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AN INDIAN PIONEER OF SCIENCE.

LIFE AND WORK OF SIR JAGADIS C. BOSE. By Patrick Geddes. London: Longmans and Co. Pp. xii. 259. 16s. net.

Twenty years have gone by since the scientific public of Europe began to hear of wonderful things being done in a Calcutta laboratory by an Indian man of science. His results, it was said, were being achieved by experimental methods and apparatus and brilliant originality. They were understood to illuminate especially the borderland of the organic and inorganic, of biology and physics. A series of books on plant response and allied subjects started soon afterwards, and in due course Professor Bose began his personal conquest of the Western scientific world. In the summer when the war began he was giving demonstrations in several European capitals, and during the past year his name and the renown of his contributions to what is to-day the most fascinating and fruitful field of scientific research have become the common possession of educated people.

Professor Geddes, long known as a stimulating teacher of biological and social science, has given his book a somewhat unusual design. He furnishes a full exposition of the Bose experimental research, relating it to the kindred work of his contemporaries upon plant life and ethereal waves; and he does this so successfully that there is nothing to prevent the reader of ordinary education, though he may be without technical knowledge, from grasping the main principles and results. This exposition is woven in with an extremely interesting personal narrative of a boyhood exceptionally full of opportunity in Eastern Bengal, student life in India and England, a long spell of teaching and research in Calcutta, and a rich experience of travel and friendships. Sir Jagadis Bose's career culminates in the establishment of the Bose Research Institute at Calcutta—the first considerable step, as it is hoped, in the great work of reconciliation and co-ordination between the science of the West and the intellect and spirit of the East. Professor Geddes, it may be added, has performed a difficult task in such a manner as to earn for his book an assured place in scientific biography.

## Vorwärts (Berlin)

Nr. 42.

**Das Herz der Pflanzen.****Zum Tode des indischen Gelehrten Jagadis Bose.**Dieser Tage starb der große  
indische Gelehrte Jagadis Bose.

Die wissenschaftliche Welt wurde von dem plötzlichen Tode des eigenartigen indischen Gelehrten Sir Jagadis Chund Bose überrascht, der mitten aus seiner bedeutungsvollen wissenschaftlichen Arbeit herausgerissen wurde. Noch erwartete man von diesem seltsamen Forscher neue und ungeahnte Erkenntnisse über den Nervenmechanismus der Pflanzen, die wohl heute schon buchemäßig vorliegen, aber noch nicht als abgeschlossen von Jagadis Bose betrachtet wurden. Doppelt schmerzlich der plötzliche Tod des 69jährigen indischen Gelehrten, der seine westeuropäische Bildung niemals verleugnen konnte, so wenig, wie seine tief im indischen Volkstum wurzelnde Seele.

Was den indischen Gelehrten, der in Kalkutta das Bose-Forschungsinstitut leitete, in der wissenschaftlichen Welt und unter den gebildeten Vätern so berühmt machte, waren seine aufsehenerregenden Untersuchungen über das „Herz der Pflanze“. Wenn Bose das Herz der Pflanze entdeckte und durch ganz besonders fein hergestellte Apparate experimentell nachweisen konnte, so dürfen wir das Wort „Herz“ nicht begrifflich so genau aus der Biologie übernehmen, so wenig die Pflanzen auch menschenähnliche Nerven besitzen, um nun Parallelen zwischen menschlichem und pflanzlichem Herz zu ziehen. Daß aber ein innerer Organismus in der Pflanze vorhanden sein muß, der die Säfte aus den Wurzeln bis hinauf in die höchste Spitze und in die feinsten Verzweigungen führt, ergibt sich aus der Beobachtung des pflanzlichen Lebens. Jagadis Bose weist nun nach, daß jede Pflanze ein schlauchartiges Organ von unten bis oben besitzt, das die Pflanze mit Nahrung versorgt, denn nur durch das Hinauspumpen der Säfte ist das pflanzliche Leben möglich. Auf kleinsten und feinsten Registrierapparaten ist sogar der Herzschlag der Pflanzen festzustellen und darüber hinaus jede Veränderung im Leben der Pflanze.

