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COMMUNIST CHINA'S CAPABILITIES AND POTENTIALITIES IN MEDICAL SCIENCES

CIA/SI 27-59
20 July 1959

CENTRAL INTELLIGENCE AGENCY

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Scientific Intelligence Report

COMMUNIST CHINA'S CAPABILITIES AND POTENTIALITIES IN MEDICAL SCIENCES

NOTICE

The conclusions, judgments, and opinions contained in this finished intelligence report are based on extensive scientific intelligence research and represent the final and considered views of the Office of Scientific Intelligence.

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COMMUNIST CHINA'S CAPABILITIES AND POTENTIALITIES IN MEDICAL SCIENCES

PROBLEM

To assess Communist China's current and future trends and capabilities in national health and medical research through 1967.

CONCLUSIONS

1. Communist China is exploiting and applying Soviet and Western medical research and has made significant strides in controlling its major disease problems, educating its physicians and medical scientists, and establishing health standards consistent with the attainment of its national objectives.

2. Communist China's public health program is directed primarily toward the application of public health measures on a national scale in order to overcome serious infectious disease problems that have plagued China throughout its history. Since 1950, the Chinese Communists have been very successful in attacking this serious infectious disease phase of the health and medical problem. The success they have had with their public health program should result in an increase in life expectancy and productive work years for the average worker, as well as a decrease in the man-years lost through epidemic and endemic diseases.

3. The paradoxical resulting increase in population will produce major problems for planners with respect to adequate medical care, food supply, and other essential commodities. By Western standards, Communist China's present medical manpower and facilities are not adequate to provide an acceptable level of care, aside from the serious infectious diseases, for either the current population or the expanded population that has been predicted for the next 15 years. The manpower and facilities are completely inadequate to cope with a national disaster producing mass casualties.

4. Communist China is directing its limited medical research effort toward five major areas in support of its national public health program. To date, the volume of medical research has been severely limited by the lack of well-trained investigators and assistants, and the health program has been staffed largely by semiprofessional personnel. The few well-trained scientists are used primarily for teaching and for modest research based on priority programs.

5. The organization and planning of public health and medical research programs in Communist China are highly centralized and patterned after those of the Soviet Union. The planning aspect appears to be sufficiently flexible to allow maximum use of current medical assets.

6. During the period 1962–67, approximately 2,000 PhD level Chinese Communist medical investigators will become active in research. This additional manpower will provide some improvement in the quality and quantity of medical research. Furthermore, the Communist Chinese Government will continue to emphasize nonscientific traditional medicine during the next 10 to 15 years in order to exploit the large number of traditional doctors in whom the people have faith, and thus compensate to some degree for the serious shortage of scientifically trained physicians.

SUMMARY

Achievements accruing from the overall Chinese Communist health program in combating epidemic diseases and establishing concepts of sanitation among the people are impressive when measured in terms of the rate of progress that has been made under the severe handicaps of trained manpower shortages and overcrowded medical facilities.

Communist China's research in medical sciences is primarily concerned with five high priority areas.

1. Epidemic diseases. These diseases, most seriously affecting the health of the people, include schistosomiasis, tuberculosis, malaria, Japanese B encephalitis, typhus, and dysentery. Of the six diseases, schistosomiasis and tuberculosis take the largest toll of life and man-hours. Although the great epidemics of pre-Communist days are now being controlled, these diseases will not cease to be of primary national importance until 1962–67. Even then, tuberculosis and Japanese B encephalitis will continue to be of economic and social importance.

2. Antibiotics research. This research is directed toward improving production techniques for common antibiotics and investigating potential indigenous antibiotic substances. At present, China's supply of the most important antibiotics is low, but there is enough for use in the largest clinics and hospitals. The rural population has extremely limited access to drugs. It is possible that China will be self-sufficient in the important antibiotics within 5 years for both civilian and military purposes. Until then, a national disaster would find them extremely short of all antibiotics.

3. Industrial and occupational diseases. The industrialization of China is causing great increases in accidents and in diseases such as silicosis, pneumonitis, and tuberculosis. Although investigators have uncovered many health hazards and recommendations have been made for their remedy, it is unlikely that positive results of any medical program will be able to keep up with the rapid rate of industrialization, and worker health will continue to be subordinated to production quotas until at least 1967.

4. Nutritional research. Chinese work in this area is directed at: (a) finding combinations of native foods that will afford maximum nutrition per unit of weight and which will act as partial substitutes for animal products that are in short supply, and (b) establishing a set of nutritional standards for Chinese workers in various occupations. These efforts are marginal at best and are being handicapped by a general food shortage which will take many years to overcome. In the meantime, the "leap forward" will probably not be seriously weakened unless the present food : population ratio becomes lowered by crop failure. Nutritional research, although important, will not greatly alleviate food shortage problems.

5. Basic theoretical problems. Research in this area is limited not only by the shortage of trained manpower, but also by the relative priority assigned to other research under the 12-year plan. All basic research is conducted in support of priority national objectives and is expected to remain limited until 1962–64. The four most important types

of research concerned with theoretical problems are:

(a) Physiological research, which emphasizes current Soviet trends of neurohumoral control of bodily processes rather than conditioned reflexes alone.

(b) Pharmacological research, which is centered primarily in the search for more effective antischistosomials and secondarily in testing the efficacy of native herbs used in traditional medicine.

(c) Biochemical investigations, which consist mainly of repeating Western and Soviet work and are centered in protein metabolism with emphasis on nucleic acids and the enzyme-coenzyme systems involved.

(d) Microbiological research, which stresses infectious diseases with emphasis on vaccines against trachoma, Japanese B encephalitis, bacillary dysentery, brucellosis, schistosoma, and leptospira.

In addition to the five major research areas, the Chinese are devoting increasing attention to nuclear medicine and the understanding of human behavior but are giving only marginal support to their civil defense program.

(a) Nuclear medicine is getting underway with the installation of at least two Co^{60} clinical treatment devices in Peking. In addition, radioactive antimony, iodine, and phosphorus have been used clinically. China has a 10-MW heavy-water atomic reactor supplied by the USSR that is producing 33 radioactive isotopes, including Co^{60}, Na^{24}, P^{32}, and Ca^{45}. Research includes the effect of ionizing radiation on water, proteins, nucleoproteins, and nucleic acids and on some phases of the pathophysiology of radiation sickness. The single reactor is expected to produce all of the research isotopes which can be used until at least 1967.

(b) The understanding of human behavior and its scientific manipulation and control is believed to be the ultimate goal of psychological and neurophysiological research in China. Although most Chinese behavioral research is still centered in Pavlovian reflexology, newer Western concepts and methods of electrophysiology have been introduced since 1956 that are expected to establish the future trend for such research. Soviet experience and research in behavior are apparently well understood by the Chinese Communists, and Soviet methods have already been applied in the rectification movement visited upon scientists in 1957–58 and in the systematic efforts to break down the family system which are being carried out in the communes.

(c) Medical support of military and civil defense includes protection of the military and civilians against nuclear, biological, and chemical warfare agents. In general, the medical establishment is capable of rendering reasonable care to the military but can serve only in a first aid capacity for the general population within the foreseeable future.

Traditional medicine in China cannot be properly included among scientific research areas because it is essentially nonscientific, but it is receiving considerable emphasis and therefore merits some consideration. It is of three distinct types: herb medicine, acupuncture, and moxibustion. Of the three, only herbal medicine appears to have even limited value and is receiving the most research attention. Political considerations stemming from the critical physician shortage play a leading part in the propagation and advancement of traditional medicine. The people have an age-old faith in the traditional doctors which the regime is exploiting to tide them over until the shortage of trained physicians is alleviated. Some 20,000 traditional doctors have been placed in Western-style clinics, probably in an attempt to orient them towards Western medical concepts without causing them undue "loss of face."

The organization of medical sciences in Communist China is presently divided among (i) a department of the Academia Sinica; (ii) the Academy of Medical Sciences of the Ministry of Health; (iii) research institutes of the Ministry of Health; (iv) the Chinese People's Liberation Army Academy of Medical Sciences, under the Ministry of Defense; and (v) the research laboratories of the medical colleges and comprehensive universities. Coordination of activities is through the State Council's Medical Division of the Planning

Committee for Scientific Development. By 1967, it is probable that all medical research activities except for military medicine will be vested in the Academy of Medical Sciences but that planning procedures will not change appreciably.

Planning of medical research is based primarily on the 5-year plan principle which presently operates under a 12-year master plan (1956–67) for scientific and technical development. Five-year and one-year plans continue to be formed and executed within the general framework of the 12-year plan, which gives considerable flexibility of planning and allows for ad hoc changes in emphasis where necessary. The Chinese have recently published their intention to complete the 12-year plan by 1962. This decision is unrealistic and an extension of the medical sciences part of the national plan is expected before 1962.

Medical education in Communist China primarily stresses Western concepts of medicine but, at the same time, supports the concept and practice of traditional Chinese medicine vigorously in order to compensate for the shortage of trained Western-style medical practicioners. China's expanding economy and large disease problem has necessitated a rapid expansion of the medical education system in order to produce the largest number of physicians and investigators in the shortest possible time. In their haste, the Chinese have overcommitted both the facilities and the instructional staff. This has resulted in poor training, lack of a standard system of professional degrees, and overspecialization beginning at the undergraduate level. These factors will limit the adaptability of workers graduated during the First Five-Year Plan and make them dependent upon continued tight central organization and planning.

By 1967, there should be a standard system of MD and PhD level degrees patterned after those of the USSR, and the overcrowded and substandard medical educational facilities of today should become adequate to accommodate a balanced program of education and research that would be sufficient to fulfill high priority goals. Nevertheless, it will take at least 10 to 15 years to eliminate the effects of the inadequacies of the present educational system.

Chinese Communist clinical and research manpower consists of approximately 43,000 health workers,* with from 2 to 4 years of training; about 3,000 investigators in medical sciences, including about 150 at the PhD level; 500,000 traditional doctors without any scientific training of which some 20,000 are associated with Western-type medical institutes; and about 20,000 subprofessional "doctor's assistants." The 43,000 health workers represent a medical worker to population ratio of about 1:15,000 on the average. By 1967, there are expected to be approximately 100,000 MD's, about two-thirds of whom will have had 5 years of training, and the physician to population ratio should be about 1:8,300. By then, there should also be 504,000 traditional doctors; 35,000 "doctor's assistants"; and 5,000 well trained medical investigators, including some 2,200 trained to the PhD level. The traditional doctors can be eliminated as a useful group in any peacetime activities but might be psychologically useful in the event of a national disaster with casualties too numerous to be treated by Western-style medical workers.

Facilities for medical research can be expanded with the labor and materials that are available at a much greater rate than teachers and scientists can be produced to use them. Present laboratories and institutes are overcrowded and generally inadequate; but, as a result of a new building plan, medical facilities are expected to be expanded. By 1967, there should be adequate facilities to house all available medical research personnel and to accommodate large medical and graduate classes comfortably.

China's medical equipment is being produced in increasing but still inadequate amounts. Most of the Chinese manufactured equipment is nonprecision with most of the precision equipment being imported from

* The present total of 43,000 does not differentiate between MD's, pharmacists, and possibly other health workers.

Bloc and Western countries. First priority is given to equipping undergraduate teaching institutes and colleges and secondarily to equipping graduate and priority senior research programs. Self-sufficiency may be reached in nonprecision equipment by 1967; but extensive production programs for precision equipment will not be instituted before 1967, due to the lack of industrial potential as well as sufficient numbers of trained investigators to make such an effort worthwhile.

DISCUSSION

INTRODUCTION

The nine years of Communist regime in China have been characterized by a rapid rate of development in science and technology. Before the Communists took over, China was one of the most technically backward countries of the world. Since 1949, it has been directed by a new regime that has laid the organizational and conceptual foundations of a modern technical-industrial nation.

