formation of one which has already been dealt with and we must not, so to speak, try to cash in on the same coincidence twice over.

Let us, however, waive the objection and accept the suggestion made. We have then to suppose that all the numbers of the order of 10^{39}, including the age of the universe, owe their approximate equality to something in the fixed order of nature. When the universe attains to 10 times its present age, the 10^{39} which measures its age will have increased to 10^{40} and all the other big numbers will have done likewise. Thus while the ratio of electrical to gravitational attraction will be ten times what it now is and so on, the number of particles in the universe will have increased 100-fold, so that creation must still be in progress. In brief, some or all of the quantities that we used to regard as unalterable constants of nature lose their quality of constancy and must change continually with the time. Milne was led to the same conclusion by a very different road; he reached it from a study of his cosmological principle. By whatever road we arrive, we come into a fantastic new world.

We may avoid the need for a continual creation of matter by supposing that the natural physical unit of time changes *pari passu* with the age of the universe. Then the measure of the age of the universe stays always the same as does also the number of particles in the universe. But now we find that either the mass or the charge of an electron must continually change.

All these seem strange to old-fashioned physics, but it simplifies some things and removes some difficulties. When, for instance, we study the spectrum of a nebula at 250 million light-years distance, we are in effect watching the emission of light from atoms as they were 250 million years ago. And a simple interpretation of what we see is that the atoms of those days were not the same as the atoms of to-day. Hydrogen atoms seem to have given out radiation of longer wave-length than they do now, and so were apparently larger—or perhaps their electrons moved more slowly in their orbits and so took longer to complete their revolutions, possibly because the electric attraction on them was less intense. There are many possibilities, each with its merits but also with many demerits.

Whatever the final solution of this vast problem may prove to be, it is already clear that there is no solution on the lines of the kind of dynamics that we learned at school. The mechanical interpretation of the universe fails as completely in the large-scale world of astronomy as it has already failed in the small-scale world of atomic physics. The quantum-theory has replaced mechanics in the physical world; we still do not know what is destined to replace it in the world of astronomy.

SCIENCE IN CHINA

By CHUNG YU WANG

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CHINA is, paradoxical as it may seem, the youngest and the oldest in science among the family of nations. The remark of Gore about Western civilization, that "the origin of many important discoveries lies buried in the obscurity of past ages," is none the less true of Chinese inventions and discoveries. It may be recalled that compass, paper, printing, glass, porcelain, gun-powder, etc., were discovered in China long before the time of Galileo, Bacon and Newton. In the realm of physical and biological sciences, some fundamental conceptions may be found buried in some Chinese ancient classics.

In the twelfth and thirteenth centuries, as a reaction against the "Subjective Philosophy" of Zennism, the "Rational Philosophy" of the Neo-Confucian philosophers was heralded in with the slogan "go to the things and investigate their reasons," a phrase as if taken out of Bacon's "Novum Organum." The greatest leaders of this movement were Chang I (1022 to 1107 A.D.) and Chu Hsi (1129 to 1200 A.D.). Chu Hsi wrote: "In every human mind, there is the knowing faculty; and in everything there is its reason. The incompleteness of our knowledge is due to our insufficiency in investigating the reason of things. The student must go to all things under heaven, beginning with the known principles, and seeking to reach the utmost. After sufficient labour has been devoted to it, the day will come when all things will suddenly become clear and intelligible" (translation by Dr. Hu Shih). This statement sounds quite modern in the sense that it may be construed to indicate the problem and procedure of what is now called science. Unfortunately, in the ensuing centuries, this movement, due to the introverted mentality of its leaders, had degenerated into a mere study of the classics of the ancients, and through centuries of classical education, by which, as Carlyle pertinently remarks, "they do attempt to make their Men of Letters their governors," the study of science was muffled and stifled.