Außer diesen hochbedeutenden wissenschaftlichen Feststellungen untersuchte Jagadis Bose auch das sogenannte Nervensystem der Pflanzen. Auch hier darf man nicht unsere Vorstellung von menschlichen Nerven als organische Träger aller Empfindungen auf die Pflanze übertragen, denn Bose stellt keineswegs die Behauptung auf, daß die pflanzlichen Nerven Empfindungsträger seien. Was er untersucht und auch behauptet, ist nur der Versuch, den Mechanismus der Reaktionen und Bewegungen festzustellen und darzulegen, daß funktionell kein Unterschied zwischen den menschlichen und pflanzlichen Nerven besteht. Mit seinen selbsterfundenen Apparaten, die allein schon außerordentliche Bedeutung in der wissenschaftlich-physikalischen Welt besitzen, stellt Bose fest, daß die pflanzlichen Nerven genau so auf Reize reagieren, wie die Nerven der Menschen und ebenso reizaufnehmend sind. Wer schon einmal Pflanzen beobachtete und die Reizwirkungen studierte, muß die Tatsache existierender Pflanzennerven bejahen. Die Existenz pflanzlicher Nerven kann nicht allein deshalb verneint werden, weil die pflanzliche Nervenstruktur andersartig ist als bei den Menschen. Die wissenschaftlichen Kritiker des indischen Gelehrten Bose weisen auf die Unhaltbarkeit seiner Behauptungen hin, weil nicht allein aus der Funktion das Vorhandensein von Nerven geschlossen werden darf, sondern auch eine vorhandene biologische Struktur nachweisbar sein muß für die Existenz von pflanzlichen Nerven.

Selber hat der zu schnelle Tod dem indischen Gelehrten die Möglichkeit genommen, selbst auf die Einwände seiner wissenschaftlichen Gegner einzugehen. Daß mit dem Tode Jagadis Boses einer der eigenartigsten und originellsten Forscher verloren ging und mit seinem Tode noch viele ungelöste Probleme begraben wurden, wird allein schon aus der knappen und umrissenen Schilderung ersichtlich sein.

Mit Jagadis Bose starb ein tiefer Erforscher des pflanzlichen Innenlebens und ein wunderbarer Beobachter des pflanzlichen Lebens.

E. F.

## Neue Zürcher Zeitung

Nr. 2323.

**Die Pflanzenschrift.** Sir Jagadis Chunder Bose, dem Blute nach Inder und Besitzer eines großen pflanzenphysiologischen Instituts in Kalkutta, hat neue experimentelle Methoden gefunden, mit denen sich das Leben der Pflanzen in seinen innersten Regungen auffuchen, einfangen

und beobachten läßt. Er hat Apparate gebaut, die sich am Pflanzentkörper äußerlich oder innerlich anbringen lassen und in Kurvenform nicht nur selbsttätig niederschreiben, was im Zustand des gereizten oder ungereizten Lebens an Ort und Stelle geschieht, sondern auch imstande sind, die feinen, unserem Auge verborgenen Regungen in ungeheurer Vergrößerung spiegelbildhaft nach außen zu werfen, so daß man am Wandschirm die Zuckungen und Pendelschwingungen des vorüberziehenden Lebensstromes ablesen kann. Es ist keine Frage, daß diese raffinierten Methoden neue, auch theoretisch sehr wertvolle Einblicke in die Werkstatt der Pflanze gezeitigt haben. Die Mechanik des Säfteflusses und des Wachstums, der Reizbewegungen und der Atmung, der Ermüdungs- und Schlafzustände, des Krankseins, Ablebens und schließlich des Sterbens wurden mit einer optischen Genauigkeit bloßgelegt, die alles Dagewesene und auch alles Erwartete weit übertraf. Indessen waren bisher Berichte über Boses Forschungen meistens nur in Fragmenten zu uns gelangt. Jetzt hat er selber aus vielen Büchern ein neues gemacht, das in 27 Kapiteln den wesentlichen Ertrag seiner Arbeit zusammenfaßt und seit einigen Tagen unter dem Titel „Die Pflanzenschrift“ auch in deutscher Uebersetzung vorliegt (Notapfel-Verlag, Zürich). Der Wiener Botaniker Hans Molisch hat dem gemeinverständlichen Buch ein sehr herzliches Geleitwort geschrieben. Von Einzelheiten des Inhalts wird in späterer Zeit noch zu reden sein. —Isch.



Neue Zürcher Zeitung

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Nr. 2213

Sir Jagadis C. Bose

—Isch. Patrick Geddes, dessen schon 1920 erschienene englische Biographie des indischen Naturforschers Bose nun auch in deutscher Sprache vorgelegt wird,\*) ist als Menschengestalter kein Strachey und kein Paul de Kruif, nicht einmal ein Emil Ludwig. Sein Buch ist daher ausgefallen wie unzählige andere Lebensbeschreibungen auch, die von wohlmeinenden und unterrichteten Menschen über eine verehrte Persönlichkeit mit viel Andacht und Fleiß, aber ohne eigentliche Begabung, ohne Blick für das Wesen des Schicksals und ohne Sinn für die künstlerische Seite der Aufgabe niedergeschrieben worden sind: es hat keine Achse, um die sich das Bedeutende und Unbedeutende in charakteristischer Ordnung gruppiert, ist verschwommen in Kontur, matt in den Farben und uninteressant an allen jenen Stellen, an denen es genau zu sein wünscht. Denn die Pflicht zur Bestimmtheit wird verwechselt mit sorglicher Alibie zufällig bekannter Einzelzüge, die oft herzlich belanglos sind oder es durch die Art ihrer Darbietung werden.