An outstanding example of this rapid rate of development is the rise of medicine and public health. Combining Soviet organizational and material aid with a very small cadre of its own Western-trained medical scientists, Communist China is exploiting and synthesizing Soviet and Western medical thinking, and has made significant strides in controlling its major disease problems, in educating physicians and medical scientists, and in establishing health standards consistent with the attainment of its national objectives.

The use of Western-trained medical and other scientific personnel has necessitated a comprehensive program of political indoctrination which involves "phasing" the politically neutral scientist into the increasingly regimented life of the Communist state while simultaneously extracting from him a maximum of effort and zeal. This process proceeded from the "let all schools of thought contend" principle to the sudden rectification program of 1957–58 in which principle scientists publicly cleansed themselves of bourgeois ideas of individual competition and subscribed to the party line of collective efforts in science. Thus consolidated, the "great leap forward" of 1958 brought forth a maximum effort in all priority areas of medical research and other disciplines and culminated in the somewhat rash assertion that the goals of the 12-year plan (1956–67) of scientific development could be achieved by 1962.

ORGANIZATION AND PLANNING OF CHINESE COMMUNIST MEDICAL RESEARCH

Organization

The Scientific Planning Committee of the State Council was inaugurated in 1956. In 1957, the Committee had 106 members and was headed by Nieh Jung-chen, who is a vice premier and the top person dealing with scientific activities. All science in Communist China is ultimately controlled by this group.

Medical education and research have been organized in a pattern similar to that of the Soviet Union and the program has been established in close collaboration with Soviet experts at all levels. By 1956, medical research was being carried out in one department of the Academia Sinica; in the Academy of Medical Sciences, under the Ministry of Health; in the Chinese People's Liberation Army Academy of Medical Sciences, under the Ministry of Defense; and in the research laboratories associated with medical colleges. The Medical Division of the State Councils' Planning Committee for Scientific Development is the final authority to which all of these organizations are responsible.

Academia Sinica — The Academia Sinica (AS, Chinese Academy of Sciences) can be considered equivalent to the Academy of Sciences, USSR, although it is presently a considerably smaller organization.

Of the five departments of the AS, only the Department of Biology is concerned directly with medical sciences, although the Organic Chemistry Research Institute of the Department of Physics, Mathematics, and Chemistry does do a certain amount of research in the chemistry of alkaloids, steroids, carbohydrates, polypeptides, and microbiochemistry which has medical application. In 1956, six institutes and one laboratory of the former department were concerned with medical research.

Coordination between the institutes responsible for important national scientific problems was insufficient in 1955 according to Kuo Mo-jo. The AS, therefore, established a special committee responsible for coordinating interinstitutional research and for securing the cooperation of workers pursuing research in other establishments. This special committee is also charged with maintaining contact with the Chinese scientists abroad. [2 3 13–17 19 20]

Chinese Academy of Medical Sciences—The Chinese Academy of Medical Sciences (AMS) was formed in 1956 under the Committee on Medical Research of the Ministry of Health and included the Central Institutes of Health, Peking.

At least ten departments and six institutes are known to be associated with the AMS, and an additional two departments and three laboratories are probably associated with it. The China Union Medical College was added in 1958, and the Clinical Psychology Department of the AS will probably be expanded and moved to the AMS by 1962. It is the policy to convert departments into separate institutes whenever possible, particularly when the work of the department is concerned with a research area currently receiving high priority. The Industrial Hygiene Department, for example, was raised to institute status with six subordinate departments in 1957 as a result of the new overall medical research policy aimed at improving industrial and labor health conditions. Eventually, all departments will become institutes and the general organizational pattern will continue to follow that of the Soviet Academy of Medical Sciences. Visiting scientists have been informed that institutes presently under the Ministry of Health or Provincial Governments will eventually be brought under the AMS in Peking. This organizational goal will probably be accomplished by 1967.[3 4 8–11 29]

Chinese People's Liberation Army Academy of Medical Sciences — The Chinese People's Liberation Army Academy of Medical Sciences (CPLAAMS) was apparently established about 1951 in Shanghai under the Ministry of Defense. The CPLAAMS is primarily concerned with military medicine, although its medical research establishments are working closely with civilian research centers in an attempt to fulfill the 12-year medical research plan ahead of schedule.

Figure 1

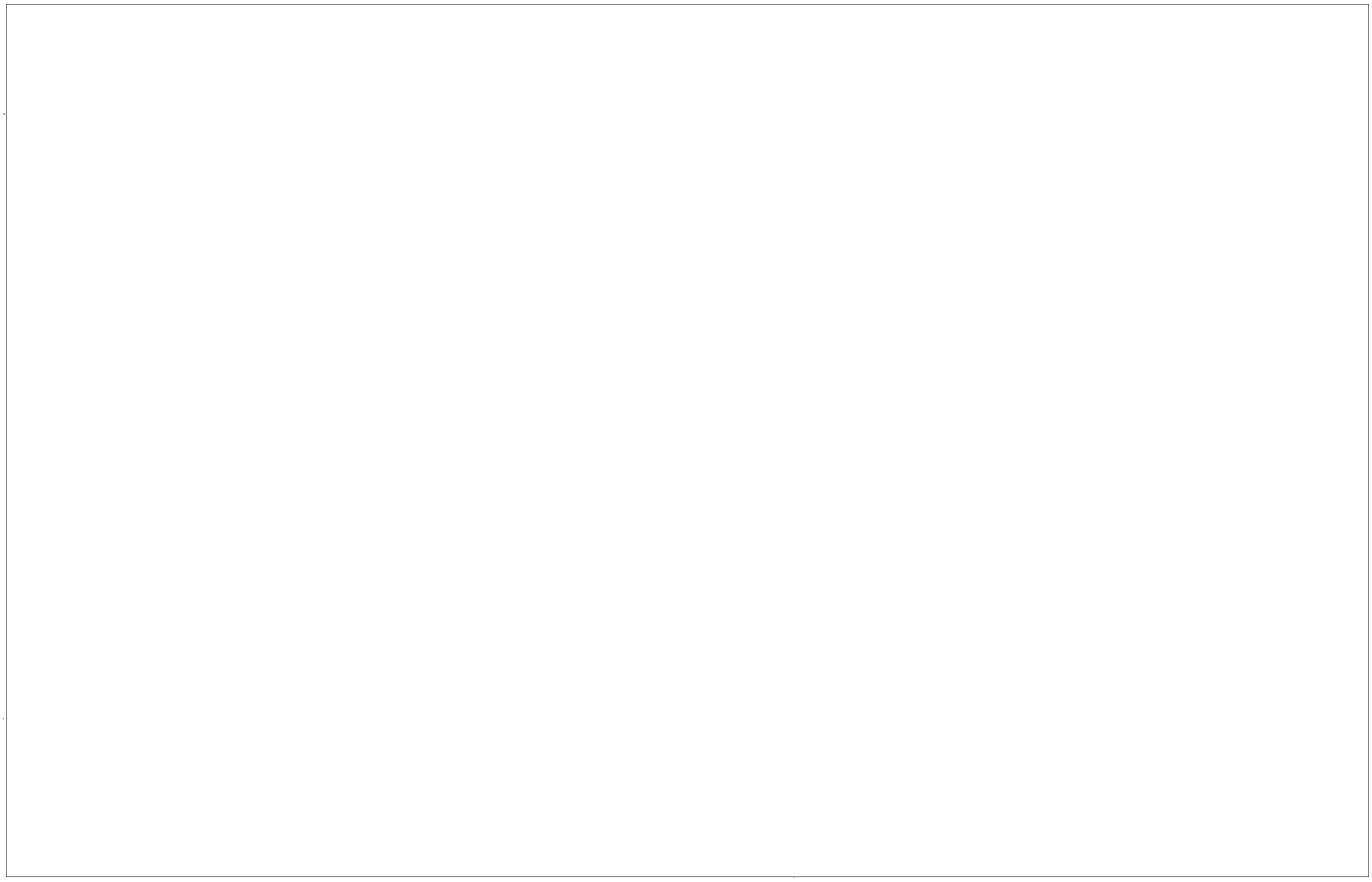


Figure 2

Figure 3

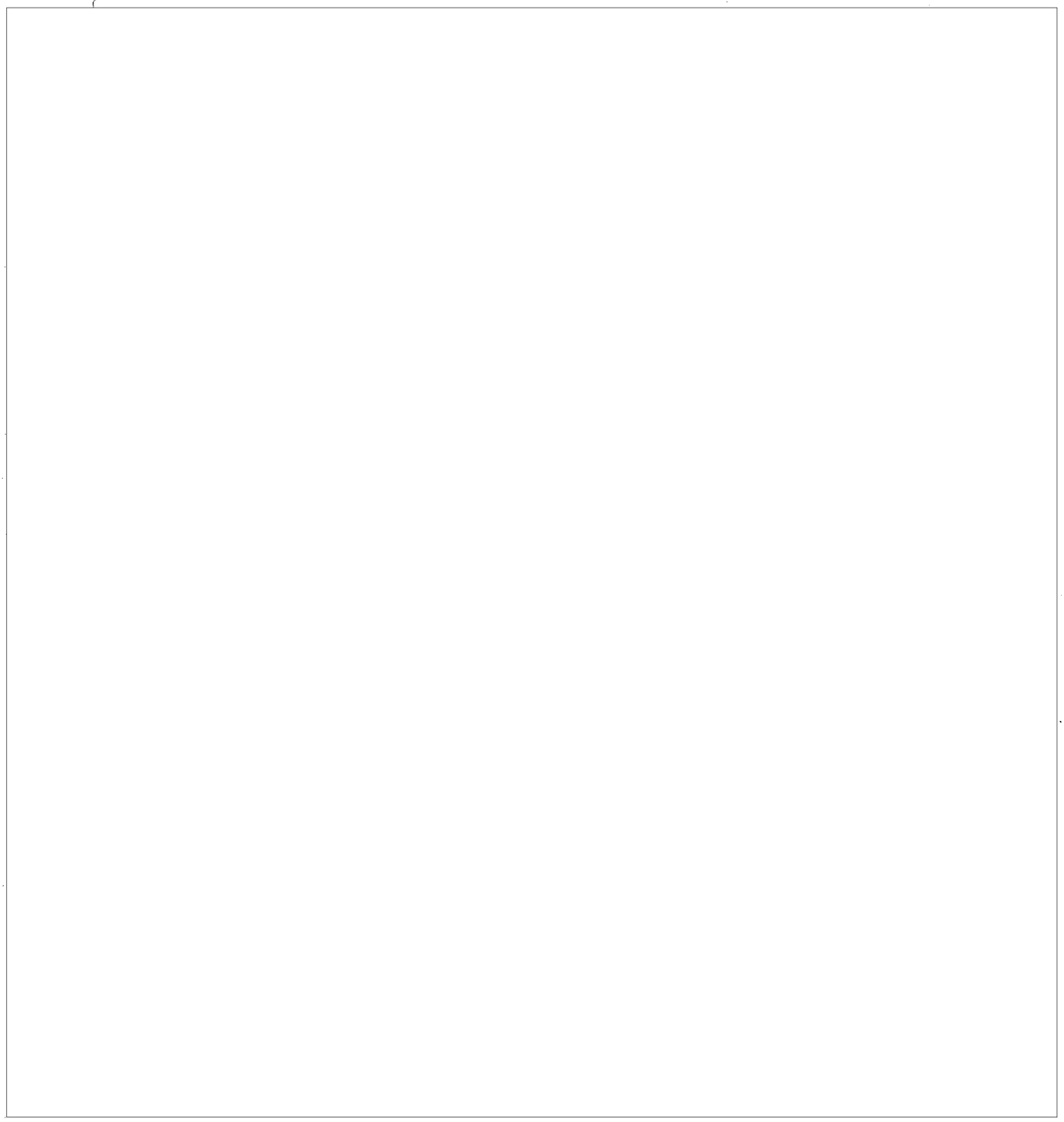


Figure 4. Hall of Chemistry, Academia Sinica, Peking.

