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Speech for the Opening Meeting of the Fifteenth International Congress of the History of Science at Edinburgh (11th Aug, 1977)

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Joseph Needham (Great Britain)

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Chairman and Friends:

My assignment today, as I understand it, is to say something about the Second International Congress of the History of Science, the only previous one held in the United Kingdom; to mention some of the great historians of science which these islands have produced; and to direct our thoughts for a few moments to the historiography of science, technology and medicine, namely the guiding ideas in the light of which one should attempt to write it. So much has already been said in thanks to the city and the university in which we are now assembled that I could hardly add to it, except to express my personal sense of elation at coming on this occasion to the "Athens of the North" where so many distinguished men have lived in the past, from mediaeval times onwards.

The 1931 Congress took place in London in June and July. I must be one of the very few people who were also present on that occasion, and I am sure I am the only member left of its organising council, to which I was invited by the secretary, that great historian of the steam-engine, and of engineering in general, H. W. Dickinson. Probably I owed my co-option to the history of embryology which I had written for the first volume of *Chemical Embryology*, published earlier the same year. The President of the Congress was Charles Singer, and the Treasurer was the crystallographer and physicist, Sir William Bragg. Of course the organising body was in the first place the Comité international d'histoire des sciences, of which Aldo Mieli was the Secrétaire Perpétuel. The meetings of the Congress took place at the South Kensington Science Museum, and there were visits to Darwin's home, Down House, in Kent, to the British Museum for an exhibit and demonstration on the first century of science in England, *i.e.* Giordano Bruno to Isaac Newton (1584-1687), to the National Portrait Gallery where many paintings of famous scientists were exhibited, and to Crosby Hall in Chelsea, associated with the name of Sir Thomas More. There were many other visits as well, as may be seen from a copy of the programme,

which I have brought with me; and the badge, which I am happy to be wearing today, was a representation of an ecliptic armillary sphere. Some of the symposia were exceptionally interesting; for example, one on "The Historical and Contemporary Inter-relationship of the Physical and Biological Sciences" to which there were contributions, among others, by J. S. Haldane (one of the last things he ever wrote) J. H. Woodger, Lancelot Hogben, L. L. White, and A. Joffe.

But the main excitement of the Congress was the unexpected appearance of an important delegation from the Soviet Union, headed by none other than N. I. Bukharin himself. The group consisted of at least a dozen members, and I have a vivid recollection of Charles Singer in the presidential chair trying to shut the Russians up after they had each had their twenty minutes, by the comic expedient of a large ship's bell which he continuously rang. The Russians had of course come expecting to be able to speak for at least an hour each, and they would have been well worth listening to. The greatest sensation was produced by Boris Hessen with his paper on *The Social and Economic Roots of Newton's "Principia"*, in which he maintained that however remote Isaac Newton's interests may have appeared to be from the ordinary world of men, they were in fact induced by the needs of the rising bourgeoisie for aid in commerce, transport, war, etc. This may be called "vulgar Marxism" today, but I prefer to think of it as a plain blunt Cromwellian statement. It started an intellectual battle, the reverberations of which can still be heard, even at one of the symposia of the present Congress. Another important contribution was that of the ill-fated N. I. Vavilov on *The Problem of the Origin of the World's Agriculture in the Light of the Latest Investigations*; and to mention a third, on the borderline of the philosophy of science, there was B. Zavadovsky on *The "Physical" and "Biological" in the Process of Organic Evolution*, a presentation which had much influence on the thinking of those concerned with theoretical biology. The Russians, piqued at not being able to set forth their ideas in full, had all the papers printed by Kniga, a Soviet press which existed in London at that time, and the book *Science at the Cross-roads* probably had much more influence than they themselves would have had if they had been able to talk for hours. It was re-issued in 1971 by Cass of London, with a new introduction by P. G. Werskey.

