

# UNIVERSITY OF MYSORE

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## THE SRI KRISHNARAJENDRA SILVER JUBILEE LECTURE, 1941

(Founded by Mr. V. SUBRAHMANYA IYER, B.A.)

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Dr. K. S. KRISHNAN, D.Sc., F.R.S.,  
(Mahendralal Sircar Professor of Physics, Calcutta),

will deliver the lecture

ON

*Saturday, the 11th October, 1941, at 6 p.m.,  
in the Intermediate College, Bangalore.*

*Subject :*

### The Place of Fundamental Research in Industrial Progress

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Dr. J. C. GHOSH, D.Sc., F.N.I.,  
Director, Indian Institute of Science, Bangalore,  
will preside.

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NOTE.—Admission to the lecture will be by tickets for which application should be made to the Principal, Central College, Bangalore. The students of the University Colleges should show their College Membership cards.

UNIVERSITY OFFICE, }  
MYSORE, }  
30th September, 1941. }

C. S. PICHAMUTHU,  
Registrar. }

# The Place of Fundamental Research in Industrial Progress

I deeply appreciate the honour of being invited to give the Sri Krishnarajendra Jubilee Lecture, and I take this opportunity to express my thanks to the Mysore University. <sup>Though</sup> the choice of my subject, namely "The Place of Fundamental Research in Industrial Progress" was determined to some extent by the conditions of the Lectureship Trust, there is an appropriateness in the choice of this <sup>particular</sup> subject for a lecture <sup>before an audience</sup> in Bangalore. There is something in Bangalore soil, probably in Bangalore air, which makes both fundamental researches and the industries thrive better than in many other parts of India. Here in Bangalore you are served hot from the anvil, some of the latest results of fundamental research of far reaching importance, in the same way in which you are, or will soon be, with some of the latest models in <sup>aircraft.</sup> ~~air craft.~~

There is an intimate relation between fundamental research and <sup>the</sup> industrial <sup>es.</sup> ~~progress~~, much more intimate than is generally realized in India, and it will be my endeavour in this lecture to emphasise this relation.

Science, as we understand by the ordinary connotation of that term, is as old as man. It was ~~z~~ born when man began to observe, ~~and~~ think, and draw inferences. The earliest recorded experiment was that of the first man when he tasted the forbidden fruit, and all through the ages one may detect in some of the applications of Science a touch of that viciousness. ~~xxxxxxxxxxxx~~ It merely shows that the Scientist too, ~~a touch of~~ ~~that viciousness~~ is human. But on the whole, science has been

beneficial, and has contributed much to the intellectual and cultural development of mankind, and in an even larger measure to its material progress. The contributions of Pythagoras, Archimedes, Galileo, Newton, Darwin, Pasteur and Einstein to our intellectual and cultural heritage will compare favourably with the contributions of the philosophers, ~~or~~ the poets or the artists. Intellectually, the ~~works~~<sup>it works</sup> are some of the best productions of the human mind. It was the great Lagrange who said " If you wish to see the human mind truly great enter Newton's study when he is decomposing white light, or unveiling the system of the world. " Many <sup>works of art,</sup> ~~Some~~ of them are also ~~perfect artistic~~ <sup>nearly the same</sup> ~~pieces, little gems,~~ which give us ~~as much~~ aesthetic pleasure as the best poetry, or music, or painting. It is as it should be. If art ~~according to Aristotle,~~ "is an ~~im~~itation of nature", science is ~~Nature~~ herself unveiled.

Take for example the famous Equations of Maxwell, or Fourier's Theorem, ~~or Fermat's,~~ or the Bohr model of the atom, or the ~~relativis-~~<sup>is</sup>tic universe. Apart from their immense importance to Science, they all have a personality and a beauty of their own. They are all productions impelled by the creative urge in the artist.