Unter diesen Umständen sind jene Kapitel die besten, in denen die wissenschaftliche Arbeit Boses und die mannigfachen Kämpfe um die Anerkennung ihrer Resultate durch die europäischen Gelehrten oder die englischen wissenschaftlichen Gesellschaften — Royal Society, Vinnegesellschaft usw. — geschildert werden. Hier braucht es keinen Blick für das Allgemeine und Besondere, was an der Naturform eines Menschen wesentlich ist, und seiner Gestaltungskraft, sondern nur Vertrautheit mit dem altentwässerten Material und die Fähigkeit, zu referieren. Beide Ansprüche werden erfüllt. Die betreffenden Abschnitte werden wie in einem Lehrbuch überschrieben. Man liest da als Titel: „Die ersten physikalischen Forschungen“, „Reaktion des Belebten und Unbelebten“, „Die Reizbarkeit der Pflanzen“, „Tropismen“, „Der Schlaf der Pflanzen“ und ähnliches mehr. Wer über Boses Lebenswerk nicht schon unterrichtet ist, aus seinen eigenen Büchern, etwa aus der „Pflanzenkraft“, kann sich hier alle erwünschte Belehrung verschaffen. Er kann, um mit Geddes zu sprechen, sich überzeugen, daß hier viel Pionierarbeit geschehen ist, und zwar von einer so hohen Warte aus, wie sie selten erreicht wird, wobei Gebiete ineinander übergreifen, die man gemeinhin getrennt behandelt: Physik, Physiologie, ja sogar Psychologie. Bahnbrechendes in allen diesen Disziplinen hat Bose nicht nur dank seinen ungewöhnlich vielseitigen Interessen, seiner außerordentlichen geistigen Beweglichkeit und Erfindungsgabe geleistet, sondern auch, weil er geführt, begeistert, ja leidenschaftlich hingeworfen war von der außerordentlich tiefen Kraft seines Glaubens an eine kosmische Ordnung und Einheit, der wesentlichen Grundlage aller Wissenschaft. Nebenher wird dem Leser vielleicht auffallen, daß die lächerliche Angst um Prioritätsrechte diesen doch scheinbar aus einer ganz andern Welt kommenden Mann genau so geplagt hat wie manches weniger

bedeutende Gestirn am europäischen Gelehrtenhimmel, und daß er nichts untersucht ließ, um diese Rechte zu wahren. Manchmal scheint er auch wirklich dazu genötigt gewesen zu sein, weil dieser und jener englische Bonze es für ganz in der Ordnung hielt, dem „Farbigen“ das Fell über die Ohren zu ziehen oder ihn fühlen zu lassen, daß es für ihn — als Angehörigen eines „verwalteten“ Volkes und englischen Regierungs-Stipendiaten — unziemlich sei, einen veritablen Ordner oder Cambridger Professor an Ingenium zu übertreffen.

Dennoch hat man den Eindruck, daß Bose sein Indertum in der Karriere wenig geschadet hat, weil er schon früh durch seine Erziehung und seinen Bildungsgang — ähnlich wie sein Freund und Landsmann Rabindranath Tagore — so vereuropäisiert und verengländernd wurde, daß sein Indertum dauernd nur noch etwas wie eine Plage auf Halbmaße war. Er wurde am 30. November 1858 in der Nähe von Dacca in Westbengalen geboren als Sohn eines Inders, der selbst schon in englischen Diensten stand, zuerst als Bezirksrichter, später als Exekutive Officer, und der es auch nicht an Versuchen hat fehlen lassen, durch Landerwerb, industrielle und landwirtschaftliche Unternehmungen, ja sogar durch Gründung einer Bank sein Glück auf möglichst breite irdische Füße zu stellen, wenn zuletzt auch vergeblich. Jedenfalls hat Bose nur ganz vorübergehend die indische Schule besucht. Vom neunten Lebensjahr an wurde er in einem englischen College in Kallutta erzogen und nachher hat er vier Jahre in England Medizin und Naturwissenschaften studiert. Schon mit 26 Jahren wurde er zum Physik-Professor am Presidency College in Kallutta, der vornehmsten Bildungsstätte Indiens, ernannt, und wenn es auch gegen diese Anstellung Einsprüche und unerquickliche Auseinandersetzungen mit der subalternen Beamtenschaft gab, so hat die Gunst des Vizekönigs und anderer hoher Herrschaften die jeweiligen Schattentwollen doch immer schnell verjagt und ihm schon in jungen Jahren zu einem langen bezahlten Europaaufenthalt und der Möglichkeit, seinen Ruhm durch persönliches Auftreten in London, Paris usw. zu begründen, mit Geschick und politischem Weitblick verholfen. Politisch ist denn auch Bose niemals hervorgetreten, was von seinem Biographen an versteckter Stelle gleichsam entschuldigt wird mit dem verwachsenen Säglein (S. 227): „Er gelobte, nie dürfe seine Liebe zu Indien seiner umfassenden Liebe zur Menschheit im Wege stehen.“

Die Liebe zur Menschheit: — wer sich lieber von Oblaten nährt als von Roggenbrot, mag sich von mir aus gern an solchen blaffen Weltbürgerfähigkeiten erfreuen. Ich kann es nicht.