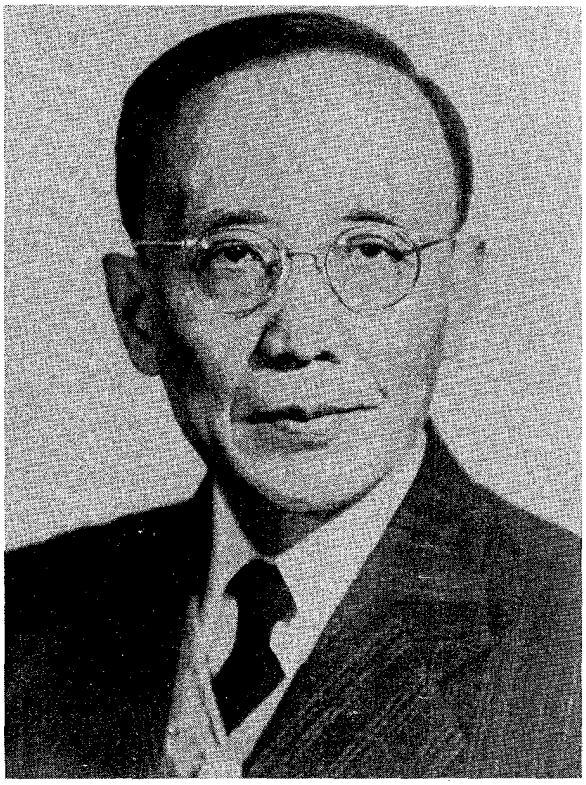
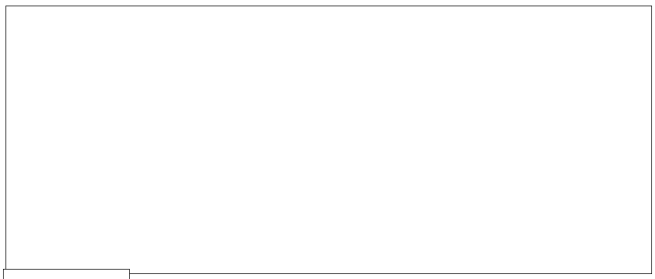


Figure 5. Kuo Mo-jo, President, Academia Sinica.

Figure 6. Li Teh Chuan, Minister of Health.



Research Laboratories Associated with Medical Colleges — Since the 1954 reorganization, research in basic and applied medical sciences has been carried out in the higher medical colleges which now number approximately 38 and which are organized under the Department of Medical Training of the Ministry of Health. Most of this research is carried out at the six largest medical schools, the most important of which is the China Union Medical College. Other medical college laboratories engaged in important research include those of the Canton Medical College, Hangchow Medical College, Shanghai First Medical College, Shanghai Second Medical College, and Peking Medical College. Coordination of the research activities of these laboratories with those of other national research organs would presumably occur through the Ministry of Health, but no details are currently available.

Planning

In June 1955, the status of planning for scientific research in Communist China was described by Kuo Mo-jo as poor and inadequate. He indicated that China at that time had no clear idea of the capabilities of her manpower, what fields to expand, or what institutes to enlarge. International coordination was particularly poor. In the last 2 years, however, organizational improvements have led to more realistic and comprehensive planning which has been reflected materially by the "great leap forward" of 1958.

In 1956, the Medical Division of the Planning Committee for the Scientific Development of the State Council published a long-range, 12-year plan for scientific and technical development in China upon which the 1-year and 5-year plans of all ministries are to be based. The purpose of the 12-year plan is to bring China up to the world level of competence in certain prescribed areas of science and technology by the end of the Third Five-Year Plan, 1967. The plan outlines overall tasks for research; points out central problems important for social construction in China; decides the number of research personnel necessary; makes organizational arrangements for an interinstitutional, multidisciplinary approach to medical research; determines the rate and sequence of development; and establishes coordination procedures among the AS, AMS, various ministries, and other research organizations.

The Medical Science Research Committee of the Ministry of Health, guided by the 12-year plan, prepares 1-year and 5-year plans for medical research in cooperation with the AMS.

The First Five-Year Plan concerned itself primarily with applied research on nationally important diseases, leaving fundamental research for a later time. In November 1956, a 1-year plan for medical research in 1957 was developed, based on the 12-year plan, and distributed to all responsible medical research units. It called for research on some 280 subjects, which included: the prevention and cure of diseases most seriously endangering the health of the people; antibiotic research; sanitation; medical equipment; theory and practice of Chinese traditional medicine; protection of worker health and the prevention and treatment of occupational diseases; nutritional research and physical culture; and basic theory of surgical and medical procedures, physiology, biochemistry, pharmacology, and others. Over 140 medical research units responded, pledging themselves to some 3,000 individual research projects which were reviewed by the Committee on Medical Research in February 1957.

Leadership and coordination were to be improved by the addition of several experts in both traditional and Western medicine to the

Committee on Medical Research of the Ministry of Health. These experts were to establish provincial and municipal research committees to formulate and examine research plans from institutes and laboratories in their respective areas.

Each medical research organization selects its own topics based on the broad directives of the 12-year plan and on the information given in the proposed 1-year or 5-year plan originating from the Ministry of Health. Proposed topics must be discussed by the Scientific Research Standing Committee of the originating unit, be approved by the controlling agency for that unit (AMS and Ministry of Health Committees), and then be submitted to the Medical Division of the Scientific Planning Committee of the State Council for final decision.

Although the main planning body for medical research is to be vested in the AMS, the Chinese feel at this time that tighter ministerial control must be exercised over priority projects because of the lack of trained investigators and facilities. It is planned, however, that these shortages will be sufficiently alleviated within the period of the 12-year plan to allow all of the planning, administration, and execution of medical research to be carried out under AMS.

Political influence in planning can be best exemplified by the 1957 health plan, which, by party direction, includes an extensive investigation of the efficacy of traditional practices and medicines, over the objections of many medical men.

In spite of the political considerations and other faults which could be termed "growing pains," the 12-year medical plan has proceeded at such a rapid rate that it has been decided to attempt its completion by the end of the Second Five-Year Plan, 1962. This ambitious attitude follows the Soviet decision to reduce their 15-year plan to 7 years but, in the case of China, is less than realistic. An extension of the plan will probably be necessary before 1962.[3]

CHINESE COMMUNISTS' OBJECTIVES, MAJOR ACHIEVEMENTS, AND TRENDS IN MEDICAL SCIENCES

Research Areas Under the Twelve-Year Plan of the Ministry of Health

Research on Infectious Diseases — A very large part of China's medical research effort is devoted to the prevention and cure of six infectious diseases that are responsible for extensive worker absenteeism. These are:

Schistosomiasis — The control of schistosomiasis, caused by the blood fluke *Schistisoma japonicum,* is essential to the Chinese economy. The rapidly increasing population will need increasing amounts of food, and this means the expansion of the agricultural areas, especially the rice growing areas, and an increase in healthy agricultural manpower. Most of the estimated eleven million persons afflicted with this disease are rice farmers or persons residing in the rice growing areas where the host snails, *Oncomelania,* are abundant and where human feces are used for fertilizer. Left unchecked, this disease alone could cut down the effective working time of farmers sufficiently to produce a rice shortage. Schistosoma teams presently number about thirteen hundred, but only about one million of the eleven million infected persons have received the three-day course of treatment. Research teams from the Institute of Materia Medica of the AS and the Chinese People's Liberation Army Academy of Medical Sciences are attempting to find an antischistosoma drug which is less toxic than the tartar emetic (antimony potassium tartrate) now in common use. The most promising drug so far among the many tried is the water soluble ammonium antimony gluconate which appears to be as effective as tartar emetic and only one-third as toxic. Because no immunization methods exist, great emphasis has been placed on snail destruction and feces sterilization. The large remaining problem is to get enough public health diagnostic and treatment teams to the people. Although the antischistosomiasis campaign was originally to be completed by 1967, the "leap forward" policy has made it necessary to meet the goal by 1962. The disease will be

partially under control by that time only if vector control campaigns are successful.[11 27 28 56 58 60 62 64 77]

Tuberculosis — Tuberculosis is probably the most widespread serious infectious disease in China. It is not a reportable disease and, therefore, it does not receive the publicity of schistosomiasis or encephalitis. The number of persons infected is unknown but can be assumed to be even greater than those infected with Schistosoma. Approximately 70 percent of the cases of tuberculosis are primary minimal and have been discovered only since the use of mass chest X-ray campaigns. Although the number of tuberculosis beds has increased 22 times since 1951, hospitalization is still inadequate even for the advanced cases.

Many primary minimal tuberculosis cases are treated at work, in outpatient clinics, and at home. The Chinese claim that in a series of studies performed between 1952 and 1956 which involved some six hundred patients observed over a period of 1 year, the control group receiving no medication or bed rest did not worsen or improve. Further, it is claimed that when isoniazid (INH) was administered, 79 percent of the no bed rest group improved and only 3 percent became worse. All patients initially had both positive roentgenograms and sputum.

This research appears to be similar to the findings of Western investigators and lays the groundwork for claims that tuberculosis can be controlled without extensive loss of working time. However, the Chinese have overlooked the factor that nonisolated ambulatory patients with positive sputum are a constant source of infection. The large number of cases of active tuberculosis balanced against the available medical resources precludes adequate hospital treatment and will surely result in a serious strain on Chinese economy. It is not likely that China will gain practical control over its tuberculosis problem before 1967, and control comparable to that in the United States will probably not be accomplished until a standard of living comparable to that of the United States is achieved.[27 28 62–66]

Malaria — There has been a high morbidity from malaria in the coastal and southern provinces for many years. However, by 1957, the government had successfully placed medicinals, such as atabrine and quinine, within the reach of the people and had controlled mosquito breeding areas through large DDT spraying campaigns. Although the malaria elimination plan will continue to emphasize mosquito abatement measures, considerable research is being done on antimalarials. This includes toxicological and therapeutic studies on the antimalarial chlorophenyltriazine (chloroguanide) whose potency is said to be 20 times that of quinine and 10 times that of proguanil. Clinical tests using chlorophenyltriazine at the Kweichow Cadres Hospital reportedly showed that tertian, quartan, and malignant forms could be brought under control in two to four days. No reference is made in the literature to earlier (1945) Western work with this drug. Other work includes a comparative study of the toxicology of dichroine and quinine, attempts to overcome the emetic effect of dichroine, and the general screening of the Dichroa and Hydrangea for possible antimalarial effects. Although no new antimalarials are expected to be developed, by 1962, the mosquito eradication program outlined for the Second Five-Year Plan will probably reduce the incidence of the disease to the point where it will no longer represent a major public health threat to the Chinese.[27 28 56]

Japanese B Encephalitis — Although influenza and the common cold can be considered the most important virus diseases in China from the point of view of lost man-hours, most Chinese viral research is directed against Japanese B encephalitis, and a SovBloc Central Coordination Institute for Japanese B Encephalitis Research has been located in Peking.

Much of the Chinese encephalitis research consists of repeating Soviet and Western work, although the published results of many of the experiments would lead the uninformed to believe that they are of Chinese origin. Three examples, however, which appear to be original Chinese work are: (1) the isolation of a Peking strain of Japanese B encephalitis

which is less effected by changes in temperature, pH, and culture media than the more common Nakayama strain, and which has created interest in the West; (2) the isolation of several different naturally occurring strains of Japanese B encephalitis which differ in pathogenicity; and (3) the development from local strains of a new encephalitis vaccine which is claimed to be more effective and less toxic than the one used presently.

