

INSTITUTE OF CURRENT WORLD AFFAIRS

CHGO-2
A.A.A.S. Symposium on Chinese Science
Part II: China's Scientific Revolution

The Pines, Nuns Walk,
Virginia Water, Surrey,
England.
February 8, 1961.

Mr. R.H. Nolte,
Institute of Current World Affairs,
366 Madison Avenue,
New York 17, N.Y..

Dear Dick,

In New York City recently, twenty five experts reviewed the status of the sciences in Communist China. The occasion was a symposium organized by the American Association for the Advancement of Science. I discussed the background to this symposium in my last letter and will now tell you about the picture of contemporary Chinese science which was painted by these experts.

To fully appreciate this picture it is first necessary to recall the relatively bare condition of its canvas when the Communists came to power in 1949. Then there were few scientists, very little money for scientific work, little industrial production, and morale was at a very low ebb. Today there are many scientists, a lot of money for scientific work, a great deal of industrial production, and science is in a thriving and vigorous state. China hasn't caught up with Western science yet, but the experts at the symposium thought that she probably will do so within the next ten to fifteen years.

One of China's main tasks since 1949 has been to increase her scientific manpower. To do this she has built many new universities and other institutes for higher education. Technical training has been separated from the universities and put in the hands of newly created technical institutes. At these institutes students are given extensive, but narrow, training in specialised technical subjects. In this way the Chinese hope to rapidly train many more technicians than would otherwise be possible. The universities maintain a balance by concentrating on the fundamental subjects. Despite all the training and expanded facilities, China is still short of scientists. Some of the speakers at the symposium believed that part of the shortage is due to government misplacement of scientists, and that in the drive for increased scientific manpower, quality has been sacrificed for quantity.

Education in science and technology continues all the way down the academic ladder to the peasant. Everyone is encouraged to improve production and agricultural methods, great publicity being given to successful innovations.

In order to utilize to the utmost China's resources of trained manpower and finance, the Communists have concentrated on

applied science. Russian and Western methods and equipment have been copied and applied to Chinese problems.

While new methods and equipment are being introduced, the use of old and often primitive methods and equipment is encouraged. In China, this use of old and new is called "Walking on two legs". As a result, many backyard factories and blast furnaces have been built. The productivity of these minor industries is quite low, but production is not their only purpose. They also serve to train workers in readiness for the new factories.

One of China's objectives is to catch up with Western science, but she realised that she must develop her own basic research or be content to always lag behind. The basic research is largely carried out in the universities and some of it has been published. Although it constitutes only a small part of China's scientific effort at the present time, it is of high quality.

These general trends were mentioned by most of the speakers, and there can be little doubt as to their validity. It is more difficult, from what was said at the symposium, to assess the attitude of the Chinese scientists towards the Communist regime and vice versa. Certainly there is evidence that some of the scientists have suffered because of their political beliefs; but there has been no general purge as in the case of the landlords. There has been some brain-washing and some scientists have been required to publish confessions. That these things happen is reasonably certain. What we don't know is the scale on which they happen, and the result they have on the morale of the scientists. I think it is significant however, that those Western scientists who have visited China in recent years have all come away impressed with the tremendous enthusiasm of Chinese scientists. Professor J.T. Wilson, a geophysicist, was the only scientist at this symposium to have visited China since 1949. He told of the government cars, the excellent library facilities, the new laboratories and equipment and the many assistants, which have been provided for the Chinese scientists by the Communist government. He was impressed by the enthusiasm which he met wherever he went and thought it was fired by a passionate release of nationalistic energy, even though many of the scientists may not necessarily be sympathetic towards communism. It could be argued that this was an isolated case and perhaps only applied to geophysicists. On the contrary it seems to be the opinion of all the scientists that have actually visited China.

For most of this letter I shall confine my comments to views and facts presented at the symposium. But because, with the single exception of Professor Wilson, none of the experts there had visited China recently, I would like to quote from a talk given last week on a B.B.C. radio program. The speaker was Dr. Kurt Mendelssohn, F.R.S., Reader in Physics, at Oxford University. Dr. Mendelssohn visited China last year and said in his talk ...

"Technology is a great and joyful experience and adventure into which they (the Chinese) have thrown themselves with enormous enthusiasm. Anyone watching them at work will be struck with this enthusiasm, which to me at least, appears the most significant feature of their technological advance".

So far I have discussed the general outline of the Chinese scientific developments as it emerged from the symposium. Now I will fill in parts of this outline by summarizing some of the highlights from some of the sciences.