It is not possible to think of the London Congress without recalling Charles Singer, that scholar of outstanding geniality and kindness, to whom I myself would claim a filial relation even though I never attended a single formal course of lectures by him. Charles Singer (1876-1960) worked first in Oxford, where he published his *Studies in the History and Method of Science* in 1917. Thereafter followed classical books in short order, the history of anatomy in 1925, the history of medicine in 1928, the history of biology in 1931, the history of science in general in 1941, and finally, in comparatively old age, the splendid feat of producing five volumes (with the aid of others as editors and contributors), on the history of technology in general (1954-1958). His spouse, Dorothea Singer (1882-1964), was also a distinguished historian of science in her own right, noted especially for her catalogue of Latin alchemical manuscripts, produced between 1924 and 1931, and for her definitive book on Giordano Bruno in 1950. It was in the late twenties, when working on my history

of embryology, that my wife and I got to know Charles and Dorothea Singer on the basis of personal friendship, and if I may so speak, discipleship, which lasted right down to the time of their own deaths in the sixties. We often used to spend weekends or whole weeks with them in London, and later at Kilmarth in Cornwall, that beautiful manor-house overlooking St. Austell's Bay, not far from the town of Par and quite near the little fishing village of Polkerris. I was thus able to make use of Charles Singer's wonderful personal library in its romantic setting overlooking the sea; and I would go so far as to say that if there is any person more than any other whom I have missed during the past twenty years it has been Charles. Besides a vast equipment of scholarly skills, he had a most judicious mind, but that did not conflict with an ever-bubbling sense of humour and a basic optimism. I remember occasions when I was working at the far end of the library at Kilmarth, and suddenly Charles would be heard chuckling away to himself at the other end; when I investigated, it would be something that Galen had said in the work on anatomy which he was translating. The faculty of finding amusement even in the driest writers of the past is something for which I always envied Charles. I have so many memories connected with Kilmarth, for example accompanying him down to Polkerris, Charles with a majestic alpenstock, to collect the gar-fish which the mariners saved for us since it will not sell on the ordinary market. This is most delicious to eat, but ordinary people avoid it because of its green bones in which it has a habit of accumulating biliverdin. Or we would go and swim at the end of the pier at Polkerris, or spend an afternoon attacking the overgrowth on the paths round the estate with machetes. Charles Singer also did something which I have not known other historians of science to do—he bought very widely in the field, much more so than he actually needed for his own work, and then with the expenditure of a little time in describing the items he would sell them again through dealers and so successfully add to his research funds. Charles Singer was unforgettable, and is unforgotten.

If only he were here now he would summarise much better than I can the contributions of these islands to the history of science during the past few centuries. We are indeed an International Congress, but it is reasonable to allow a few minutes for celebrating the achievements of the people of the country which receives the great assembly from all over the world. If Francis Bacon was "the Bell that call'd the Wits together", and modern science began with him as well as with Galileo and the others, then the history of science could be regarded as one of the effects of modern science itself. To us Cambridge men, William Whewell (1794-1866) looms the largest, and it may be significant that in the preface to his *History of the Inductive Sciences* published in 1837, he traces his ideas back to Bacon's *Advancement of Learning* and the *Novum Organum*. He dedicated the book to another Englishman, the astronomer Sir John Herschel, but he based his work on the earliest histories of science written in other European countries, notably Montucla for mathematics, Delambre and Bailly for astronomy, Gmelin for chemistry, and Sprengel for botany—these were all of the eighteenth or earlier nineteenth century. Three years after his history, he published his *Philosophy of the Inductive Sciences, founded upon their History* and this he dedicated to Adam Sedgwick. In 1848 he founded both the Natu-

ral Sciences Tripos and the Moral Sciences Tripos at Cambridge, and eighteen years afterwards he died as Master of Trinity College. Basically Whewell was a geologist and mineralogist, but he also did massive work on the phenomena and theory of the tides. Whether anyone in Cambridge had made any study of the history of the sciences and technologies before his time, I do not know, but I doubt it; certainly little or nothing was done thereafter for the next hundred years, so narrow and conventional were the lines of study which custom consecrated in Cambridge.