It is not surprising that these creative minds were content with ~~deify~~<sup>the cultivation of</sup> science for its own sake, and did not ~~worry~~<sup>bother</sup> about its applications. The ~~famous~~<sup>well-known</sup> toast for Science, "Let it be of no use to any one at any time", expresses no more than the natural desire of the

creative artist to be left ~~alone~~ to do his work. The saying generally attributed to Gauss to the effect that "if mathematics is the queen of the Sciences, then the theory of numbers is, because of its supreme uselessness, the queen of mathematics," ~~also~~ expresses the same sentiment. <sup>Probably it ~~also~~ (also, Professor)</sup> Hardy believes, <sup>the</sup> a sense of rejoicing that when ~~science~~ <sup>Scientific Knowledge</sup> is being so much misused, there are some

<sup>of science</sup> branches/at any rate "whose remoteness from ordinary human activities should keep them gentle and clean". ~~It may also express~~ <sup>is also expressed in</sup> Speaking about the toast for

*We find the same sentiment expressed in science, I am reminded of a story in the Mahabharata. When man*

was granted certain new powers, all the wise men gathered together to deliberate on how best to use them. Their first choice was for not using the new powers at all. Their second was for using them in the cause of Truth, their third in the cause of Dharma, their fourth in the cause of Love. How much one wishes that ~~all~~ those in whose hands have been placed the newly acquired powers of Science, follow ~~the~~

this <sup>wise</sup> counsel, ~~of the wise men. Even in the Mahabharata days there were not many who acted up to this advice.~~ <sup>New para</sup> [While speaking about the ~~misuse~~

misuse of science, I wish to refute a charge which is frequently made, and I think ~~but~~ unfairly, laying the responsibility for the misuse on the shoulders of the ~~scientist~~ <sup>Scientist</sup>. The accomplishments of science, as Saranoff once

said, may be an adjunct of war, but they are not the cause of it.

Belligerency is a state of mind, ~~and~~ not of matter, and therefore the scientist is not concerned with it.

We can understand the ~~attitude~~ <sup>desire</sup> of the pure scientist, engaged in fundamental research~~es~~, to be left alone to do his job, ~~which~~ <sup>It-</sup> is a (desire which we should) ~~very~~ natural. ~~We must~~ appreciate ~~it~~ and encourage ~~it~~. In these days when there is so much lip sympathy given to intellectual freedom it is refreshing to find that there are at least some who ~~appreciate~~ <sup>value</sup> that freedom and ~~maintain~~ <sup>cherish</sup> it. The fundamental researcher belongs to this small class. But for that freedom scientific research would be impossible.

~~Having said so much for the attitude of the fundamental~~

~~researcher, it is not surprising that the scientific community has~~

If science had done nothing more than help us to understand nature, and to give us intellectual and aesthetic pleasure in the pursuit of it, it would have wholly justified itself. But science has done much more than that. ~~Actually~~ <sup>even we</sup> In practice, fundamental sciences are ~~not~~ so wholly isolated, or so far removed, from human activities as the ~~creators of the sciences~~ <sup>creative scientists</sup> would wish us to believe. ~~It~~ <sup>Their</sup>

influence on human activities has been immense. Darwin's theory of evolution, which is a product of ~~the~~ pure academic research, has alone wrought more changes in the social outlook of man, than any of

major revolutions in history. Take again the discoveries of wireless waves, photo-electricity, X-rays, radioactivity, the electron and the rare gases, which followed one another in quick succession at the end of the last century. All of them were discoveries made in the laboratory, in response to the creative urge in the scientist, and without any regard to their possible technical applications. These discoveries have not only revolutionized physics — the new physics initiated by these discoveries bears little resemblance to the old physics — but have also found numerous applications in industries. Almost any modern industry if not directly based on some of these fundamental discoveries, makes use of them in some form or other.