\*) Leben und Werk von Sir Jagadis C. Bose. Von Patrick Geddes. Rotapfel-Verlag, Erlangen-Zürich und Leipzig.

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Nr. 27422

**SIR J. C. BOSE**

**A Great Indian  
Scientist**

**PLANT RESEARCHES**

**His Theories Rejected by  
Biologists**

[Vols. VII. and VIII. of the Transactions  
of the Bose Research Institute, Calcutta,  
have recently been issued.]

(From our Scientific Correspondent.)

Sir Jagadis Chunder Bose is the son of an able Bengali magistrate who was interested in the revival of Indian culture, tea-planting, banking, and many aspects of life. His family sent him to England to study. He won a scholarship at Christ's College, Cambridge, and studied physics under the direction of the late Lord Rayleigh, who was impressed by his ability.

On the recommendation of eminent British scholars the Indian Education Department was requested to find a first-class scientific appointment for him. Though Indians had received first-class literary and philosophical appointments they had not hitherto received any first-class scientific appointment. The Indian mind was supposed to be incapable of first-class scientific work. According to Geddes's account, the recommendation of Bose was badly received, and Bose himself was treated with shocking rudeness. Nevertheless, after graceless delays he was appointed a professor of physics in the Presidency College, but he received only one-third the salary paid to Europeans for the same grade of work.

**RADIO WAVES**

In 1894 he began the researches which established his reputation. His laboratory equipment was slight, but within a few months he made important contributions to the study of radio waves. These had been discovered in 1887 by Hertz, who had established their qualitative similarity

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### RADIO WAVES

In 1894 he began the researches which established his reputation. His laboratory equipment was slight, but within a few months he made important contributions to the study of radio waves. These had been discovered in 1887 by Hertz, who had established their qualitative similarity to waves of light, but his apparatus was cumbersome and inexact. Bose invented an emitter which produced short waves, not much longer than those of light, and a more sensitive receiver. These enabled him to demonstrate exactly that radio waves possessed the more refined properties of light waves, such as double refraction and polarisation.

These excellent researches received Kelvin's most enthusiastic praise and much impressed the scientific world. Their importance was not scientific only. They were the first important contribution to physics made by a modern Indian and the first demonstration of the falsity of the prejudice that the Indian mind was incapable of research in physical science. They thus destroyed the argument that scientific education should not be provided for Indians because they were incapable of acquiring it.

### PLANT SENSITIVITY

During his experiments with radio waves Bose noticed the phenomenon of fatigue in metallic receivers. He found that a receiver fatigued by continuous use could recover its sensitivity after rest. If a receiver remained unused for a long period it became insensitive. These phenomena could be compared with those of fatigue and atrophy in living muscle. Further, he found that metallic receivers could be poisoned and their sensitivity impaired by chemical treatment, as living material can be poisoned by drugs.

These parallels excited his imagination deeply. He became interested in similarities between dead and living matter, and the principles that might be common to both. From this he swiftly came to the study of the unitary, the monistic aspect of the universe. Thenceforth his researches were directed by this monistic interest. Among his searches for similarities those on plant behaviour became particularly well known. His gift of physical invention enabled him to construct extremely sensitive apparatus for the detection of movements in plants. With these detectors he was able to show that plants had unsuspected powers of response to weak stimuli. He showed that messages went along certain channels in plant leaves, and compared these channels with the nerves of animals. He compared the movements of sap to the circulation of the blood.



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### VIEW OF CRITICS

Bose was disappointed by the reception of his monistic ideas of the similarities between dead and living matter and between plant and animal life. Whereas his early work on radio waves had received universal acceptance, his subsequent work was received with opposition. The majority of experimental biologists still do not agree with Bose's interpretation of his observations on plants. They regard his comparisons of dead and living matter and of plant and animal life as uninformative because they are not based on a sufficiency of precise details. The establishment of the existence of nerves in plants requires observations of hundreds of parallels besides the passage of electrical and motor disturbances.

It seems to Bose's critics that he has never thoroughly grasped the conception of control in biological experiments. He seems to them to have made the mistake most frequently made by physicists entering the study of biology—to suppose that simple biological experiments can also be exact. Dead material is simple enough to give exact answers to simple questions, but living matter is usually too complicated to give instructive answers to simple questions. His critics find his parallels between the behaviour of dead matter, animals and plants, far too vague to be helpful.