This type of original investigation indicates a limited, narrow effort in medical virology on the part of a very few competent virologists.

Following earlier Soviet work, the Chinese have claimed that when the Japanese B encephalitis virus is given subcutaneously to mice under conditions of normal sleep their mortality rate decreases. This is another factor used to explain partially the observed differences in severity of the disease. Another follow-up experiment by C. J. Wu has confirmed the Soviet observation that farm animals exhibit a clinically nonapparent Japanese B encephalitis viremia in endemic areas during preepidemic periods. This work would suggest that farm animals may play a part in the cycle of the disease. Although the Chinese work to date establishes the presence of viremia in the animals, it has not been shown to indicate impending epidemic in humans nor does it indicate that animal reservoirs contribute to epidemic conditions.

An advance in the early diagnosis of Japanese B encephalitis was made by the Soviets in the form of a more sensitive complement fixation test run at low temperature. Subsequent work was done by M. S. Chow et al. using the sera of 397 patients; each serum specimen was processed by means of the old and the new methods. A 49 percent increase in positive findings using the new test was observed, which tends to confirm the Soviet results. Although no treatment for Japanese B encephalitis exists other than an often inadequate antiserum, such an improved diagnostic test could be of considerable importance in early identification and evaluation of an epidemic.

An end to the encephalitis problem in China will not come until specific drugs are discovered which are active against these small viruses. Since it is unlikely that such a discovery will be made in China, the problem will exist until the results of future foreign advances can be applied.[62 65 66]

Typhus — The typhus problem is still serious in China and points up the inadequacies in the Chinese public health system. The failure to eliminate typhus as a major epidemic disease is due to the lack of sufficient vaccine and chlortetracycline and of enough trained medical personnel to cover the rural areas. It is significant that traditional doctors are not used even to administer vaccines or antibiotics in the rural areas where they still provide the largest amount of medical care. Research on typhus presents no new approaches, and the control effort is being directed at an increase in both the quality and quantity of typhus vaccine and antibiotics.

If the development of the antibiotic and biological industry is completed on schedule (1960–62), typhus can be expected to be under control probably by 1965. Until then, any natural disaster or war could cause serious epidemics.[62]

Bacillary Dysentery — Research on dysentery has centered mainly around the serological typing of the disease found in China. Results show that *Shigella flexnerei* and *S. sonnei* are the main groups present and that most of the strains are sensitive to sulfathiazole, dihydrostreptomycin, and chloramphenicol. China is capable of producing drugs in sufficient quantities to deal with this problem; therefore, the lack of trained manpower and environmental sanitation rather than the lack of drugs is responsible for the high (but unstated) incidence of dysentery.

The Second Five-Year Plan should see a significant decrease in this disease, but complete control will probably not be effected for at least another 20 years.[62]

Antibiotics Research — The infectious disease problem in China has necessitated a large research effort in antibiotics directed

by the National Antibiotics Research Committee. This effort is divided into two areas: the improvement of production techniques for common antibiotics and the investigation of indigenous antibiotic substances.

Common Antibiotics — The largest research area to date has been improving the production techniques for penicillin, synthesizing chloramphenicol, and developing and producing chlortetracycline and streptomycin.[36 67–71 73–75]

Penicillin

Penicillin production is well established and research is directed at the use of indigenous raw materials, such as cotton seed and peanut cake, instead of corn steep liquor, and maize paste, instead of lactose. Research on production techniques in 1956 resulted in increased yields and an increase of the period in which a tank could operate without "infection."

The quality of Chinese penicillin is presently below Western standards, although it has been improved considerably since 1956. Soviet aid has not emphasized production techniques although the Soviets subsidized the building of the large Shanghai Pharmaceutical Factory Number 3. For some unknown reason, the Chinese have not taken full advantage of Western published work on penicillin, because many of the problems stated in their journals were solved some years ago in the West. For instance, no work has been observed which deals with oral penicillin.

Chloramphenicol

Chloramphenicol (chloromycetin) research in Communist China still seems to be centered on the development of a commercially feasible method of isolating chloramphenicol from its isomers at the end of the synthesis, although Western work on this problem has been published since about 1950. The most promising research in this direction is the use of a four step synthesis based on the prins reaction and reported by H'sing Ch'i-i in May 1957. The product is a less potent mixture of isomers called synthomycin. Soviet production methods are used and most of the practical Chinese research has been on methods of quality stabilization and the production of a pure, tasteless synthomycin. This drug appears to be generally available in the clinics of the larger cities.

Chlortetracycline

Chlortetracycline (aureomycin) was prepared in crystalline form in China in 1955, and pilot plant production started in 1956. Most of the research since 1956 has been on reducing the number of steps in the refining process and the use of better solvents. Limited production was started late in 1957 by the Shanghai Pharmaceutical Factory Number 3 using a strain of *Streptomyces aureofaciens* yielding over 2,300 units/ml from which 80 percent of pure chlortetracycline could be obtained. The quantity of chlortetracycline to be manufactured is expected to surpass the quantity presently imported, and self-sufficiency will probably be achieved by 1962.

Streptomycin

Streptomycin production is presently quite limited, and the drug is found only in the larger clinics. Apparently, the Chinese have not yet selectively bred a strain of organism that is sufficiently potent and also resistant to bacteriophage. Present research is directed at finding a potent phage-resistant strain to be used in a new but as yet undescribed ion exchange extraction method which is said to produce pure streptomycin.

Indigenous Antibiotic Substances—The second main area of antibiotics investigation in Communist China has been concerned with indigenous antibiotic substances and a research program of considerable magnitude has been in progress since 1956. To date, the only known antibiotic discovery to come out of this program is an allegedly new tumor-inhibiting actinomycin which has been labeled actinomycin K. Considerable claims have been made for this substance, but nothing has been published on its structural formula or on experimental details. The Institute of Pharmacology of the Academia Sinica

in Shanghai indicates that the new strain of actinomyces was derived from nigrescent actinomyces found in the soil of Kwei-lin in Kwangsi province. The material is said to resemble actinomycin C, but chemically it is a new substance. In experiments run against abdominal implants of Ehrlich ascites tumor virus in mice, it is claimed that the tumors were generally inhibited and life prolonged. Further, it is claimed that all mice treated with actinomycin K previous to tumor implantation failed to develop the tumor. Toxicity tests indicated that the drug is well tolerated and is less toxic and more effective than actinomycins A, C, and D. The drug is said to be easy to produce.

Since no experimental details are available it is possible that the Chinese are merely overstating the effects of an antibiotic that may not really be new. However, the Chinese have the facilities, the competent personnel, and the advisors required to do what they have claimed and final judgment must await the examination of more detailed experiments.

Until the First Five-Year Plan was well underway, China imported essentially all of its antibiotics. In 1956, the stated year's production of penicillin was only thirteen billion international units which is equivalent to only 260,000 fifty-thousand-unit doses. The proposed penicillin production for 1957 was 14,800 billion international units although the realization of this figure has not been confirmed. At present, China is producing a supply of the most important antibiotics which appears to be ample for use of the largest clinics. During the Second Five-Year Plan, 1958–62, China is expected to become self-sufficient in the production of penicillin, chloramphenicol and synthomycin, chlortetracycline, and possibly tetracycline. Also during this period, erythromycin and nystatin will be investigated. The management of the Shanghai Pharmaceutical Factory Number 3 is even more hopeful and expects to be producing sixteen different antibiotics within three years.

It appears that China will be self-sufficient in the important antibiotics within 5 years for both civilian and military purposes. At present, however, a national disaster would find them extremely short of all antibiotics.

Industrial and Occupational Diseases—The remarkable rate of progress that China has made in the transition from an agricultural to an industrial economy has meant the subordination of worker health to production quotas. This in turn has given rise to a great increase in accidents and in occupational diseases, such as silicosis, pneumonitis, and tuberculosis. This has caused the Scientific Planning Committee of the State Council to call for a maximum research effort aimed at the elimination of the causes of the major industrial diseases and accidents as soon as possible. In addition to working a 10-hour day, Chinese laborers spend several more hours taking part in political meetings; serving on street committees of one type or another; and doing voluntary labor, such as building factories, clearing land, or smelting iron. This regimen imposes minimum health conditions and will lead to minimal efficiency unless the industrial medical program of the Second Five-Year Plan is successful. Research team recommendations include: (i) equipping of all factories with anti-air-pollution devices; (ii) assuring eight hours sleep per day for workers; (iii) reorganizing and expanding medical services in industrial plants for early diagnosis of occupational diseases; (iv) making psychological studies for work efficiency, placement of equipment in the shops, and mental and aptitude testing of workers; (v) establishing sanitary inspection systems; and (vi) making nutritional studies designed to bring workers up to dietary standards that will insure maximum efficiency and less illness using locally available foods.

These recommendations must be carried out if China is to make the most of her skilled labor, but even the large scale industrial medical program that has been projected cannot possibly keep pace with the speed of industrialization, and optimal working conditions will not be achieved until the current practices associated with industrialization lessens.[20 55]

Nutrition — China's large population and inadequate agricultural development has made malnutrition with its deficiency diseases one of the major problems to be solved in the "building of Socialism." Nutritional research is limited in scope and is centered in the departments of nutrition of the medical colleges and the Academy of Medical Sciences. The main research projects have arisen from problems encountered in moving large numbers of workers from their home provinces to provinces where the food supplies and eating habits are different and from nutritional problems created by communalization where large numbers of workers must be fed from a common mess hall.

Research projects at Peking Medical College in 1957–58 are generally representative of the effort and include:

1. adapting of digestive enzymes to changes in dietary habits;

2. studying soybean-wheat cereal combinations to determine how the protein components of both complement each other and the best formula for such a diet;

3. studying the protective effect of irradiated bran oil against rickets;

4. studying the effect of mold on the nutritional value of soybean curd.

Also, in 1957, the Academy of Medical Sciences studied the rate of utilization of vegetable proteins by animals and humans and the relation between vitamin B_2 and proteins. Other research will include the nutritional constituents of various fish and cereals; human requirement for vitamins B_1, B_2, and C; and sanitation measures in the production of egg products. All research is of a practical nature with nothing original or unique being apparent.

Communist China will be many years in developing its food potential, particularly livestock production, to the point where it can adequately feed its expanding population. This cannot be accomplished by 1967, because adequate animal supplies will not be available for at least 20 years. For the immediate future, therefore, Chinese workers will subsist on a nutritionally marginal diet, but this diet will be better in many cases than before 1949. To date, the relatively poor nutrition has not visibly hampered the "leap forward," and there is no reason to feel that it will do so in the future as long as the food : population ratio does not become more acute than it is now.[4 11 75 76]

Basic Theoretical Problems — Basic research in the medical sciences is limited mainly by the scarcity of trained manpower who can be freed from teaching long enough to do effective original work. The basic research that is being done is in support of the 12-year plan for medical research. The following is a brief outline of the type of work being done in the major medical science disciplines:

a. Physiology — Although the study of the nervous system still seems to predominate in nearly all physiological research, attention is being given to humoral as well as nervous factors in studies of stress, which indicates that trends in Chinese physiological thought are similar to those of the USSR. Typical research projects presently underway include studies on: (i) the action of various drugs, such as DL-tetrahydropalmitine, on conditioned reflexes; (ii) problems of stress and urinary 17-ketosteroids; (iii) neurohormonal control of gastric secretion; (iv) the adaptation of digestive enzymes to changes in dietary habits; (v) the mechanism of the action of nonspecific stimuli, such as croton oil, on neurological changes caused by encephalitis; (vi) changes in acetylcholine content of tissues under conditions of central inhibition and traumatic shock; (vii) the relation between dyscrinism and tumorogenesis; (viii) and the influence exerted by hormones upon the physiological processes of nerve. In addition, work concerning the effect of positive pressure breathing on interoceptive reflexes is being carried out at the Liberation Army Academy of Medical Sciences, Shanghai. This particular work has application in aviation medicine, but no acknowledgement of this aspect is made in physiology journals.

b. Pharmacology — Antischistosoma drugs unquestionably occupy first place in Communist China's pharmacological research today.