Geology

One of the most urgent requirements of any new State is an inventory of its natural resources. The Chinese realise this and have given a high priority to the training of geologists.

Dr. Edward C.T. Chao of the U.S. Geological Survey told the symposium that at the end of World War II there were fewer than 200 active geologists in China. Now there are over 21,000 geological workers and thousands more are being trained every year.

Most of these geologists have been employed in the exploration for new mineral deposits. They seem to have been quite successful. In fact Dr. Chao said the mineral resources are so extensive that China must now be reckoned as one of the world's chief reservoirs of raw materials. For example, 7,000,000,000 tons of iron ore have been found in the Shansi area of Central China, and another deposit estimated at 3,000,000,000 tons has been discovered in Honan Province. These are large deposits by any standard. Recent discoveries of the important alloy metal, molybdenum, used for hardening steel, make China the world's richest country in this metal.

No important uranium deposits have been reported, but there are unconfirmed reports of a huge nickel deposit. If true, this is a very important discovery, since at the present time Canada produces 90% of the world's nickel supply.

Mining and Metallurgy

Dr. Kung-Ping Wang of the U.S. Department of the Interior, reviewed the progress of mining and metallurgy.

Most of the modern metallurgical operations are fairly up to date from the engineering point of view, but, while comparing favorably with European and Japanese practices, they are much lower in productivity than U.S. operations.

Dr. Wang pointed out that China has ample supplies of iron ore and coal, including coking coal. The big problem is to transport them to where they are needed. Despite this problem

the iron and steel industry is growing at a spectacular rate. Dr. Wang expects China to progress from being seventh world producer today, to fifth in 1965 and third in 1970.

Electronics and Computing

Dr. Yao T. Li of Massachusetts Institute of Technology had some interesting things to say about the Chinese electronics industry. At the present time the Chinese are self-sufficient in the manufacture of electronic components and within five years Dr. Li expects them to have overtaken the Japanese. In 1958, one and a half million radio sets were made and twenty one television stations were in operation. This does not mean that all the peasants are getting their own television sets, but the Communists realise the value of the medium for propaganda and education and have installed television sets in many of the public halls.

I was particularly interested to find out how advanced the Chinese are in the construction of digital computers. Large electronic computers are widely used for scientific purposes in America and they have contributed a great deal to the advancement of our scientific knowledge during the last decade. Dr. Li informed the symposium that the Chinese have built a computer which is of the same calibre as the IBM 704. (This was one of the most advanced computers for scientific purposes available in the U.S. until about two years ago). Another computer mentioned by Dr. Li, and one which has fascinating possibilities, is a machine for automatic translation of the Russian language into Chinese. Its output is Chinese characters which are automatically printed onto a screen.

Astronomy

Professor F.B. Wood of the University of Pennsylvania reported that most of the recent astronomical work has been of a routine nature. Many latitude and longitude determinations have been made, but only a few theoretical papers have been published. The observational work has been hampered by the fact that the largest Chinese telescope has a diameter of only 24 inches. (The largest telescope in the United States, on Mount Palomar, has a diameter of 200 inches).

Botany

According to Professor Hui-Lin Li of the University of Pennsylvania, the main botanical project in China is the preparation of a massive eighty volume "Flora of China". The project was first conceived in 1950 and it was estimated then that it would take sixty years to complete. Volume 2 has just been published and it is now hoped to have all the volumes published within another ten years.

Zoology

The review of Chinese zoology by Professor Tien-Hsi Cheng of Pennsylvania State University was based partly on the published literature and partly on information gathered when he was a visiting professor in Hong Kong last year. The work in zoology provides a good illustration of the emphasis being placed on applied science. In fact the goal of nearly all zoological research is higher food production.

The attack on animal and insect pests has probably been the most spectacular project in the drive for more food. For centuries the locust has been one of China's most destructive pests, but now, with Russian aid it has been almost entirely liquidated. Professor Cheng said that modern pesticides are used on 300 million acres of cropland annually, and that by 1962, China expects to have completely eliminated the locust.

Sparrows eat their own weight in food every three days. The Chinese decided that this was too big a drain on the Country's food supply, and so most of the sparrows have also been wiped out. Apparently no thought was given to the useful functions of these birds, and now the harmful grubs and flies which formed part of the sparrows' diet are themselves a problem.

I would like to step outside the bounds of the symposium again for a moment to repeat an amusing story I heard recently which is relevant to this discussion. While driving in a taxi through Peking the Earl of Verulam asked his driver the meaning of a huge Chinese banner spread across the street emblazoned with red, black and gold letters. The taxi driver informed him that it meant "Death to the enemies of the People". The Earl then asked whether this "... included the British or only the Americans?", the driver replied "The enemies of the people are mosquitoes, flies, beetles and sparrows".