Almost a century, however, after the first publication of Whewell's book, the ice-jam began to break up. In 1936 two things happened which inaugurated a new era. First Hamshaw Thomas, the botanist of Downing College, organised in the Old Schools a loan exhibition of historic scientific apparatus collected from the Scientific Departments and the Colleges. It formed a memorable collection and the exhibits were catalogued by R. T. Gunther (1869-1940), who later described them in his *Early Science in Cambridge*. Gunther was famous also for his book on astrolabes, published in 1932. In the same summer (1936), the Faculty Board of Biology **B**, goaded to fury by my continuous repetition of a slogan something like *Carthago delenda est*, in other words, that something must be done about the history of science in Cambridge, appointed me a committee of one to co-opt others and organise a History of Science Lectures Scheme. This I succeeded in doing, with the support of the Faculty Board of Biology **A** and that of Physics and Chemistry. Our first committee included besides Hamshaw Thomas, Sir William Dampier (1867-1952), whose well-known history of science had appeared in 1929, Desmond Bernal the crystallographer, Herbert Butterfield the historian (later Master of Peterhouse and well-known for his masterly account of the scientific revolution) and Michael Postan the economic historian. As secretary we obtained the services of Walter Pagel, then a tuberculosis pathologist, but later to be world-renowned for his Helmontian and Paracelsian studies. Such were the beginnings of the History of Science Department in Cambridge, which at present includes an *ad hominem* Professorship, two Readerships, three University Lectureships, one Assistant Lecturer, and one Assistant Director of Research (the celebrated editor of the *Collectaneum Whitesideanum* of Isaac Newton's manuscripts). With the Department is associated the Whipple Museum of the History of Science with its Curatorship.

"Let us now praise famous men, and our fathers that begat us...". Whewell, Singer and Dampier we have already mentioned, but as a general historian of science we ought not to forget also the name of Abraham Wolf of University College, London, whose very useful histories of science, technology and philosophy in the seventeenth and eighteenth centuries came out in 1935 and 1938. I should like to recall also the mild and amiable Librarian of the Science Museum at South Kensington, H. T. Pledge, whose *Science since 1500*, also very useful, came out in 1939. On the background of Greek science, there were several distinguished names, for example Cyril Bailey (1871-1957) who dealt with the Greek atomists, Francis Cornford (1874-1943) who wrote of Greek scientific philosophy in general, and Ben Farrington (b. 1891), who explored the social relations of science in ancient Greece in books between 1941 and 1948.

In the field of mathematics Britain produced a really outstanding writer in Sir Thomas Heath (1861-1940) to whom we owe many books on the elucidation of Greek mathematics, perhaps the most famous of which appeared in 1921. There was also J. K. Fotheringham (1874-1936), expert in ancient mathematical astronomy and calendrical science. In astronomy proper we can go back to a much earlier time and to one of the figures of the scientific revolution itself, namely Edmund Halley (1656-1742) after whom is named the comet, for he made much study of Greek mathematics and astronomy, publishing an important book on the subject in 1710. In the very same year was born George Costard, who followed Halley as a historian of astronomy and before he died in 1782 extended Halley's work to cover much information taken from Arabic authors. In this field he followed of course another Oxford Arabist, John Greaves (1602-1652). Naturally enough, Britain contributed a number of specialists on Indian astronomy, notably Edward Burgess, whose translation of the *Sūrya Siddhānta* was published in 1860. Long before him, of course, there had been the *Asiatick Researches* launched by Sir William Jones (1746-1794) in Calcutta, and great Sanskritists such as H. T. Colebrooke (1765-1837) who studied deeply Indian mathematics. Here in Edinburgh there was John Playfair (1748-1819), the Professor of Natural Philosophy, who took great interest in Indian astronomy. Most of the early work on the history of Chinese astronomy, however, was done in France. Among other historians of astronomy in this country one should mention Robert Grant of Scotland, whose history of physical astronomy came out in 1852, and Arthur Berry whose short history of astronomy appeared in 1898. J. L. E. Dreyer (1852-1926) was of Danish origin, edited the papers of Tycho Brahe, and contributed a fine work on planetary astronomy in 1906. Finally there was Eva Taylor, who achieved world renown for her works on astronomical navigation in sixteenth-century England entitled *The Haven-finding Art* and *The Mathematical Practitioners of Tudor and Stuart England.*

For physics, the name of Sylvanus P. Thompson (1851-1916) immediately comes to mind, with his notable work on the history of magnetism and electricity. Then another Scottish figure, H. W. Turnbull (1885-1961), started the *editio princeps* of Isaac Newton's letters which is still proceeding today. In chemistry there were rather more, perhaps more colourful, figures. F. Sherwood Taylor (1897-1956) was the first director of the Old Ashmolean Museum of the History of Science at Oxford; he was a great connoisseur of Hellenistic proto-chemistry, and published a definitive work on alchemy in 1949. A devout member of the Latin Church, he was the more able to sympathise with the mystical alchemy of seventeenth-century figures such as Thomas Vaughan and Thomas Traherne. J. R. Partington (1886-1965) on the other hand, was a very pragmatical little man with an insatiable appetite for work. For most of his life he occupied a Chair of Chemistry and produced many substantive works on the subject, but besides that, a number of books on the history of chemistry which would comfortably have furnished him with a great reputation if he had never done anything else. I am thinking of his *Origins and Development of Applied Chemistry* in 1935, and then later on, towards the end of his life, the great history of chemistry in several volumes. I recall him with almost as much devotion as I do Charles