Compounds presently under consideration include: water soluble organic trivalent antimony compounds of which only ammonium antimony gluconate is both stable and effective; oil soluble organic trivalent antimony compounds whose antischistosomal activity is doubtful; organic pentavalent antimony compounds; the derivatives of benzenesulfonamides and polyhydroxy acids; organic arsenic; mercury and tin compounds; derivatives of xanthones and thioxanthones; derivatives of acridines, anthraquinones, chromanones, and thiochromanones; the quinoline derivatives; the piperazine derivatives; and derivatives of 4,4′ diamino-diphenoxy-alkanes. Attention is being given to decreasing the toxicity of tartar emetic by facilitating its excretion with such compounds as sodium dimercaptosuccinate. In spite of this research, tartar emetic and ammonium antimony gluconate remain as the only reliable antischistosomal drug readily available and will probably remain so until about 1960–62. Considerable effort also is being spent in the characterization and analysis of Chinese medicinal herbs to determine the active principal of those which are found to possess therapeutic activity. Although this work has been discredited to some extent in the West, there is a possibility of new drug discoveries from this source. To date, no entirely new drugs have been discovered, but one hypotensive drug in the Rauwolfia group has been isolated.

Other fields of research include work on new antihelminthics; the tuberculostatic effect of hydrazine derivatives; the effect of ginseng on alloxan diabetes and on the vitamin C content of the adrenal glands; the effect of berberine-containing coptis herbs on bacillary and amebic dysentery; and research in antibiotics and anesthetics.

c. Biochemistry — A small but increasing amount of work is being done in many of the major areas of biochemistry by competent Western-trained Chinese investigators. To date, however, research has consisted mainly of reports based upon earlier Western efforts and no noteworthy contributions have been made to world knowledge. This is due not only to the lack of sufficient time and to relatively low priority presently assigned to basic work, but also because of a lack of competent assistants.

The Department of Physiology and Biochemistry of the Academia Sinica still leads in basic biochemical research. This Department, headed by Feng, Te-pei, covers the following fields:

(1) Protein research includes studies on metabolism of proteins and amino acids and on the biosynthesis of proteins and the physico-chemical properties of proteins, especially those of the nervous system and connective tissues. Specifically, studies are being made of the changes produced by sound irritation in the cerebral proteins of mice. Here, physico-chemical properties are to be correlated with function.

(2) Enzyme research includes studies on the respiratory enzymes, especially the cytochromes; dehydrogenases containing flavines; and liver amino acid oxidases.

(3) Nucleic acid research includes general studies on the metabolism of nucleotides and nucleosides.

(4) Vitamin research includes studies on the biosynthesis of vitamins C, E, and riboflavin in animal tissues, with emphasis on the enzyme systems involved.

d. Microbiology — Efforts in this field are about evenly divided among virology, bacteriology, and parasitology.

In addition to Japanese B encephalitis, virological investigations have included the successful isolation and culture of trachoma virus and the preparation of a preventive vaccine. This work, done in conjunction with Soviet investigators, is of outstanding importance because no successful mass treatment for trachoma is known. The development of a good vaccine, therefore, would have considerable propaganda value if proven. Also, studies have been made of the biological characteristics of the influenza virus, and antigenic studies have been carried out on some 15 strains of these isolated in Peking.

Rickettsial research centers about typhus and the employment of antibiotics against tsutsugamushi fever.

Figure 7. Flooded rice paddy where cercariae of Schistosoma japonieum invade through the skin.

Figure 8. Antibiotic research at Drug Research Laboratory, Academia Sinica.

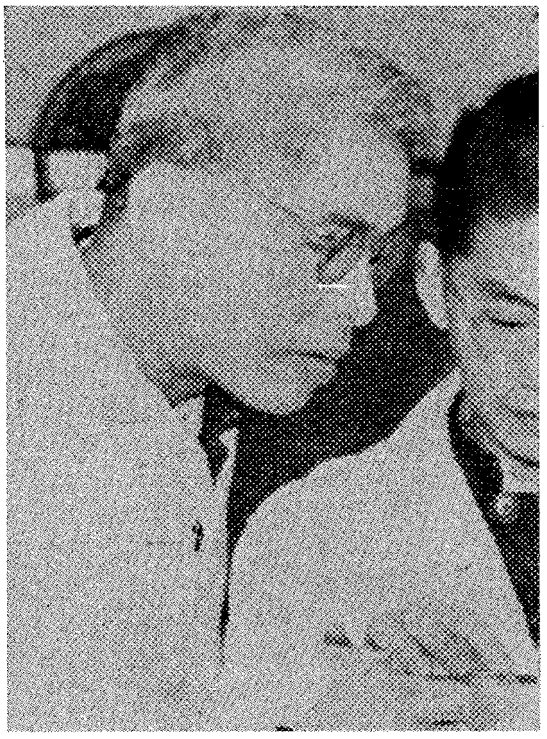


Figure 9. Feng Teh-Pei, Director, Department of Physiology and Biochemistry, Academia Sinica.

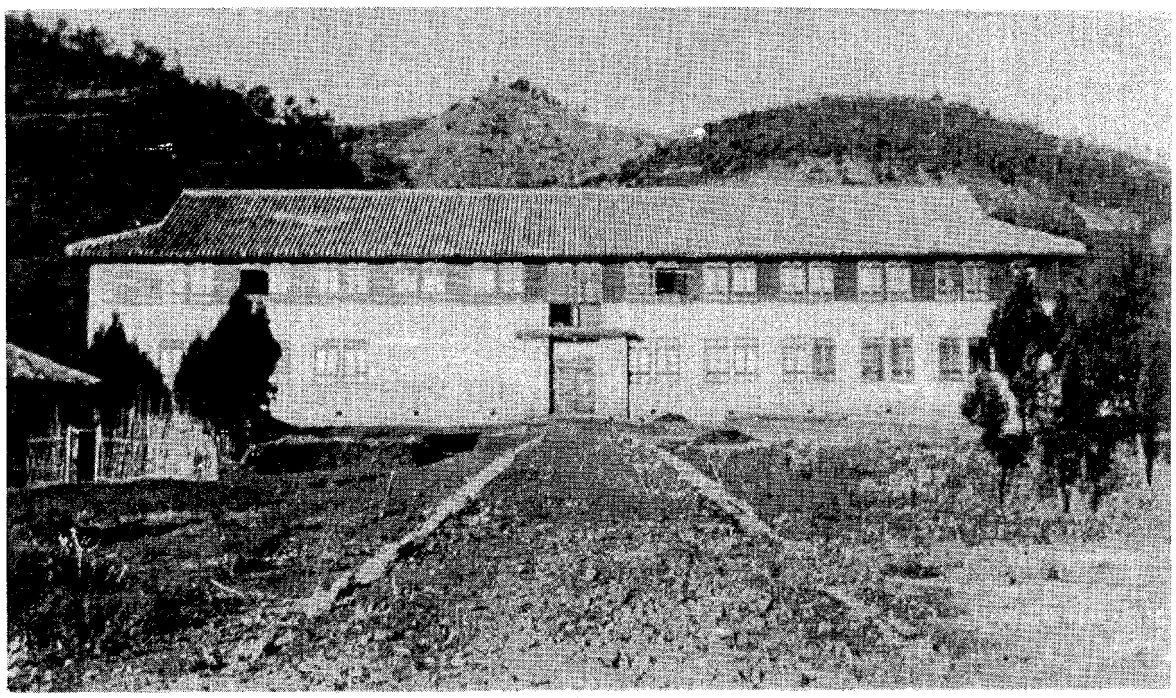


Figure 10. National Vaccine and Serum Institute, Kunming.

Figure 11. C. H. Huang, MD, Chief, Virus Diseases Department, China Union Medical College, Peking.

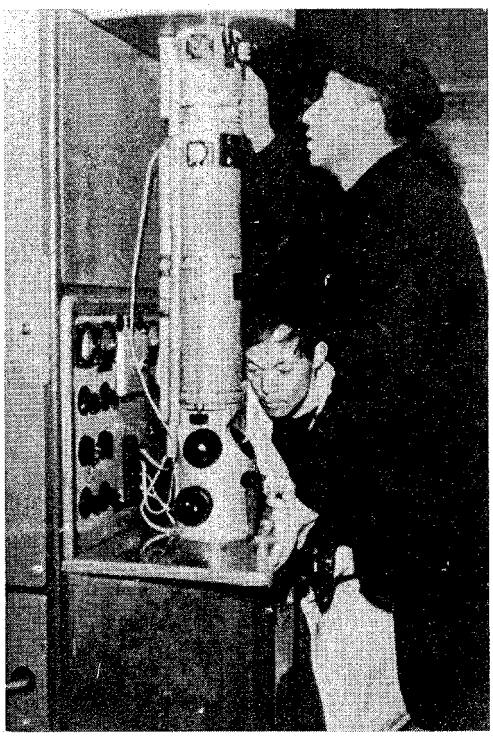


Figure 12. Electron microscope of foreign manufacture, Institute of Scientific Research, Ch'ang-Ch'un.

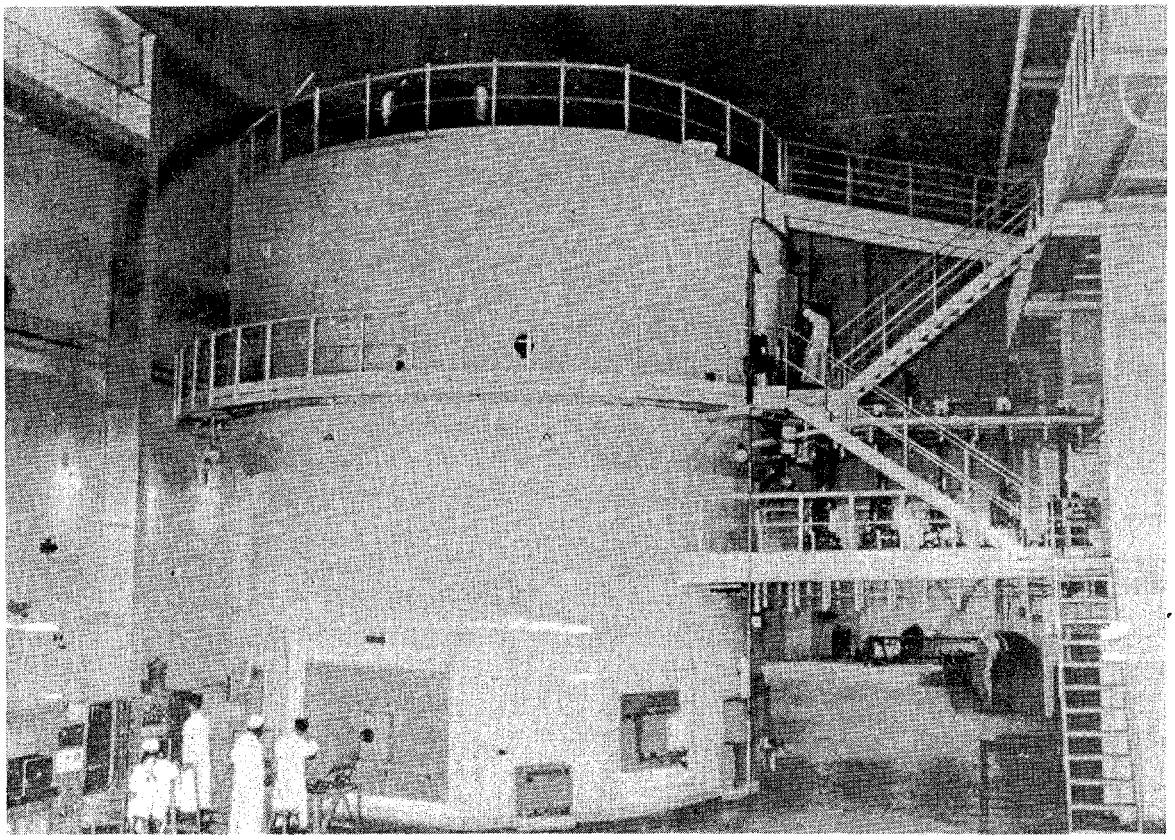


Figure 13. 10 MW heavy water reactor supplied by the USSR to the Institute of Atomic Energy, Academia Sinica, Peking.