These developments made Bose's life a singular drama. His early scientific achievements and his personality made him the founder of modern Indian

science. He became a symbol of national prestige. Then he devoted himself to a line of research which has excited much interest but little professional conviction. His attachment of the new movement in Indian science to a theory that does not receive universal acceptance has, so far, appeared unfortunate. Perhaps the future may show that his action was correctly inspired and that he was in front of his time.

#### THE BOSE INSTITUTE

Shortly after he retired from the Government service he founded, in 1917, a research institute, the first of its sort in India. Its aims resemble those of the Royal Institution in London. Its staff engage in research and the exposition of science, and a yearly volume of transactions is published. A wide variety of researches is described in the two latest volumes ("Transactions of the Bose Research Institute, Calcutta." Vols. VII. and VIII. Longmans, 25s. and 21s.). Bose's own papers describe an investigation of the method of catching fish by throwing plant extracts into the water of hill streams. The respiratory mechanism of the fish appears to be paralysed by the extract. G. C. Bhattacharjee has photographed the fish-eating spiders of Bengal in the moment of capturing their prey and has given an interesting description of their behaviour. P. C. Basu has started anthropological studies in the institute by a paper on Burmese crania. The volumes contain many papers on experimental plant physiology treated in the characteristic Bosian style. They contain a large number of new facts the significance of many of which is obscure if one is unable to accept Bose's theoretical assumptions.



## FALLECIO AYER EL NATURALISTA HINDU SIR JAGADIS CHUNDER BOSE

Calcuta, noviembre 23 (United) — En su residencia de Giridin, falleció hoy, a consecuencia de un ataque cardíaco, el sabio naturalista hindú sir Jagadis Chunder Bose, quien iba a cumplir la semana próxima 79 años de edad.

### PERSONALIDAD DEL SABIO CHUNDER BOSE

Hay una misteriosa afinidad espiritual entre el gran naturalista hindú cuyo fallecimiento anuncia el



cable y aquel insigne Fabre, "el poeta de los insectos", que consagró su larga y fecunda vida a estudiar el instinto maravilloso de aquellos pequeños seres. En efecto, así como Fabre se apartó de los trillados caminos de los naturalistas librescos y apegados a tediosas nomenclaturas para penetrar—llevado por su alta visión de una providencia infinitamente previsora y sabia—, el enigma de ese instinto perfecto que parece inteligencia y que en forma incomparable describe en su obra inmortal; el ilustre sabio hindú, imbuido desde niño en el principio védico de que "todos los seres tienen su vida interior", consagró lo mejor de su vida a la difícilísima y jamás antes intentada tarea de penetrar el misterio de una posible conciencia rudimentaria, o por lo menos de un grado de sensibilidad en las plantas.

No fué la botánica su vocación inicial, pues así como por un curioso encadenamiento de experimentaciones y observaciones, Pasteur se remontó de su estudio sobre los paratartratos y de sus trabajos sobre fermentaciones a la creación de la bacteriología, Jagadis Chunder Bose empezó a investigar el inmenso misterio de la vida, partiendo de los metales. Terminados sus estudios elementales en Calcuta, la madre de Jagadis, que presentía su genio, vendió las joyas que había heredado de sus antepasados y envió a su hijo a perfeccionar sus estudios en Londres y en Cambridge. Lo mismo que Fabre, Chunder Bose se interesó profundamente en la física y la química. Más de una vez se ha dicho que es a él a quien se debe la perfección alcanzada actualmente por el microscopio. Varias observaciones de gran importancia le debe la telegrafía sin hilos y no pocas teorías—combatidas por muchos, aceptadas por otros como posibles—, le debe la química.

En el curso de sus experimentos llamó profundamente su atención el "estímulo" provocado en una hoja de latón por cuerpos químicos, tales como el alcohol o el cloroformo. Ideó y construyó aparatos de una técnica admirable y de una precisión pasmosa, que permitieron comprobar que

ral bien podrían tener su equivalente, más pronunciado, más fácil de traducir y, por lo tanto, más inteligible, en el reino vegetal. Llevado por tal ilusión, dedicóse desde entonces a experimentar con diversas plantas, particularmente las que acusaban una mayor sensibilidad. Ya el genio de Carlos Darwin se había asomado por esa ruta en que tan difícil y lentamente penetrará el ansia de saber del hombre. Su obra "Movimientos y hábitos de las plantas trepadoras", fué indudablemente una guía para el investigador hindú.

