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## APPENDIX

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### THE INDIAN TEMPLE OF SCIENCE

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BY PROF. PATRICK GEDDES.

The following descriptive account of the Bose Research Institute in Calcutta, which was opened towards the close of last year, is from the pen of Prof. Patrick Geddes:—

The scientific event of the year in Calcutta is the opening of the Bose Research Institute, with its great scheme not only of continuing the researches of its founder, but of carrying on his large conceptions of the investigation of the processes of life and with help of all the resources and refinements of the physical sciences.

The Institute stands in the very centre of intellectual activity of Calcutta. The building which is meant to be a temple dedicated to science is a striking and dignified one. It is constructed of fine greyish purple sandstone, and in Indian style, of the pre-Mahomedan period, and the ornament and its details are symbolic throughout and repay study. In front is a small garden, appropriately of sensitive plants, with fountain and pool, and with sun dial and electrically controlled clock dial for mutual comparison. A vivid sign of tracing, being the Institute and its work is a

large double automatically made in two parallel curves before the eyes of the observer. One of these curves records the resultant of the essential changes of the atmospheric environments—temperature, light, etc., while the other summarises the responses of a large tree to those changing conditions for every minute of the twenty-four hours. This autograph of the tree gives striking and vivid demonstration of Sir. J. C. Bose's discovery that all plants, including even rigid trees, are fully sensitive to the changes around them. Even the passage of a drifting cloud is perceived and recorded by the tree in its own peculiar script and by an instrument invented for this purpose, a marvel of scientific ingenuity. Here then we have a conspicuous illustration of the significance of this Institute as no mere laboratory of this and that line of physical or physiological research among many, but from the first aiming at the concentration of the main resources and methods of the physical sciences, and of those to bear upon the central problem of all the biological sciences—that of the essential processes of life itself.

The spacious Entrance Hall has a long series of glass cases which at once exhibit and preserve the essential apparatus of many past years of inquiry, from physical researches on electric waves to physiological researches on life. These are arranged in sequence, that of their increasing perfection in observation and record. Step by step one thus passes from instruments direct and simple to the present, well-nigh of magical elaboration of delicacy and exactitude. Here we have Bose's

first apparatus for space signalling by which so far back as 1895 he sent at the Town Hall ether wave through a solid wall, and a line of men including the Governor, and made it displace a heavy weight, ring a bell and explode a miniature mine placed in a closed room. Recent instruments record the imperceptible pulsation in a plant, note the perception-time within the thousandth part of second, and measure ultra-microscopic movements. The significance of this Institute as a centre of new invention, of exceptional skill in the construction of the most delicate apparatus, and in the possibilities of all these to science, and ultimately to industries thus becomes apparent. For it is here worth noting that most of the great physical discoverers and inventors from—Watt and Kelvin, back Galileo and Leonardo de Vinci, or onwards to Bell and Edison and now Bose himself, have been their own instrument makers, or hand and brain thus alternately stimulate each other, to the complementary advances we call "discovery" and "invention" respectively.

Let us first pass through the great Lecture Hall, look into the actual Laboratories, where the researches, preliminary to all announcement of them, have to be made. These are partly in the main building but more largely in the annex, and indeed largely almost primarily, on the garden around, with which we may therefore best begin. Again, sensitive and other moving plants preponderate like twiners and climbers, which cover a long and shady pergola which will serve also as a college cloister, and its "Philosophers' Way."

The nearer ground is laid out with pleasant lawns, with fountain and tank for water-plants and with a group of trees, partly old inmates of the garden, partly lately transplanted hither, at full size, under anæsthetics. Under these trees is a variety of apparatus and above is perched an open platform for observation and thought by turns, since this alternation of keen outlook and meditative interpretation is the very process of science, the rhythm of its intellectual life.

From these beginnings of the future Biophysical Garden we may now enter the Laboratories. Here beyond the small marble entrance porch, again kept free for observation and meditation, are glass houses—white, red and blue, for the study of the growth and behaviour of plants under light from opposite ends of the spectrum, as compared with normal conditions. Beyond these are the larger laboratories, electrical and chemical, mechanical, and microscopic and physiological.

For so many enquiries the three new storeyed annex is already insufficient. Research work must thus flow back into every available room of the main building even into the long space under the gallery of the lecture hall, economically contrived for work and use. The further new building already begun, will thus soon be required.