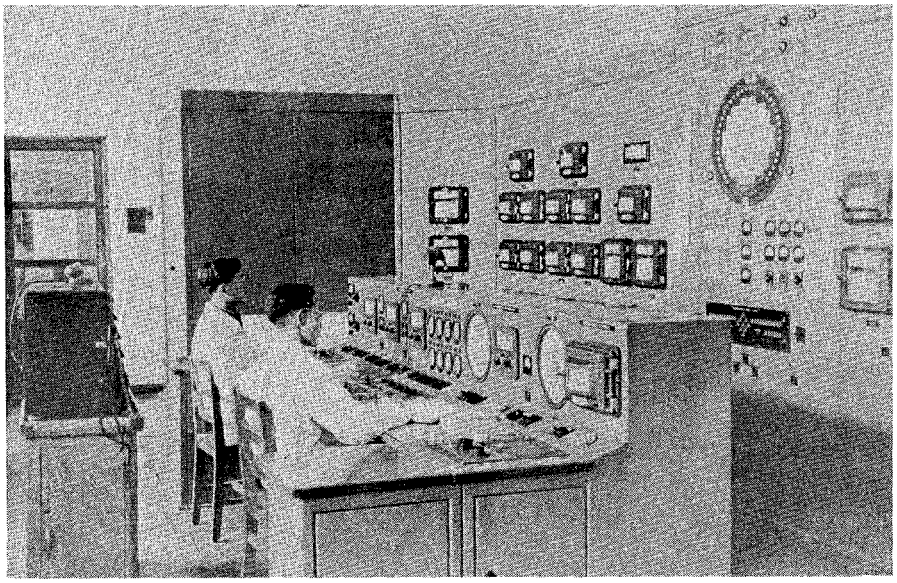


Figure 14. Central control board for the 10 MW heavy water reactor.

Figure 15. Counting equipment for the detection of radioactive tracers.

Bacteriological research includes:

(1) The isolation and characterization of four strains of *Shigella sonnei* from rodents, and the search for a good dysentery vaccine to replace the relatively ineffective bacteriophage which is being propagandized.

(2) Testing the comparative sensitivities of 160 strains of hemolytic staphylococci to penicillin and to the Chinese drug *coptis sinensis*. Reports claim to show 100 percent sensitivity to coptis and only 35.62 percent sensitivity to penicillin. No evaluation of these claims can be made because no details are available on any of this work. Its importance lies in the possibility that the Chinese are having the same difficulty with highly resistant "hospital staphylococci" as is being experienced in the United States and other Western countries.

Parasitological investigations in addition to schistosomiasis include:

(1) The study of new complement fixation tests for more rapid diagnosis of toxoplasmosis.

(2) Studies on the preparation of immune sera for four leptospira strains, isolated by agglutination tests, which are thought to be responsible for most epidemics.

(3) Investigations on the possible implication of the trypanosome in K'uo shan disease.

Except for one or two good pieces of research, the general character of the work in microbiology is what could be described as a "holding action." The few well-trained investigators attempt to keep up with their fields, within the priority limitations set by the government; therefore, their work should not be judged too harshly. By 1962–65, well-trained and experienced investigators will be available for research and creditable work can then be expected.[4 11 62-64 76 78-92]

Radiobiology and Nuclear Medicine

Radiobiology — Active Chinese research in radiobiology started in September 1958 after completion, in July, of a 10–MW heavy water atomic reactor supplied by the Soviets and located at the Institute of Atomic Energy of the Academia Sinica in Peking. On September 27, this reactor started production of 33 radioactive isotopes for research, including cobalt-60, sodium-24, phosphorus-32, and calcium-45. Using products of the new reactor, research projects include the effects of ionizing radiation on water, proteins, nucleoproteins, and nucleic acids and the study of the pathophysiology of radiation sickness when large local doses of radiation are applied to the vascular receptors of the carotid sinus and adjacent areas. The use of Chinese-made carbon-14 in metabolic studies is apparently not yet underway.[11 80 93]

Experimental production of various types of counters, spectrometers, vacuum pumps, and pulse-height analyzers necessary for atomic research also is being carried out.

Nuclear Medicine — The diagnosis and treatment of diseases with Chinese-made radioisotopes are getting underway. The Medical Instruments Manufacturing Factory at Peking has produced a pilot model of a cobalt-60 apparatus for cancer therapy, and the USSR has equipped the cancer clinic of the Academy of Medical Sciences in Peking with complete cobalt-60 treatment facilities. Radioactive antimony has been reportedly used in research on the neutralization of the toxic effects of antimony in antischistosomials, and radioactive iodine and phosphorus are reportedly in use against thyroid disease and blood dyscrasias at the Tsientsin Medical College hospital. It is not clear at this time whether the antimony-labeled antischistosomal drug and the iodine-131 mentioned are of Chinese manufacture or whether they are imported.

Both radiobiology and nuclear medicine have just gotten underway in Communist China. Prior to the building of the new atomic reactor in Peking, China had no capability for such work other than those isolated experiments which could be carried out with imported isotopes. In spite of this tardy entry into the field, Chinese research on biology, biochemistry, and clinical medicine can be rapidly modernized provided that sufficient isotope material can be made available. Since the single reactor is of the high flux type,

it should produce all of the isotopes necessary for medical research for the next 10 years. With its expanding body of medical research workers and continued Soviet aid, it is possible for China to approach the present world level of knowledge in radiobiology and nuclear medical research by 1967, although significant advances in the field will continue to originate in the USSR and the West.[94-98]

Psychology and Neurophysiology

The desirability for understanding human behavior has always been a subject of intense interest for the Communists. Until 1956, Chinese Communist studies in psychology and neurophysiology were based solely upon Pavlovian reflexology. In 1956, however, Chang Hsing-t'ung, a physiologist from Yale University, returned to the mainland at Peking University where he is presently conducting experiments which represent an extension of Pavlov's theories, including microelectrode implantations and the recording of responses in the visual system. This electrophysiological work is patterned after that of Magoun in the United States and more recently of Anokhin and Sokolov in the USSR who have adopted the American investigative approach.

Although this modern approach to neurophysiology in China is presently limited to the work of Chang, it establishes a base line for behavior studies at the same qualitative level as that of the United States and Soviet Union. The results of these studies promise to shed more light on the nature of behavioral mechanisms, and such knowledge interpreted and scientifically applied in tightly controlled social situations, such as those provided by the developing communes, might help substantially in effecting consolidation of the Communist regime by dissolving the traditional Chinese family system and by the ideological indoctrination of racial and cultural minority groups. An organized effort to consolidate minorities is already forecast by extensive plans for expanding the Institute of Psychology of the AS into Sinkiang, Kirin, and Yunnan by 1962, for the purpose of "closely studying the people."

It is strongly suspected that this psychological and neurophysiological research, as well as the extension of the psychology institute facilities, is directed ultimately at behavior control.

Military and Civil Defense Aspects

Nuclear Warfare Defense —

For civilian use, a manual on defense against nuclear, biological, and chemical warfare has been published by the China Youth Publishing House and edited by the Liberation Army. Also, the Science Propagation Publishing House has published a civilian manual entitled "Defense Against Atomic Weapons for Civilians." This manual gives a general description of nuclear weapons, and tells how to prepare for and act under attack, including self-aid and decontamination. Most of the information contained in these manuals is of Soviet origin.

To date, the Chinese have not published any data on radiation protective compounds; and there is no word on plans to do so in the future although such research is bound to be undertaken at some time. As in the case of chemical warfare, China is medically defenseless against a nuclear attack and will remain so for at least another 10 years unless great material aid is rendered by the Soviets, shelter areas are built, and other basic civil defense measures are taken.[106-108]

Chemical Warfare Defense — A CW attack on Communist China by the West would be disastrous for the Chinese. The civil population cannot be protected even against standard gases due to lack of gas masks; and even

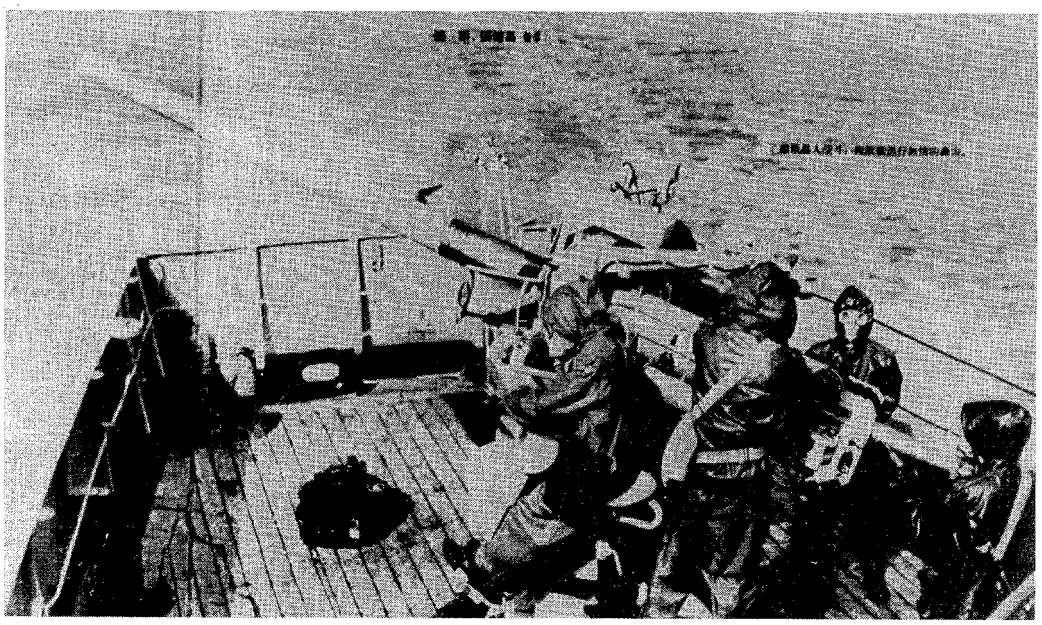


Figure 16. Chinese Communist gun crew simulating atomic warfare conditions.

Figure 17. Chinese Communist radioactive decontamination team on a naval vessel.

Figure 18. Lecture on acupuncture and cautery for Western-trained doctors, Hsian Medical College.