Dr. Cheng also told the group about recent Chinese work on types of plankton. These are studied primarily to help locate valuable fishing grounds, but also because they provide a way for studying the pattern of ocean currents and water masses. Furthermore, phosphorescent plankton has military significance since ships sailing at night into areas where it is abundant run the risk of being exposed.

Yunnan Province in Southwest China has always been one of China's most backward areas. For three years a joint Russian Chinese expedition studied the region and then made recommendations for its development. These recommendations are now being implemented and Dr. Cheng considers the expedition to have been "One of the most significant happenings of the last decade, in terms of impact on a region".

Genetics

Genetics is a subject which tends to be colored by politics and hence is something of a touchy subject for scientists. Perhaps some day this might make an interesting topic for a news letter, but for the moment I only want to mention one of the experiments in animal breeding which Dr. C.C. Li of the University of Pittsburgh told us about. The main draught animal in North China is the yellow cow, and in South China it is the buffalo - which requires a bath every day. These have now been crossed and a hybrid produced. This hybrid can do the work of one and a half ordinary cattle on less food and without the need for a daily bath!

Geophysics

I have already mentioned that Professor J.T. Wilson of the University of Toronto was the only speaker at the symposium who had visited China since 1949. His appraisal of the status of geophysics was therefore of special interest.

As might have been expected, geophysics has been used extensively for mineral exploration. No details were given of the total number of geophysical crews in operation, but Professor Wilson did mention that 45 gravity meters and a similar number of magnetometers and electro magnetic equipment had recently been purchased by the Chinese from a Canadian company. The amount of gravity work possible in a year with this one Chinese order of gravity meters is 540 crew months (45 meters x 12 months). This is almost identical to the number of crew months of gravity work carried out in the United States for petroleum exploration in 1959. It actually exceeds the totals of both Latin America and the non-communist Eastern hemisphere.¹

One important piece of seismic research was carried out not by geophysicists, but by historians. A seismicity map (showing frequency of earthquakes) of China was prepared by 150 historians who searched Chinese literature for evidence of earthquakes. The earliest one they discovered occurred over 3,000 years ago in 1139 B.C. The map has been most useful in dam engineering studies.

More surprising than the work on prospecting has been the extent of the work on the physics of the solid earth. Much of this falls into the category of fundamental or pure research

1. U.S.A. 548 crew months gravity work in 1959
 Latin America ... 383 " " " " "
 E. Hemisphere ... 517 " " " " "
 (non-communist)

and yet it was quite apparent that the Chinese Government was giving it ample support. For example the Chinese carried out quite an extensive program of research for the International Geophysical Year. Due to political reasons however, the results have not been published.

Much of Professor Wilson's talk was a personal narrative of his trip through China in which he discussed the scientists, laboratories, and universities he had seen. However, he also spoke about his visit to Taiwan which immediately followed his visit to the Peoples' Republic of China. In Taiwan he visited the Formosan geophysicists and saw their research facilities. He was disappointed with what he saw. Professor Wilson found that the morale of the Formosan scientists was low, that they received little support from the Nationalist Government and that their equipment was antiquated. He said "I have no doubt that there were more new books and many more recent periodicals in the libraries of Peking, Sian, Lanchow and Canton than in those of Taipei, that the university buildings were better, that the equipment was newer and more abundant and the whole scientific atmosphere was not only greater but much more vigorous on the Mainland than in Taiwan".

Physics

Dr. R.T. Beyer of Brown University said that the physical sciences in China were extremely well planned. Great emphasis is placed on theoretical work while at the same time technical workers are taught to make and operate equipment. The Russians have been very helpful, particularly in training new Chinese physicists. For example, about one third of the scientific papers originating at the Soviet nuclear research center at Dubna near Moscow have Chinese names attached to them.

Dr. T.C. Tsao of Columbia University told the symposium that the Chinese now have four nuclear reactors in operation. They are all quite small and apparently are used for peaceful purposes. However, he felt it likely that there were others which we do not know about and predicted that China would have atomic bombs "within a very few years".

Returning to England I reflected on the general impressions of Chinese science that the symposium had given me. I decided that the main conclusion to be drawn is that China is in the midst of a scientific revolution. At the moment she is still relatively backward, but the wheels of progress are turning, she is now in second gear, but it will not be long before she changes into top and then - China will rapidly become one of the most scientifically advanced nations in the World.

Sincerely,

Geoff. Oldham.