The Institute has as yet only the beginning of a Library, at present lodged in Sir J. C. Bose's house. But additions are urgent and these on a comprehensive scale are required by this Institute as not only a laboratory of varied research, but

also more and more as a meeting place and clearing-house at once of physical and biological sciences, and these in their ever-widening relations.

A hostel for workers, of Indian simplicity yet also with something of Indian Art, and free from that too official and too often-almost prison-like character which these institutions of late years have too often been acquiring alike in East and West will also be erected, while the Director's House is intended, in the—we trust still distant—future as a further hostel.

Having thus broadly surveyed the new Institute, and seen, or foreseen, something of its working we may now enter the great Lecture Hall which is seated for some 1,500 auditors. Here the inaugural ceremonies of the Institute took place and as soon as may be thereafter, a course of lectures by Sir J. C. Bose will be given embodying the main results of his studies in physics and in physiology, both plant and animal. These will afterwards be published as a volume. After courses individual lectures will also be announced from time to time, and fresh researches described as these advance to the level of publicity.

As the laboratories and grounds of the Institute afford various fresh and vivid departures from conventional academic design, so also this great Hall, of the as yet best attainable environment for scientific exposition. And this first and foremost as a monument of simple, beautiful and efficient design, in which a large audience can at once see and hear without the visual interruption and the

acoustic defects too common in auditoria designed without the collaboration of the physicist.

The purpose of this Hall is thus neither restrictedly scientific, as its magnitude shows, nor yet simply popular. The essential idea is that of providing for the scientific exposition of new knowledge, and this at its highest appeals to the intelligent public, much as does the Royal Institution of London.

The Hall itself is decorated with symbolic meaning and this at once for scholar and artist as well as scientist. The ceiling design, with its great radiating lotus is freely adopted from one of the cathedral caverns of Ajanta, yet with the sensitive plants so specially connected with the work of the Institute, around its border. The body of the Hall is left quiet and plain, as befits its purpose of attention, but above the lantern screen, is a frieze painting, an allegoric masterpiece. "The Quest" by Nandalal Bose, a well-known member of that little group of Calcutta artists who are recovering the tradition of Indian painting, yet adapting these to modern interest and individual expression. Starting from the sacred river at dawn, strides forth the tall and keen braced figure of "Intellect" feeling the sword edge with which he has to cleave his way and companioned in his adventurous journey by his bride "Imagination" inspiring him with her magic-flute. Thus here in the institute its distinguished scientific leader will stand as thinker with the artist, the philosopher and the poet. The final and focal ornament of the Hall the great relief in bronze, silver and gold



is that of the sun-god rising in his chariot to the daily cosmic strife of light with darkness.

How this new Institute may act and react with Indian thought and life, as well as with the world's science, and how also it may advance here industry, there agriculture, there again medicine, and above all the needed emancipation and renewal of higher education, it is too soon to predict. Enough for the present that this flowering of a creative life should now fully be opened. Its fruits will ere long be maturing, and even its seeds of new activities spreading throughout India and flying over the world.

# ESSAYS AND DISCOURSES

BY

DR. PRAFULLA CHANDRA RAY, C. I. E.

This is a comprehensive collection of the writings and speeches of Dr. P. C. Ray, the well-known Indian chemist. At the request of the publishers, the papers collected for the first time in this volume have been selected and revised by Dr. Ray himself. Appropriately enough Dr. Ray's contributions on Scientific Researches and Hindu Chemistry in particular find precedence in this collection. The volume opens with a paper on "The Problem of Scientific Education in India" written as early as 1889 in the pages of the *Calcutta Review*. Among other papers in this section are "Progress of Chemistry in Bengal," "Possibilities of Chemical Industries in India," "Higher Science in the Universities," "Chemistry and Medicine" and the special lectures on "Hindu Chemistry" delivered by Dr. Ray in February last at the Madras University. This is followed by papers on Education and Industries—Dr. Ray's evidence before the Royal Commission on Public Services, on the Educational Services as also before the Indian Industrial Commission in 1917. Dr. Ray's thoughtful article on "Bengali Brain and its Misuse" which had provoked a great deal of discussion in the Indian Press in 1910, his presidential addresses to the Bengal Literary Conference and the last Social Conference at Calcutta, are also included in this volume. Then follow Dr. Ray's appreciations of the late Ananda Mohan Bose, Dadabhai Naoroji and Sir William Wedderburn. The appendix contains a complete list of the researches of Dr. Ray and his pupils. The volume is bound in Clot

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