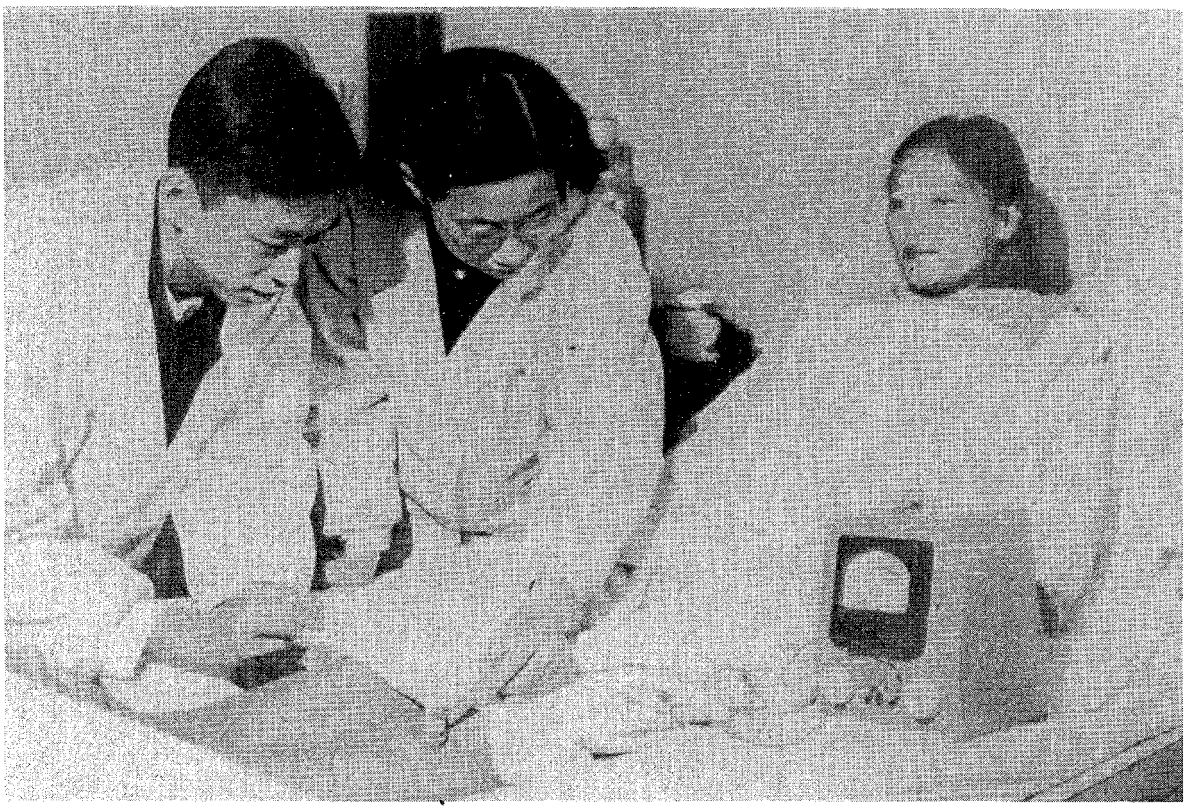


Figure 19. Method of needling and cautery being introduced in treatment of appendicitis.

the army is not adequately protected against G and V agents, even though it receives some defensive and offensive CW training.

Biological Warfare Defense —

For at least the next 6 years, China will have barely enough manpower, antibiotics, and vaccine-serum production capability to resolve its natural disease problems.

In spite of the great "leap forward" in Chinese public health since 1949, the present ratio of trained medical personnel and facilities to population makes China a prime target for BW and she would stand to lose more by offensive use of it than she could possibly gain.[36 109 110]

TRADITIONAL CHINESE MEDICINE

The existence and propagation of traditional Chinese medicine is a monument to the flexibility of Communist ideology. Declared decadent immediately after the "liberation," traditional medicine was quickly reinstated as an "institution of the people" when it was realized that China could not become self-sufficient in Western-type medical doctors until at least 1968, even if the present extraordinary rate of progress were to continue.

Chinese traditional medicine consists of three basic disciplines: herbal medicine, acupuncture, and moxibustion. Of the three, herbal medicine alone appears to have some pharmacological basis. Some of the herbs used for centuries have been found to have therapeutic value. One in particular belongs to the Rauwolfia class and possesses hypotensive activity. The remainder of these herbs appear mainly to possess simple diuretic, laxative, or analgesic properties although the Chinese are confident that useful drugs exist among the thousands of presently uncharacterized species available. Acupuncture and moxibustion on the other hand are considered largely fraudulent and their greatest value seems to be as a mass placebo in support of public health propaganda. Acupuncture appears to be based upon the principle of counter irritation applied in the form of a 9 or 10 centimeter needle with which the subject is impaled at one or more of 700 points on the body. These points are often remote from the site of the pathology. In spite of the considerable amount of money and time which have been spent on the pseudoscientific development of this technique, the best Western medical thought likens this treatment to stepping hard upon the toe of one afflicted with a headache.

Moxibustion uses a considerably more subtle approach to the problems of pathology. Instead of stimulating the organism by the introduction of a long needle into the body, a rolled cone of wormwood is placed at certain specified points of the body and its upper tip ignited, thus producing a remote warming of a circumscribed portion of the anatomy. The claims for this form of treatment are approximately the same as that for acupuncture.

The regime has gone so far as to connect traditional medical theory with the concept of central nervous control of all bodily processes. Chu Lien, Director of the Tradi-

tional Therapy Institute of the Ministry of Health, declares that both acupuncture and moxibustion work through complex reflex actions of the peripheral nervous system and that this in turn will stimulate and readjust the higher nervous system's power of control and regulation and bring about the desired cure. Comment on this would be superfluous.

Traditional doctors have been lauded primarily for political reasons and in 1957 a figure of 500,000 was given for them. Four traditional medical colleges are said to produce about 100 graduates each per year, which would make a total of 504,000 by 1967. In addition, intensive 2- and 3-year courses in traditional medicine are given Western-type doctors, some of whom are ultimately to carry out research. The ultimate was reached when a 2-year postgraduate course in traditional medicine was offered for advanced traditional doctors. The practice has been to have traditional- and Western-style doctors working side by side in clinics in order to lend greater credibility to traditional medicine and possibly to expose traditional doctors to Western medical concepts and practice without loss of "face." The Chinese are using this method in order to exploit all of the available manpower to cover the severe lack of medical doctors. The people have faith in traditional medicine and this can be used to placate them until the traditional doctors can be replaced by doctors with Western-style training.[23 27 35–41]

CHINESE COMMUNIST MEDICAL EDUCATION AND MANPOWER

Education

In the years before the Communist victory, Chinese medical education was confined to a very few good Western-oriented medical colleges which produced small numbers of well-trained physicians and investigators. Emphasis in the medical schools at that time was on quality and owing to a scarcity of equipment and instructors only a few students per year could be admitted. This resulted in vastly inadequate medical services and allowed the almost unchecked progress of communicable and other diseases.

With the advent of Communism, an increasing emphasis began to be placed on industrialization. Since maximum production can only be achieved by a healthy labor force, the Communists immediately set about to expand education in medicine and public health. This expansion was to establish a basic system of public health, which along with an increased research training program, could be expected to reduce morbidity and mortality from controllable diseases and thus reduce the severe loss of man-hours in the new industries. The too rapid training of these professional people, however, has resulted in larger but still inadequate numbers of graduates who are forced into rather narrow specialization, even at the undergraduate level, a condition reminiscent of the Soviet fragmentation of education in the 1930's.

Physician Training — The training of physicians in China is carried out in 34 Western-style civilian medical colleges that were severed from the universities in 1952–53 and placed jointly under the Department of Medical Education of the Ministry of Health and the Ministry of Education. At present, no formal MD degree is granted in China, and each medical college has its own qualifying examinations. The five largest and most important of these schools are located in Peking, Canton, Shanghai, Hangkow, and Mukden; each represents the amalgamation of from two to four schools. Each college has a director, vice directors, and working committees in charge of branches of general medicine, education, hospital, and research.

Students are selected from among those having 6 years of primary school, 6 years of middle school, and having passed a 3-day competitive entrance examination which includes biology, physics, chemistry, political science, and Chinese. Approximately 50 percent of the applicants were accepted until 1957, when the number was cut back in order to relieve badly overloaded facilities and to improve student quality.

The education branches of the largest medical colleges usually have five departments: clinical medicine, pediatrics, pharmacology, public health, and stomatology. Most medi-

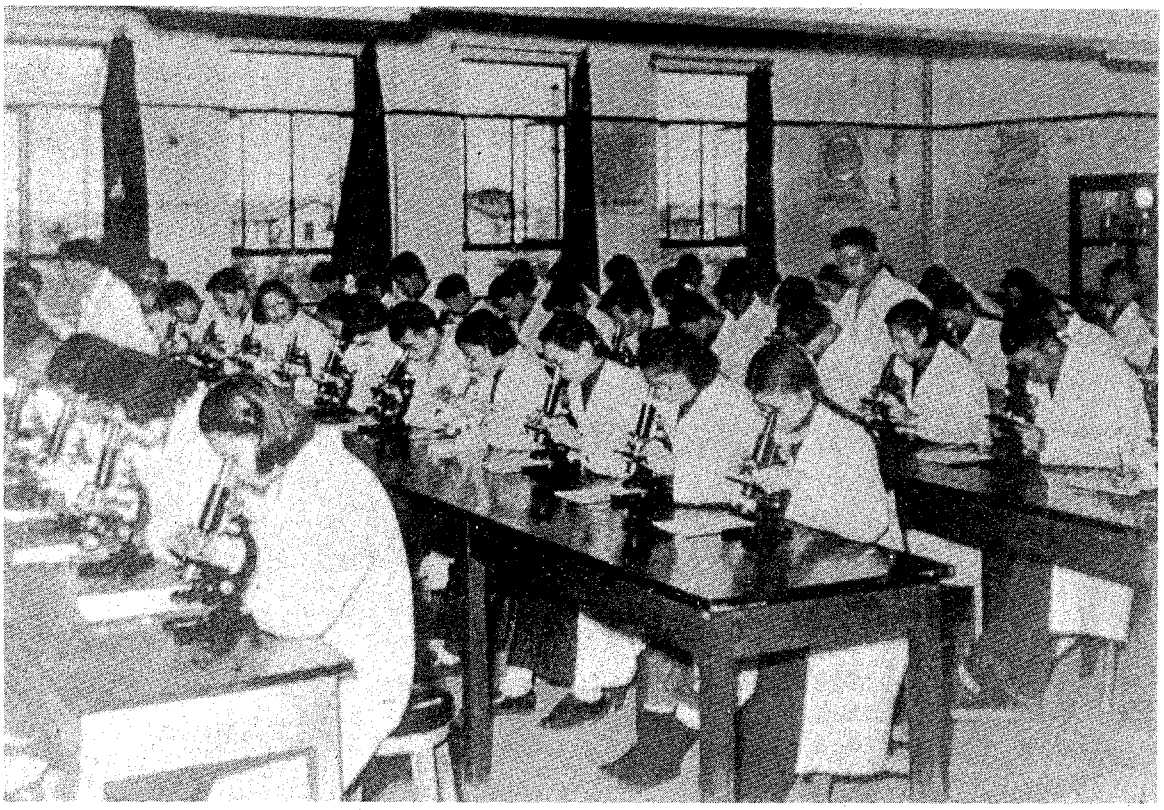


Figure 20. Chinese medical students in the Pathology Laboratory, Peking Medical College.