Planeó entonces Jagadis Chunder Bose más de doscientos experimentos, para cuya realización tuvo que inventar nuevos y delicados aparatos. Sometió diversas especies de plantas a la influencia de fenómenos físicos, sobre todo eléctricos, y a la de cuerpos químicos, y esperó y observó pacientemente sus reacciones. Ya al iniciarse este siglo, en 1900, la diversidad, originalidad y profundidad de sus observaciones al respecto despertaron profundamente la atención del congreso científico internacional reunido ese año y consagraron su nombre como el de un sabio cuya obra vincula estrechamente la ciencia a la filosofía.

Durante los 37 años trascurridos desde la reunión de aquel congreso, Jagadis Chunder Bose no ha cesado sus esfuerzos por ahondar un poco más este aparentemente impenetrable misterio de la vida de las plantas. Compró los efectos que sobre ellas producen el sol, la electricidad, la "fatiga" y, más aún, entrevió el proceso de "la muerte" en la planta y en la semilla. Su obra "Respuesta de lo viviente y de lo no viviente" contiene sus innumerables y pacientes observaciones, y sin duda será el punto de partida para las investigaciones de resultados insospechados que en ese terreno han de emprenderse en el futuro.

Los interrogantes que plantea la labor realizada por Jagadis Chunder Bose a la ciencia y especialmente a la filosofía del futuro, son apasionantes y terribles. El límite que parecía separar inexorablemente a los reinos animal y vegetal, parece borrarse lentamente. Bose demostró que la circulación de la savia equivale a la circulación de la sangre. Para el sabio hindú, en la planta hay un comienzo de sistema nervioso, lo cual implica una probable sensibilidad en el vegetal. Pero esa sensibilidad sería una manifestación de algo que vagamente pudiera compararse a una conciencia rudimentaria. De ahí las preguntas que desde hace años, desde que Chunder Bose dió a conocer sus primeras observaciones, muchos pensadores—entre ellos el poeta Maeterlinck—, se han hecho: ¿Sentirá la planta? ¿Sufrirá el rosal cuando se le arranca una rosa? El prodigio de la inteligencia humana que culmina en el verso de Homero, en la cifra de Newton y en el método de Pasteur, ¿tendrá su remoto origen en la reacción que revela una planta sometida a influencias de diversos cuerpos?

Cualesquiera que sean las respuestas que la ciencia del futuro dé a tan aventuradas preguntas, así fueran negativas, el mérito insigne de quien primero las formuló con bases sólidamente científicas, será reconocido universalmente y contribuirá a aumen-

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cable y aquel insigne Fabre, "el poeta de los insectos", que consagró su larga y fecunda vida a estudiar el instinto maravilloso de aquellos pequeños seres. En efecto, así como Fabre se apartó de los trillados caminos de los naturalistas librecos y apeados a tediosas nomenclaturas para penetrar—llevado por su alta visión de una providencia infinitamente previsora y sabia—, el enigma de ese instinto perfecto que parece inteligencia y que en forma incomparable describe en su obra inmortal; el ilustre sabio hindú, imbuido desde niño en el principio védico de que "todos los seres tienen su vida interior", consagró lo mejor de su vida a la difícil y jamás antes intentada tarea de penetrar el misterio de una posible conciencia rudimentaria, o por lo menos de un grado de sensibilidad en las plantas.

No fué la botánica su vocación inicial, pues así como por un curioso encañamiento de experimentaciones y observaciones, Pasteur se remontó de su estudio sobre los paratratos y de sus trabajos sobre fermentaciones a la creación de la bacteriología, Jagadis Chunder Bose empezó a investigar el inmenso misterio de la vida, partiendo de los metales. Terminados sus estudios elementales en Calcuta, la madre de Jagadis, que presentía su genio, vendió las joyas que había heredado de sus antepasados y envió a su hijo a perfeccionar sus estudios en Londres y en Cambridge. Lo mismo que Fabre, Chunder Bose se interesó profundamente en la física y la química. Más de una vez se ha dicho que es a él a quien se debe la perfección alcanzada actualmente por el microscopio. Varias observaciones de gran importancia le debe la telegrafía sin hilos y no pocas teorías—combatidas por muchos, aceptadas por otros como posibles—, le debe la química.

En el curso de sus experimentos llamó profundamente su atención el "estímulo" provocado en una hoja de látex por cuerpos químicos, tales como el alcohol o el cloroformo. Ideó y construyó aparatos de una técnica admirable y de una precisión pasmosa, que permitieron comprobar que los metales, sometidos a ciertos estímulos, reaccionaban en una forma parecida a la de un músculo sometido a una excitación. Tales reacciones físicoquímicas en el reino mine-

ral bien podrían tener su equivalente, más pronunciado, más fácil de traducir y, por lo tanto, más inteligible, en el reino vegetal. Llevado por tal ilusión, dedicó desde entonces a experimentar con diversas plantas, particularmente las que acusaban una mayor sensibilidad. Ya el genio de Carlos Darwin se había asomado por esa ruta en que tan difícil y lentamente penetrará el ansia de saber del hombre. Su obra "Movimientos y hábitos de las plantas trepadoras", fué indudablemente una guía para el investigador hindú.