Singer, for after his retirement he settled in a rather humble part of Cambridge, Romsey Town, alone with an elderly housekeeper, like a continental canon, and with my first collaborator, Wang Ching-Ning, I often used to visit him there. Another great book of his was *A History of Greek Fire and Gunpowder* (1960), and since he did not have any direct access to Chinese, it was a pleasure for Wang and me to keep him on the rails in that connection. I remember convivial meals in restaurants on King's Parade when we discussed such subjects. The atmosphere always had a practical kind of flavour, for Partington had been an Engineers officer in World War I, and knew exactly what it was to blow things up—quite different from my own experiences as an embryonic Surgeon-Sub-Lieutenant in the Navy. Another character demanding mention is Eric Holmyard (1891-1959), who specialised on the Arabic alchemists, utilising the knowledge of the language which, to the best of our belief, he acquired in the first place from the Imam of Woking Mosque, and utilised so fully in his book on alchemy in 1957. Lastly, one must mention Douglas McKie, also a Scot, and of University College, London, who specialised in the time of Lavoisier and devoted much of the journal which he edited (*Annals of Science*) to the chemistry of the eighteenth century.

Historians of biology I also knew and admired. In botany I particularly remember Agnes Arber (1879-1960), whose superb work on the history of the Herbals came out first in 1912 and was revised and reprinted often afterwards. She was very much a representative of the Victorian Girtonian ethos of "plain living and high thinking", and for many years lived alone with her daugther in a rather austere house in Huntingdon Road, but nothing could have been warmer than the welcome she had for younger historians of science, and our East Asian History of Science Library in Cambridge counts itself honoured to have some of her books. Then there were the two friends R. J. Harvey-Gibson and J. Reynolds-Green, whose histories of botany came out around 1920, and Eleanor Rohde who worked on the Herbals after Arber and published in 1922. In zoology I remember E. S. Russell (1887-1954), whose *Form and Function* of 1916 was a classic in the history of biological philosophy. More meticulous, if less philosophically bent, was F. J. Cole (1872-1959) of Reading, whose great history of comparative anatomy came out in 1944 and 1949. Lastly one could not forget Charles Raven, a priest who attained the seemingly incompatible eminences of being an outstanding Christian socialist and pacifist, while at the same time Chaplain to the Queen and Master of Christ's College in Cambridge. Born in 1885, he was a true follower of the Cambridge Platonists of the seventeenth century, emphasising the organicist as against the mechanicist philosophy, and grounded in natural history in the broadest sense. His book on John Ray came out in 1942 and was followed five years later by a classical work on the *English Naturalists from Neckam to Ray*. Charles Raven was a man of great intellectual distinction, with a splendid presence and a true liturgical sense, so that when, as Vice-Chancellor, he had to confer an honorary degree upon the Queen Mother and lead her thereafter in procession through the streets to Christ's, he did it in a way which no mediaeval archbishop nor Elizabethan courtier could have bettered.

Lastly, for the history of medicine, some of the names already mentioned are

relevant. Charles Singer, for example, for much of his work was concerned with medical affairs and with the sciences basic to medicine. Although the greatest works on the history of medicine during the past hundred years were not written in this country, nevertheless there is something compelling about a subject which impels its own Regius Professors such as Sir Clifford Allbutt (1836-1925) or Sir Humphrey Rolleston (1862-1944) to contribute to history. Sir Charles Sherrington (1857-1952) would be another case in point. When I was young I was impressed by the fact that all the greatest people in this subject had names beginning with "S", not only Charles Singer but also Sarton, Sudhoff and Sigerist—names to conjure with. How well they illustrated the international character of our subject. Of professional historians of medicine in this country, and especially in Scotland, we should mention Douglas Guthrie (b. 1885), whose history of medicine came out in 1945; but besides this, much attention was paid to the history of bacteriology and proto-zoology, notably in the work of William Bulloch (1868-1941) with his history of the first of these in 1938, and Clifford Dobell (1886-1949), whose celebrated book *Leeuwenhoek and his Little Animals* appeared in 1932. As in private duty bound, I should also like to mention a classmate of my own, William Brockbank of Caius, who has spent a lifetime as Consultant at the Manchester Royal Infirmary, and who made a fine contribution to the history of medicine with his monograph on *Ancient Therapeutic Arts.*