The real awakening of China to the spirit and character of science, due undoubtedly to the impact of the return of Chinese students, trained both in pure and applied sciences in America and Europe, may be said to have begun only within the last twenty-five years, although desultory attempts to introduce western sciences into China had been made in times past. The interest and enthusiasm with which the Chinese are now leaning toward the pursuit of both pure and applied sciences may be gleaned from the fact that the percentage of students in higher institutions of learning in China, majoring in pure sciences, increased from 7.6 in 1928 to 13 in 1936, and that the percentage of students in both pure and applied sciences increased from 27 in 1928 to 43 in 1936; that is, within a period of about ten years the percentage of the number of students taking up either pure or applied sciences is about double.

The same trend of increase can be discerned in the number of Chinese students studying in the United States and Canada. The percentage of Chinese students studying both pure and applied sciences increased from 30 in 1934 to 50 in 1942, while that of Chinese students studying only pure sciences increased from 3 in 1934 to 10 in 1942.

More astonishing is the growth of learned societies and research institutes of both pure and applied sciences during recent years in China. Whereas before the establishment of the Chinese Republic in 1912, there were only a few insignificant so-called learned societies of sciences, in 1936 there were found fifty-three learned societies and research institutes for natural sciences and sixty-nine for applied sciences. Naturally, paralleling the growth of these societies and institutes, is the increase in the number of publications dealing with both pure and applied sciences. Thus there were published in 1936 forty-two different kinds of periodicals, bulletins or transactions, devoted exclusively to these sciences. However, it should be mentioned that not a few of these societies and publications, just mentioned, may seem mediocre in their activities and contents, if judged by the Western standard; yet, within only a span of about twenty-five years, they have fared pretty well as a whole in their contributions to science.

Science connotes research; and the research workers in science are mostly men trained in the higher institutions of learning. To borrow an apt analogy from Professor Pupin, it may be said "scientific and engineering research is the honey-gathering process; men trained and disciplined in this field of inquiry are the honey-gathering bees." Now it is gratifying to note that both the bee and the honey are in the process of becoming in Chinese higher institutions of learning. Before the present Sino-Japanese War, there were a hundred and eight institutions of higher learning, forty-two of which were universities, thirty-four independent colleges and thirty-two technological and professional schools. Since the war began in 1937, fifty-six Chinese universities and colleges have been moved into Free Chnia, seventeen have been suspended, while the remaining thirty-five institutions in occupied China have led a precarious existence and certainly not a few of them have been closed.

About less than fifty years ago there did not exist in China any institutions of learning worthy of the name of a university. In fact the first government university, wherein sciences were taught, of necessity, in a mediocre manner, was established in 1895. It is indeed remarkable that within this short span of years China has almost caught up with the other nations in the pursuit of sciences which has taken the United States about a century and the European countries about three centuries to reach the position in which they stand to-day. This urge on the part of the Chinese to take up science in such an accelerating rate has been in a large measure due to the catalytic action of both American and European scientific thoughts on the Chinese mind.

Foremost among the many scientific research institutions in China are the Research Institutes of the Academia Sinica and the Geological Survey of China.

The Academia Sinica was established as a government institution in 1927 and is constituted of eleven institutes; they are the Institute of Physics, the Institute of Chemistry, the Institute of Engineering, the Institute of Biology, the Institute of Astronomy, the Institute of Geology, the Institute of Meteorology, the Institute of Mathematics, the Institute of History and Philology, the Institute of Social Sciences and the Institute of Psychology. These various institutes have been removed to different parts of Free China since the commencement of the present Sino-Japanese War. Dr. Chiu Chia-hua is now acting president of the Academia Sinica.

The Institute of Physics, originally located in Shanghai, has been moved to Kweilin and Kunming. In addition to the manufacture of scientific instruments for educational institutions, construction of radio broadcasting equipment and the manufacture of vibrator rectifiers, it is now engaged in the design of super-hetero-dyne receivers with crystal filters, researches on terrestrial magnetism, and on the magnetic properties of ferro alloys and steels.

The Institute of Astronomy, now located at Kunming, is engaged in the following lines of research and activities: solar research, photographic studies of variables and comets, determination of latitudes and longitudes and the studies of star clusters in the galactic system, orbits and ephemerides of comets and planetoids.

