HINDU ACHIEVEMENTS IN EXACT SCIENCE

A Study in the History of Scientific Development

BY

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HISTORICAL PERSPECTIVE

INVESTIGATIONS in radioactivity since 1896 have effected a marvellous revolution in our knowledge of Energy. The ultimate atoms of matter are now believed to possess "sufficient potential energy to supply the uttermost ambitions of the race for cosmical epochs of time."

Speaking of these new discoveries in connection with radioactivity, Professor Soddy remarks in his "Matter and Energy":

"It is possible to look forward to a time, which may await the world, when this grimy age of fuel will seem as truly a beginning of the mastery of energy as the rude stone age of palaeolithic man now appears as the beginning of the mastery of matter."

This optimism seems almost to out-Bacon Bacon's prophecy in the "Novum Organum" (1621) relating to the wonderful achievements he expected from a "new birth of science." The "new birth" was inevitable, he declared, "if any one of ripe age, unim-

paired senses, and well-purged mind, apply himself anew to experience and particulars."

Becquerel's discovery of radioactive substances is thus a quarter less than three hundred years from Bacon's first advocacy of experimental and inductive methods. The "long and barren period" between the scientific activity of ancient Greece and that of modern Europe, described by Whewell as the "stationary period of science," was drawing to a close in Bacon's time. The age was, however, yet "dark" enough to be condemned by him in the following words:

"The lectures and exercises there (at the universities) are so ordered that to think or speculate on anything out of the common way can hardly occur to any man. Thus it happens that human knowledge, as we have it, is a mere medley and ill-digested mass, made up of much credulity and much accident, and also of childish notions which we at first imbibed."

Positive Science is but three hundred years old. It is necessary to remember this picture of the intellectual condition of Europe at the beginning of the seventeenth century in every historical survey of the "exact" sciences (whether deductive-mathematical or inductive-physical), as well as in every comparative estimate of the credit for their growth and development due to the different nations of the world.

Hindu investigations in exact science, as briefly

summarized here, come down to about 1200 A.D. Strictly speaking, they cover the period from the "Atharva Veda" (*c* 800 B.C.), one of the Hindu Scriptures, to Bhaskaracharya (*c* 1150), the mathematician; or rather to the middle of the fourteenth century, represented by Madhavacharya, the compiler of "The Sixteen Systems of Philosophy" (1331), Gunaratna (1350), the logician, "Rasa-ratna-samuchchaya," the work on chemistry, and Madanapala, author of the "Materia Medica" (1374) named after himself.

We are living to-day in the midst of the discoveries and inventions of the last few years of the twentieth century, e.g., those described in Cressy's volume. To the moderns, therefore, the whole science of the Hindus exhibited here belongs to what may be truly called the pre-scientific epoch of the history of science. Its worth should, however, be estimated in the light of the parallel developments among their contemporaries, the Greeks, the Chinese, the Graeco-Romans, the Saracens, and the mediæval Europeans.

Whewell, according to whom the scientific inquiries of the ancients and mediævals "led to no truths of real or permanent value," passes the following summary and sweeping judgment on all these nations:

"Almost the whole career of the Greek schools of philosophy, of the schoolmen of Europe in the Middle Ages, of the Arabian and Indian philosophers, shows that we may have extreme ingenuity and subtlety, invention and connection, demonstration

and method; and yet out of these no physical science may be developed. We may obtain by such means logic and metaphysics, even geometry and algebra; but out of such materials we shall never form optics and mechanics, chemistry, and physiology."

Further, "the whole mass of Greek philosophy shrinks into an almost imperceptible compass, when viewed with reference to the progress of physical knowledge." "The sequel of the ambitious hopes, the vast schemes, the confident undertakings of the philosophers of ancient Greece was an entire failure in the physical knowledge."[76]

While accepting for general guidance the above estimate of Whewell regarding the ancients and mediævals, the student of Culture-history would find the following noteworthy points in a survey of the world's positive sciences from the Hindu angle:

1. The "pure" mathematics of the Hindus was, on the whole, not only in advance of that of the Greeks, but anticipated in some remarkable instances the European discoveries of the sixteenth, seventeenth, and eighteenth centuries. That mathematics is the basis of the mathematical science known to modern mankind.

2. Like the other races, the Hindus also may be taken to have failed to make any epoch-making discoveries of fundamental "laws," planetary, inorganic, or organic, if judged by the generalizations of to-day. But some of their investigations were solid achieve-

ments in positive knowledge, viz., in materia medica, therapeutics, anatomy, embryology, metallurgy, chemistry, physics, and descriptive zoology. And in these also, generally speaking, Hindu inquiries were not less, if not more definite, exact, and fruitful than the Greek and mediæval-European.

3. Hindu investigations helped forward the scientific developments of mankind through China (and Japan) on the east and the Saracens on the west of India, and this both in theoretical inquiries and industrial arts.

4. Since the publication of Gibbon's monumental history, the historians of the sciences have given credit to the Saracens for their services in the development of European thought. Much of this credit, however, is really due to the Hindus. Saracen mathematics, chemistry, and medicine were mostly direct borrowings from Hindu masters. The Greek factor in Saracen culture is known to every modern scholar; the Hindu factor remains yet to be generally recognized. That recognition would at once establish India's contributions to Europe.

5. Every attempt on the part of modern scholars to trace the Hellenic or Hellenistic sources of Hindu learning has been practically a failure.

6. But, like every other race, the Hindus also got their art of writing from the Phœnicians. Besides, the Hindus may have derived some inspiration from Greece in astronomy as admitted by their own scientists, e.g., by Varahamihira (505–587 A.D.).

India's indebtedness to foreign peoples for the main body of her culture is virtually nil.

7. Hindu intellect has thus independently appreciated the dignity of objective facts, devised the methods of observation and experiment, elaborated the machinery of logical analysis and truth investigation, attacked the external universe as a system of secrets to be unravelled, and wrung out of Nature the knowledge which constitutes the foundations of science.

8. The claims of the Hindus to be regarded as pioneers of science and contributors to exact, positive, and material culture rest, therefore, in all respects, on the same footing as those of the Greeks, in quality, quantity, and variety. An absolute superiority cannot be claimed for either, nor can any fundamental difference in "weltanschauung," mental outlook, or angle of vision be demonstrated between these two races.

It has been remarked above that the age of experimental and inductive science is about three hundred years. It is this period that has established the cultural superiority of the Occident over the Orient. But this epoch of "superiority" need be analyzed a little more closely.[55]

Neither the laws of motion and gravitation (of the latter half of the seventeenth century), nor the birth of the sciences of modern chemistry and electricity during the latter half of the eighteenth could or did produce the superiority in any significant

sense. There was hardly any difference[48] between Europe and Asia at the time of the French Revolution (1789). The real and only cause of the parting of ways between the East and the West, nay, between the mediæval and the modern, was the discovery of steam, or rather its application to production and transportation. The steam engine effected an industrial revolution during the first three decades of the nineteenth century. It is this revolution which has ushered in the "modernism" of the modern world in social institutions, science, and philosophy,[30] as well as brought about the supremacy of Eur-America over Asia.

The year 1815 may be conveniently taken to be the year I of this modernism, as with the fall of Napoleon it marks also the beginning of a new era in world-politics, practically the era in which we still live. The difference between the Hindu and the Eur-American, or between the East and the West, is a real difference to-day. But it is not a difference in mentality or "ideals" or so-called race-genius. It is a difference of one century, the "wonderful century," in a more comprehensive sense than Wallace gives to it.