Now lastly it is time to say something of the historiography of science. In spite of William Whewell's noble scope, there has always been a certain malaise between the history of science on the one hand and the philosophy of science on the other. Their distinctiveness is recognised in our own International Union with its two Divisions, but the unity, or perhaps I should say the marriage, is not exactly helped by the fact that humanistic academies tend to take charge of one side and scientific academies the other. For example, in our own country the Royal Society takes responsibility for the history, while the British Academy looks after the philosophy. I think there might be several ways of bridging this, for example by holding more joint conferences, or by inducing the philosophers of science to take a wider purview than modern physics alone, or by jointly investigating the scientific movement in cultures other than that of the Euro-American West.

I suppose we all generally agree that there is only one unitary science of Nature, approached more or less closely and built up more or less successfully and continuously, even if very slowly, by the several groups of mankind from age to age. This means that we could expect to trace an absolute continuity between the first beginnings of astronomy and medicine in Ancient Babylonia or Ancient Egypt, through the advancing natural knowledge of mediaeval China, India, Islam and the classical Western world, to the break-through of late Renaissance Europe when, as has been said, the most effective method of discovery was itself discovered.

Of course some sciences show greater continuity than others. For example, the spherical astronomy of the ancient Greeks and the ancient Chinese may be said to be still in use in modern positional astronomy. This is why it was possible for Richard Wolf to write in his *Handbuch der Astronomie* (1890), an excellent manual of general astronomy in which both the spherical geometry and the observations of

the ancients found their place in a story continuous with the post-Renaissance discoveries depending on new sciences such as optics and electricity. Such a presentation would be difficult in biology and impossible in medicine. Nevertheless, all the sciences involve a clear continuity of thought *chi shih pên mo*, from the beginning unto the end.

Of course there have been other points of view. A particularly troubling one was associated with the name of Oswald Spengler, the German world-historian of the thirties, whose works, especially *Der Untergang des Abendlandes* achieved much popularity for a time. According to him, the sciences produced by different civilisations were like separate and irreconcilable works of art, valid only within their own time-space frames of reference, and not subsumable into a single history and a single, ever-growing structure. There certainly is something strange about the fact that in other forms of human experience little or nothing of "progress" can be descried, while in the sciences it is inescapable. One can easily see that artistic styles and expressions, religious ceremonies and doctrines, or different kinds of music have tended to be incommensurable. For mathematics, science and technology, the case is altered—man has always lived in an environment relatively constant in its properties, and his knowledge of it, if true, will therefore tend towards a constant structure. Of course we must not see in the traditional sciences of China or India simply "failed prototypes" of modern science; we must get inside the minds of those who cultivated them and understand how it was that they came to their conclusions. But we must never deny the fundamental continuity and universality of all science.

On the one hand there are those individual anticipations of modern scientific knowledge which show the slow and steady development of science. On the other there are the differences between the world-views and scientific philosophies as a whole, of mediaeval China, Islam, India, and the ancient West, and how all of these differed from the outlook of modern oecumenical science. All the ancient and mediaeval systems before the coming of modern science need to be studied and defined in contrast with our present-day pattern of ideas, which itself is of course not final. In this way we would not only salute the Chinese recording of sun-spots from the first century B. C., or the earliest mention of the flame test for potassium salts by Thao Hung-Ching in the fifth century A. D., or the first correct explanation of the optics of the rainbow by Quṭb al-Dīn al-Shīrazī in 1300 A. D., as distinct steps on the way to modern science, but also take care to examine the integral systems of thought and practice which generated these innovations. Modern oecumenical science was indeed their common end, but their appearance can only be explained in the context of the various possibilities open or closed within the totality of ideas, values and social attitudes of their times and places.