The Institute of Meteorology in Chungking is now devoted to wartime military aeronautical needs. The projected activities of the institute are the establishment of additional observation stations in the northwestern and southwestern provinces, the study of long-range weather forecasts and the use of wireless meteorological instruments.

The Institute of Engineering, whose past work in the research of iron and steel has been suspended for lack of proper equipment, is now carrying on in Kunming some research work along the following lines: tungsten metallurgy, manufacture of glass and survey of raw materials for glass manufacture.

The Institute of Geology, under the able direction of Professor J. S. Lee, has been doing excellent work in the field of Chinese geology. His contributions to Chinese geology are numerous, but his most outstanding works are his "Studies of Graptolites" and his treatise on the "Geology of China," which latter has become a classic for students of Chinese geology.

Of all the different branches of science now passionately pursued in China, the science of geology bears the most fruitful results. The story of the accomplishments of Chinese scientists in geology during the last twenty-five years is alone sufficient to demonstrate the innate quality of Chinese mentality for science. It is remarkable that as early as 1200 A.D., Chu-Hsi, the Neo-Confucianist, made the following observation: "In high mountains there are shells. They probably occur in the rocks, which are the soil of older days, and the shells once lived in the water. The low places became high, and the soft mud turned into hard rock."

It was an event of no small significance when the Chinese Geological Survey was inaugurated in 1916. This event was brought about by two brilliant Chinese scientists, Dr. V. K. Ting, now deceased, and Dr. Wong Wen-hao, now Minister of Economic Affairs and chairman of the National Resources Commission, who, of verity, may be regarded as fathers of geological science in China. Time does not permit me to enumerate here the contributions of the many Chinese geologists in the fields of paleontology and stratigraphy and other branches of geology. They can be found in the bulletins, memoirs and paleontological monographs, the latter grouped under the name of Palaeontologia Sinica, published by the National Geological Survey of China. However, it is appropriate for me to mention at this juncture the name of my old teacher, Dr. A. W. Grabau, who has had a great deal to do with the training of young Chinese geologists, inspiring and guiding them in their researches.

Due to the emergency of the war in China, it is but natural for Chinese scientists and technologists to turn their energy and efforts in winning the war. The seventeen laboratories of the National Resources Commission are doing researches in raw materials, in industrial techniques and in better production methods. Experiments are being carried on in finding the magnum bonum condition for the distillation of alcohol from fibrous plants; tung oil, once a valuable product for export, is being processed to yield synthetic gasoline and rubber; motors of different descriptions are manufactured in the electrical laboratory; the machine shop laboratory is turning out machines of every description for the various industries.

One outstanding achievement of geological sciences since the outbreak of hostilities in China is the discovery of an immense oil field, northwest of Lanchow, the capital city of Kansu Province. It is estimated that the reserves of this field contain fully 140,000,000 barrels of crude, equivalent to about 1/130 of the oil reserves in the United States. Efforts are under way to produce 10,000 barrels per day.

Japan's war of aggression has precipitated an unprecedented mass migration of Chinese students, both boys and girls, and their professors to the hinterland of China. The epic of the odyssey of these intellectuals treking thousands of miles with their books and laboratory equipments, through trials and tribulations, requires abler pen than mine to describe. From this you may readily imagine the difficulties under which science is now being pursued in Free China. In spite of such difficulties, in lack of materials and equipments, studies of sciences are being carried on. To show you how the Chinese people appreciate the value of science, I would like just to mention the fact that the People's Political Council, a war-time national parliament, recently convened in Chungking in October of last year, passed a resolution to increase the appropriation for scientific and academic researches.

In conclusion, allow me to voice one of the many hopes of Chinese scientists with respect to their future work after the termination of this global war. You have been helping China as a member of the family of the United Nations in many ways during the progress of this war. We thank you. We, as your colleagues, however, dare to bespeak your future help in the rebuilding of our bombed-out universities, laboratories and libraries, as soon as the pseudo-divine barbaric mission of the Japanese is crushed. We hope we are not unworthy of your help. The Chinese scientists in the future will, with renewed energy and zeal, do their share, by laying a brick here and there, in the building up of the Temple of Science.