Planeó entonces Jagadis Chunder Bose más de doscientos experimentos, para cuya realización tuvo que inventar nuevos y delicados aparatos. Sometió diversas especies de plantas a la influencia de fenómenos físicos, sobre todo eléctricos, y a la de cuerpos químicos, y esperó y observó pacientemente sus reacciones. Ya al iniciarse este siglo, en 1900, la diversidad, originalidad y profundidad de sus observaciones al respecto despertaron profundamente la atención del congreso científico internacional reunido ese año y consagraron su nombre como el de un sabio cuya obra vincula estrechamente la ciencia a la filosofía.

Durante los 37 años transcurridos desde la reunión de aquel congreso, Jagadis Chunder Bose no ha cesado sus esfuerzos por ahondar un poco más este aparentemente impenetrable misterio de la vida de las plantas. Comprobó los efectos que sobre ellas producen el sol, la electricidad, la "fatiga" y, más aún, entrevió el proceso de "la muerte" en la planta y en la semilla. Su obra "Respuesta de lo viviente y de lo no viviente" contiene sus innumerables y pacientes observaciones, y sin duda será el punto de partida para las investigaciones de resultados insospechados que en ese terreno han de emprenderse en el futuro.

Los interrogantes que plantea la labor realizada por Jagadis Chunder Bose a la ciencia y especialmente a la filosofía del futuro, son apasionantes y terribles. El límite que parecía separar inexorablemente a los reinos animal y vegetal, parece borrarse lentamente. Bose demostró que la circulación de la savia equivale a la circulación de la sangre. Para el sabio hindú, en la planta hay un comienzo de sistema nervioso, lo cual implica una probable sensibilidad en el vegetal. Pero esa sensibilidad sería una manifestación de algo que vagamente pudiera compararse a una conciencia rudimentaria. De ahí las preguntas que desde hace años, desde que Chunder Bose dió a conocer sus primeras observaciones, muchos pensadores—entre ellos el poeta Maeterlinck—, se han hecho: ¿Sentirá la planta? ¿Sufrirá el rosal cuando se le arranca una rosa? El prodigio de la inteligencia humana que culmina en el verso de Homero, en la cifra de Newton y en el método de Pasteur, ¿tendrá su remoto origen en la reacción que revela una planta sometida a influencias de diversos cuerpos?

Cualesquiera que sean las respuestas que la ciencia del futuro dé a tan aventuradas preguntas, así fueran negativas, el mérito insigne de quien primero las formuló con bases sólidamente científicas, será reconocido universalmente y contribuirá a aumentar la gloria de la tierra milenaria de los Upanishads y los Vedas, que en nuestro siglo produce hombres tales como Tagore, Gandhi y Jagadis Chunder Bose.

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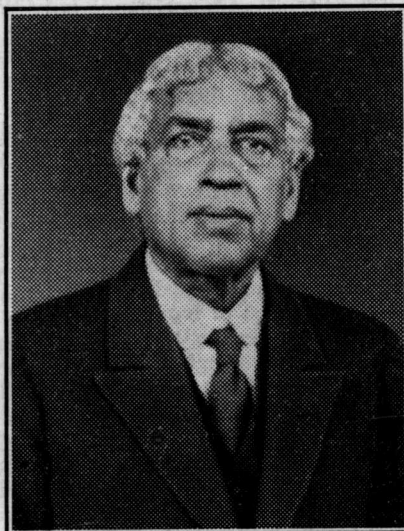
## SIR JAGADIS BOSE

### THE FOREMOST INDIAN SCIENTIST

Our Calcutta Correspondent telegraphs that Sir Jagadis Bose, F.R.S., died at Giridih, Bengal, yesterday, having nearly reached the age of 79.

The reputation he won by persistent investigation and experiment as a physicist was extended to the general public in the Western world, which he frequently visited, by his remarkable gifts as a lecturer, and by the popular appeal of many of his demonstrations. He had a keen sense of humour and powers of clear exposition, and he knew well how to draw general attention to his work without transgressing the unwritten code among scientists of restraint in statement and reticence in announcing conclusions. The ordinary newspaper reader was attracted by accounts of this wizard from the East having shown the possibility of intoxicating a plant or a bar of steel; that plants have vascular and muscular systems analogous to those possessed by animals; that plant growth may be detected in fiddle-strings; and that cobra venom has its reactions on the heart-beats of plants. He was in fact the first Indian of modern times to gain, at the price of untiring labour, a permanent place in the history of scientific discovery.

