andhra Scientific Apparatus Co.
- Rao, K. R. Professor of Physics at the Andhra University, Waltair.
- Rao, S. Ramachandra Formerly Professor of Physics, Annamalai University; now Professor of Physics, Mysore University, Central College, Bangalore.
- Ray, B. B. Was the Khaira Professor of Physics, Calcutta University; President, Physics Section of Science Congress, 1942. Died on the 29th July, 1944.
- Seshan, P. K. Assistant Foreman, H. E. Factory at Kirkee.
- Sethi, N. K. Professor of Physics at the Agra University.
- Sirkar, S. C. Reader in Physics at this Association in 1943; Radiologist, Inspectorate of Ammunition, Kirkee, Poona; then Lecturer in Physics, Calcutta University; now Professor of Optics at the Association. F.N.I.
- Sogani, C. Lecturer in Physics, Benares Hindu University.
- Sur, N. K. Regional Director, Meteorological Department; now retired.
- Vaidyanathan, V. I. Physicist, River Research Institute, Madras.
- Venkateswaran, S. Trade Marks Registrar, Bombay.

APPEAL

In releasing the present Report on the working of the Indian Association for the Cultivation of Science the Council wishes to appeal to the public for generous contributions to its funds, so that the Association may be enabled to fulfil its objective of serving the cause of humanity and of the country through science.

The contributions may take the shape of:

- (a) permanent endowments for a particular objective, viz. institution of Professorships, Readerships or Fellowships (e.g. the Mahendra Lal Sircar Professorship founded by the late Rai Bahadur Vehary Lal Mitra), or construction of laboratories;
- (b) temporary contributions for Fellowships particularly Industrial Fellowships, or other objectives;
- (c) Life Memberships on the part of firms or individuals.

The Association has to raise an amount of about 20 lacs of rupees to fulfil its present objective. This will enable the Council to give effect to its present schemes of development for which the Government of India has made a generous donation of Rs. 9.32 lacs for land acquisition and construction, and a recurring grant of Rs. 2.667 lacs for current expenditure.

Indian Press Ltd., Calcutta.