The only danger in this conception of human continuity and solidarity is that it is so easy to take modern science as the last word, and to judge everything in the past solely in the light of it. This has been justly castigated by Joseph Agassi, who in his lively monograph on the historiography of science, has satirised the mere "rearranging of up-to-date science textbooks in chronological order", and the awarding of black or white marks to the scientific men of the past in accordance with

the extent to which their discoveries still form part of the corpus of modern knowledge. Admittedly, an element of the judicial is hard to avoid. William Whewell, in the preface of his *History of the Inductive Sciences* wrote:

> It is impossible not to see that a writer of such a history imposes upon himself a task of no ordinary difficulty and delicacy, since it is necessary for him to pronounce a judgment upon the characters and achievements of all the great physical philosophers of all ages, and in all sciences. But the assumption of this judicial position is so inevitably involved in the functions of the historian (whatever be his subject) that he cannot justly be deemed presumptuous on that account.

Of course this Baconian or inductivist way of writing the history of science never did justice to the "dark side" of Harvey and Newton, let alone Paracelsus, that realm of Hermetic inspirations and idea-sources which can only be recognised by us with difficulty, yet is so important for the history of thought, as the life-work of Walter Pagel has triumphantly shown. Starting from his famous monograph *Religious Motifs in the Medical Biology of the Seventeenth Century*, many have now followed him in elucidating that Jungian dream-world which gave rise to so many of the ideas of the great pioneers of modern science. The only difference between the East and the West in this regard is that the thought-world of the Asian civilisations is even more unfamiliar to most of us. In assessing the achievements of ancient and mediaeval science in China and India no one uses, or would want to use, the criteria of any "Western" science as such, but we do use those of oecumenical modern science, the common property of all men everywhere. The fact that it began in the West has no doubt its reasons, but the point to emphasise is not the historical accident but the universality.

No, the real trouble with the "examiner's mark-book" theory of the history of science is that the corpus of modern knowledge is changing and increasing every day, and we cannot foresee what its aspect will be a hundred years from now. Fellows of the Royal Society like to speak of the "true knowledge of natural phenomena", but no-one knows better than they do how provisional that knowledge is. Oecumenical modern science is not absolutely independent of the accidents of Western European history, nor can it be a final court of appeal for an eschatological judgment of the value of past scientific discoveries, either in West or East. It is just a reliable measuring-rule so long as we never forget its transitory nature. In a word, modern science is not standing still; and who can say how far the molecular biology, the chemistry or the physics, of the future, will have to adopt theories much more organicist than the atomic and the mechanistic which have so far prevailed? Who knows what further developments of the psycho-somatic conception future advances in medicine may necessitate? In all such ways the thought-complex of traditional Chinese science may yet have a greater part to play in the final state of all science than might be admitted if science today was all that science will ever be. Things are more complex than they seem, wisdom was not born with us. To write the history of science we have to take modern science as our yardstick, for that is the only thing we can do, but modern science will change, and the end is not yet.

Of course there are many problems still on the agenda. I mentioned earlier the incursion of the Russians in 1931, and the debate between internal and external causes in the history of science has been going on ever since, though we hope that it has now reached levels of sophistication unknown forty years ago. If anything vitiated Charles Singer's magnificent *History of Technology* it was perhaps the fact that he had a persistent Nelsonian blind eye for the social and economic background of invention and innovation. There is still a tremendous amount to be done in these directions. If it is difficult enough to find out why Europe and Europe alone was the birth-place of modern science, how much more difficult it is going to be to find out why this development did not happen in China or in India? We doubt that the "paradigm", that word almost as blessed as "Mesopotamia", will ever give the full answer to these problems, and we unrepentantly offer incense to the shade of Hessen in believing that the social and economic structures of the various societies will have to be taken into account along with the many factors of intellectual difference between them. At all events, the whole world is now united in the attempt to solve these fascinating problems, and just as the prophet said that "New Zealanders would stand upon the ruins of London Bridge", so also today Japanese colleagues are studying the scientific revolution in France and Holland, while Chinese friends are investigating the life of Copernicus in Poland. It is always a delight to me to recall that one of the most profound students of the English world of the scientific revolution bears a good Gujarati name. It will take a long haul before we can answer the questions of the Sphinx about the development of the natural sciences among men, and it will take the combined efforts of all of us to do it.