Indeed one may even assert that there is hardly any branch of fundamental science, which does not find application <sup>it</sup> firstly in other branches of science, and ultimately in the industries. Take for example even some of the abstruse branches of mathematics. It was by a mathematical analysis, based on spherical harmonics, of the distribution of earth's magnetism over its surface, that Gauss was led to postulate the existence of an electrically conducting layer in the upper regions of the atmosphere, <sup>is now known to</sup> which ~~play~~ such an important part in the propagation of wireless waves over long distances on the surface of the earth. This postulate by Gauss is all the more remarkable when we remember that at the time it was made, the atmosphere was known to a bad conductor of electricity. Take again

the theory of numbers, to whose ~~xxxxx~~ supreme uselessness Gauss referred with some pride. The modern practice in the splicing of long distance telephone cables is based on a

But in order that the results of fundamental research may reach the industries we naturally need a large group of scientific men, fully equipped with the available knowledge of the fundamental sciences, who will apply them for industrial purposes; i.e. ad hoc researchers, who will take up ~~the various~~ <sup>(are of importance to the</sup> problems that ~~arise in the~~ industries and tackle them. These ad hoc researchers serve a very ~~important part,~~ <sup>useful purpose,</sup> and it is to them that we owe ~~much~~ much of the gradual filtration of the results of fundamental research, into the industries, <sup>also</sup> and the ultimate spreading of the fruits of science to <sup>the spheres of</sup> various human activities. Particularly in India, which is industrially so back <sup>ward</sup> ~~and~~, so much behind the times, we need <sup>many</sup> ~~more~~ ~~of~~ of such ad hoc researchers.

One has merely to look round to be reminded that we are living in a scientific age. Whether we like it or not, science has come to stay, and it is to science that most civilized countries owe their high standard of living. If our aim in India is to have a similar high standard of living, and in particular to provide more and more creative leisure for all — a privilege which at present is enjoyed by only a few — then some kind of organized production of the needs of man, i.e. some kind of industrialization, is inevitable. Opinions may differ as to whether the production should be on a large scale, or on the scale of cottage industries; but there is no doubt that if India is to take her place among the progressive nations, she has ~~to~~

definitely to take to industrialization. In this industrialization the scientist~~ist~~ will naturally play a very important part; not only in the organization of the industries, and in carrying on the normal routine work, but also in tackling the many little problems that arise in the industries, on the solution of which the success of the industries mainly depends. This is indeed so widely recognized that many progressive industrial concerns do spend large sums of money on such ad hoc researches, and many of them possess well equipped laboratories for research.

One should not therefore minimize the value of such ad hoc researches~~#~~ to the industries<sup>r</sup>. Probably the best representative of ad hoc research is Edison, and his genius consisted in choosing

problems that were most likely to find <sup>imme</sup>mediate application, and in ~~make~~ making a frontal attack on those problems. <sup>Only once, and that was when he invented</sup> ~~once he made the~~

~~mistake of inventing something that was not wanted, namely the vote-~~

~~the vote-recorder, a mechanical device intended to furnish complete lists of~~  
~~a according to his official biographers he made the mistake of inventing something that was not~~  
all the members voting on the two sides of a question. <sup>But</sup>

fortunately, ~~as his official biographers remark,~~ the vote-recorder was the first Edison Patent, and he thus learnt his lesson early in his career, to confine his inventive faculties only to things for which there <sup>was</sup> ~~is~~ a real and genuine demand.

But the world has ~~not~~ produced many Edisons, though there has been a great need for them; they are rarer than the returns of Halley's comet. This historical fact is ~~very~~ <sup>not without sig</sup> significant. There

are serious limitations to what can be accomplished by <sup>the</sup> ad hoc type  
of research. It is seldom that one can force ~~on~~ <sup>a</sup> secret out of Nature.  
She has to be ~~forced~~ <sup>coaxed</sup> in a hundred different ways before she can be  
induced to part with ~~it~~ <sup>a secret</sup>. One has to cultivate her company for a  
long time to understand her ways and her workings. That is why  
fundamental research, in the long run, is likely to be much more  
helpful to the industries than ad hoc research.