Jagadis Chandra Bose was born at Vikrampur, near Dacca, on November 30, 1858, the son of a deputy magistrate, who was active in public work beyond that of his ordinary routine. The inventive bent of Bose's mind received its first impetus in the industrial and technical schools established by



his father. After graduating from St. Xavier's College, Calcutta, he came to England and entered at University College, London, intending to pursue the medical profession. But

leigh, chose physics as his chief study. He took a second class in the Natural Sciences Tripos of 1883, and later received the D.Sc. degree of London.

When he returned to Calcutta, Lord Ripon's Government appointed him, a non-European, to the chair of physical science at the Presidency College. There were emphatic protests, both from the principal and from the provincial Director of Public Instruction, but Bose quickly proved his capacity as a teacher, and was confirmed in what was at first a temporary appointment.

Though the Presidency College was ill equipped with laboratory apparatus, the young professor lost no time in undertaking a series of experiments. He designed an instrument identical in principle with the "coherer" subsequently used in all systems of wireless communication. Another early invention was an instrument for verifying the laws of refraction, reflection, and polarization of electric waves. These instruments were demonstrated on the occasion of his first appearance before the British Association at the 1896 meeting at Liverpool.

From these physical inquiries Bose passed to the more difficult problems presented by the response of living organisms to various stimuli, and he investigated more particularly the electrical reactions of plants. The work was new and obscure, the methods of operation unknown, and mechanical aids non-existent. After long and patient research, he adumbrated the theory that the life mechanism of the plant is identical with that of the animal. To record the minute movements of the most delicate organs of plants he invented highly ingenious apparatus. Of these the most generally known is perhaps the crescograph, with which he experimented before audiences in Europe and America. It is a growth recorder capable of magnifying small movements as much as 10,000,000 times. He aimed at nothing less than a synthesis of science, and his achievements provide a unique example of the virtual union between the immemorial mysticism of Indian philosophy and the experimental methods of Western science. While making full use of these methods, he never lost the inspiration of his inherited monism.

Bose was the Indian Government delegate to the International Scientific Congress in Paris in 1900, and his two volumes on "Life Movement in Plants" were translated for incorporation in the Transactions. His output of papers before the Royal Society and other learned bodies, and of books published in India and this country, some of them translated into French, was large. He issued a complete account of his researches, "Nervous Mechanism of Plants," in two volumes in 1926.

Bose attracted enthusiastic supporters in scientific circles; but some distinguished physiologists were not prepared to accept all his conclusions, and this delayed his admission to the Fellowship of the Royal Society till 1920. He was the first Indian to reach this goal for scientific, as distinct from mathematical achievement. In a letter to *The Times* he complained that the necessary difficulties of his investigations had been, during a period of nearly 20 years, greatly aggravated by misrepresentations and worse. But the conclusion, he added, was happily seen in his nomination to the fellowship of the Royal Society, and the obstacles deliberately placed in his path he could now ignore and forget. Educated Indians took a natural pride in the fame of his researches, and the way in which he linked the results with Eastern philosophic thought. He gathered round him a band of devoted helpers, and he owed much of his success to the care and unflinching cooperation of his wife, a cultured Bengali lady who had



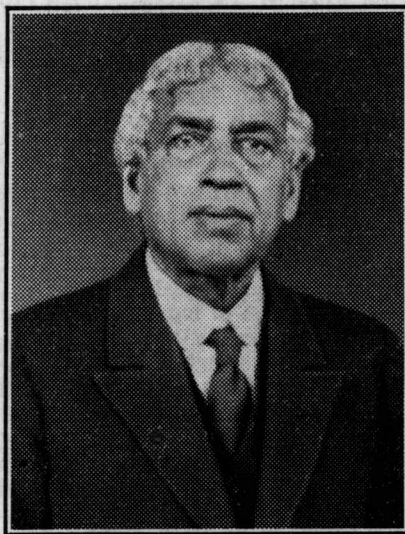
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From Government Bose received every encouragement and support when he had proved his worth. He was made a C.I.E. in 1903, and a C.S.I. in 1911, and received his knighthood in 1917. His academic honours included honorary degrees from Aberdeen, Calcutta, Lahore, Allahabad, and Benares. His occupancy of his chair at Presidency College was extended beyond the age limit, and after his retirement in 1915, on full pay instead of pension, he was made Professor Emeritus.

There followed an important development of his work. He devoted his private means and the substantial grants obtained from Government to the establishment and organization of the Research Institute in Calcutta which bears his name. With a characteristic sense of dramatic fitness, he formally dedicated the Institute to the Indian nation, before a large and influential audience, in 1917. It is equipped with numerous laboratories and with workshops for the making of the extremely delicate instrument Bose invented for experiment and demonstration. The founder was particularly anxious that young Indian graduates in science should devote themselves to research in agriculture. The post-graduate students have worked under the direction of the founder for a mere pittance, and the institute is entirely Indian in inspiration, architecture, and personnel. But Bose erected hostels for the research workers from all over the world whom it was his ambition to attract to the institute.