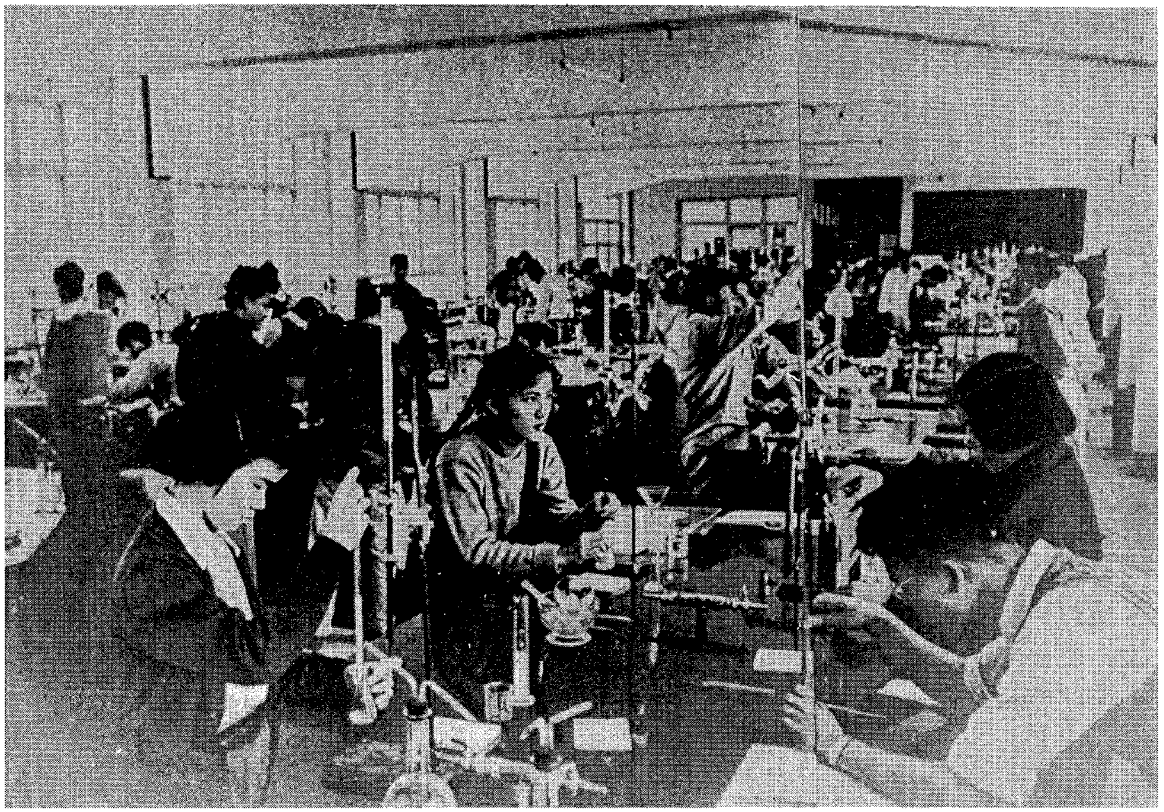


Figure 21. Chinese medical students in the Biochemistry Laboratory, South China Medical College, Canton.

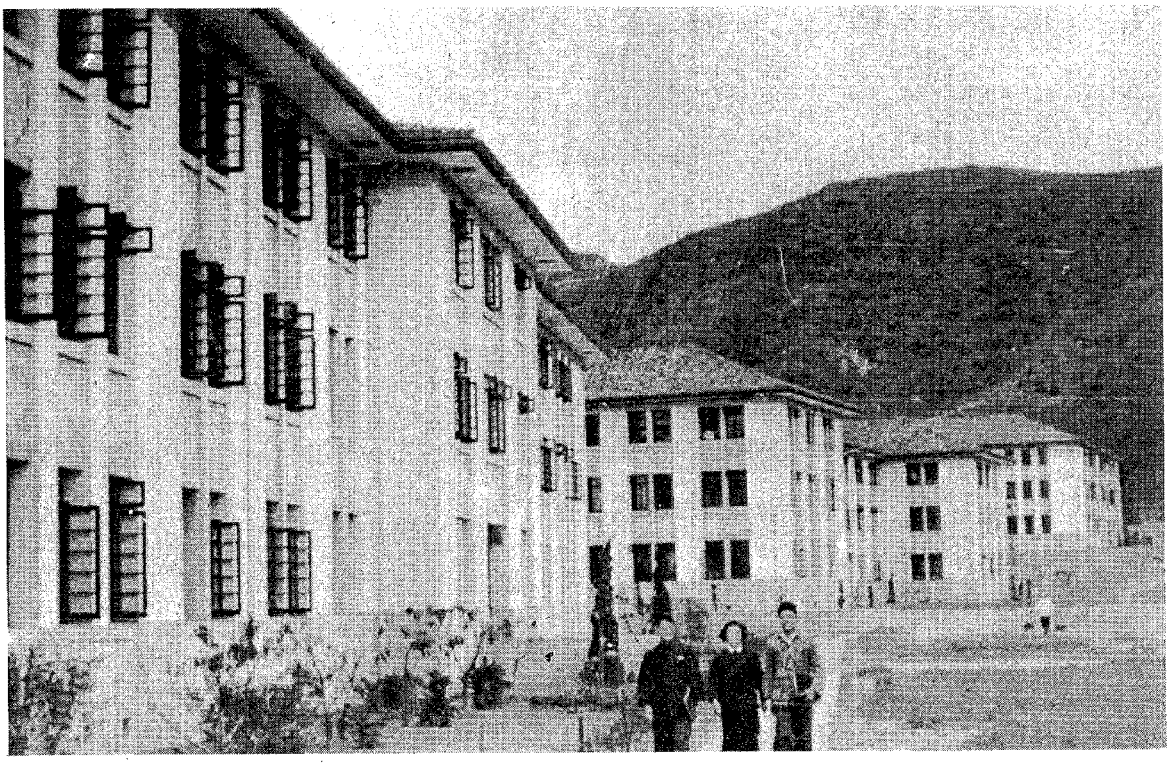


Figure 22. Chekiang University, Hangchow.

cal colleges have only four departments, pediatrics being excluded. Clinical medicine, pediatrics, and public health are presently 5-year courses of study, while pharmacology and stomatology are four years. Students may specialize in any one after completing the first two and one-half preclinical years as stipulated by the Ministry of Health.

The first year of the medical course would be considered in the United States to be on a premedical level in that it includes primarily, elementary inorganic chemistry and other undergraduate premedical subjects. This means that the Chinese student receives only 3 years of schooling that could be considered at all comparable to a U.S. program, plus one year of internship which is comparable in both systems. In terms of total years of education, the Chinese physician has approximately 17 years and the U.S. physician 20 years up through the 1-year internship.* The extra 3 years or so of study undergone by the U.S. physician provides a much firmer grounding in basic medical sciences than is possible under the present Chinese system. In spite of these shortcomings, the best of the Chinese medical students can be expected to become reasonably competent physicians after sufficient clinical experience.

Postgraduate Physician Training — After graduation, the physician is placed in a clinic or industry according to the needs of the Ministry of Health; or if he is a superior student, he may have the opportunity of continuing in postgraduate training consisting of a 1-year clinical refresher course, a 2- or 3-year postgraduate course in a clinical speciality, or of a 4-year training program in research and teaching.

The most important example of these postgraduate colleges is the China Union Medical College (CUMC) located in Peking under the Academy of Medical Sciences, and formerly called the Peking Union Medical College (PUMC). Since 1953, this school has accepted only graduate students in basic medical research and clinical sciences and these are selected from among the most highly qualified graduates from all medical colleges. The mission of this school is to maintain an optimal level with respect to teaching and research staff, facilities, and equipment in order to train medical research workers and clinical specialists and to provide department heads and other leaders for medical schools, clinics, and the institutes of the Academy of Medical Sciences and the Academy of Sciences. This school does not suffer from overcrowding, laboratory space and equipment is generally adequate, and the instructors represent the best of the Western-trained workers and the prewar graduates of PUMC. The school has been kept as a model installation and has been reported by visiting scientists to compare favorably with the better postgraduate medical schools in the West. Since 1951, 1,400 investigators and advanced clinicians have graduated, and 350 were enrolled in 1957.

CUMC, with its optimal student enrollment of 350, has less than one-tenth as many students on the average as are enrolled in the next five largest colleges.

The only major failing of CUMC to date is that the few instructors, who are capable researchers, are kept so busy writing texts and guiding graduate students that they cannot engage in significant amounts of research themselves. This situation prevails in all of the large medical colleges and institutes and is one of the primary reasons for the relatively small volume of good medical research published in China today.

Subprofessional Practitioners — Another group of Western-type medical practitioners in China are called "doctor's assistants." These consist of an estimated 20,000 junior middle-school graduates who have received three years of elementary training in Western medical techniques at special schools established for this purpose during the educational reorganization of 1952–53. They work either with qualified physicians or independently as public health workers. It is quite probable that these sub-professonal persons may be included in some of the more grandiose government figures of total numbers of Chinese physicians.

* This is assuming that the U.S. physician enters medical school with only 90 hours of undergraduate credit, otherwise the U.S. physician would have 21 or 22 years of schooling.

Institute Training — On 5 August 1955, at the 17th Plenary Session of the State Council, a 4-year program for training research students in the institutes of the Academia Sinica was presented. The plan was patterned after Soviet programs and included the presentation of an Associate Doctor of Science degree upon completion of a thesis and a series of examinations given by an academic committee appointed by the departmental and institute standing committees concerned. Regulations were formed covering enrollment, training, remuneration, and future employment in the institutes. Entrance requirements were an undergraduate degree and 2 or 3 years of experience.

During 1955, only the Academia Sinica began to undertake this postgraduate program. In 1956, it was announced that the associate doctoral program was to be extended to the medical colleges and in 1957, to the 16 comprehensive universities under the Ministry of Higher Education. This first attempt at an associate doctoral program broke down almost immediately because of the inadequate academic preparation of the students. The situation is to be partially recovered by establishing a University of Science and Technology to provide adequate academic preparation for the AS graduate program. This University will be controlled jointly by the Academia Sinica and the Ministry of Higher Education.

University Training—Undergraduate—The departments of biology of the 16 comprehensive universities offer undergraduate and graduate courses in some of the basic biological sciences requisite for medical research. In 1955, the department of biology of Peking University offered a 5-year course in zoology, botany, plant physiology, and human physiology with the first class graduating in 1960. The curriculum consisted of 2 years of general study in physics, chemistry, mathematics, anatomy, zoology, botany, microbiology, histology, embryology, and genetics, with specialized studies beginning in the third year. The fifth year students prepare and defend a thesis, and graduation is largely dependent upon its quality.

Graduate — The graduate training program when completely developed, will encompass 4 years and will require a thesis to be publicly defended. Successful defense of the thesis will qualify the student for candidacy for the degree of Associate Doctor. Present plans call for graduate scholarships to be available to all university students who qualify; but, to date, this has not been done.

In general, China's medical education is about 15 years behind that of the USSR; but, by utilizing Soviet experience, China is escaping many of the pitfalls previously encountered by the USSR. The end of the Second Five-Year Plan, 1962, may see the establishment of the Associate Doctor degree in Medical Sciences, but the true equivalent of the Soviet Kandidat and Doktor degree or the Western PhD probably will not be achieved before at least 1967.

Manpower

The best medical research and clinical manpower consists of Western-trained men, those trained in the USSR, and the relatively small number of pre-Communist Chinese graduates. These men have had to carry most of the load of teaching and research because present priorities emphasize teaching over basic research. These men are kept so busy writing textbooks that there is little time for anything other than the general direction of research activities. On the other hand, the largest group of research and clinical personnel consists of recent graduates and even undergraduates, who are receiving a minimum of direction at the time when they should be receiving maximum professional guidance. As long as these conditions exist, it is estimated that it will take approximately 5 years of research experience after graduation before these clinicians and investigators begin to produce creditable work. Therefore, if the year 1954 is set as the probable date when most medical colleges abandoned the 4-year curriculum and instituted the 5-year training program and assume that economic pressures will not allow a slackening of clinical and research personnel demands until 1967 at the earliest, then the period 1962 to 1964 will see the first 5-year

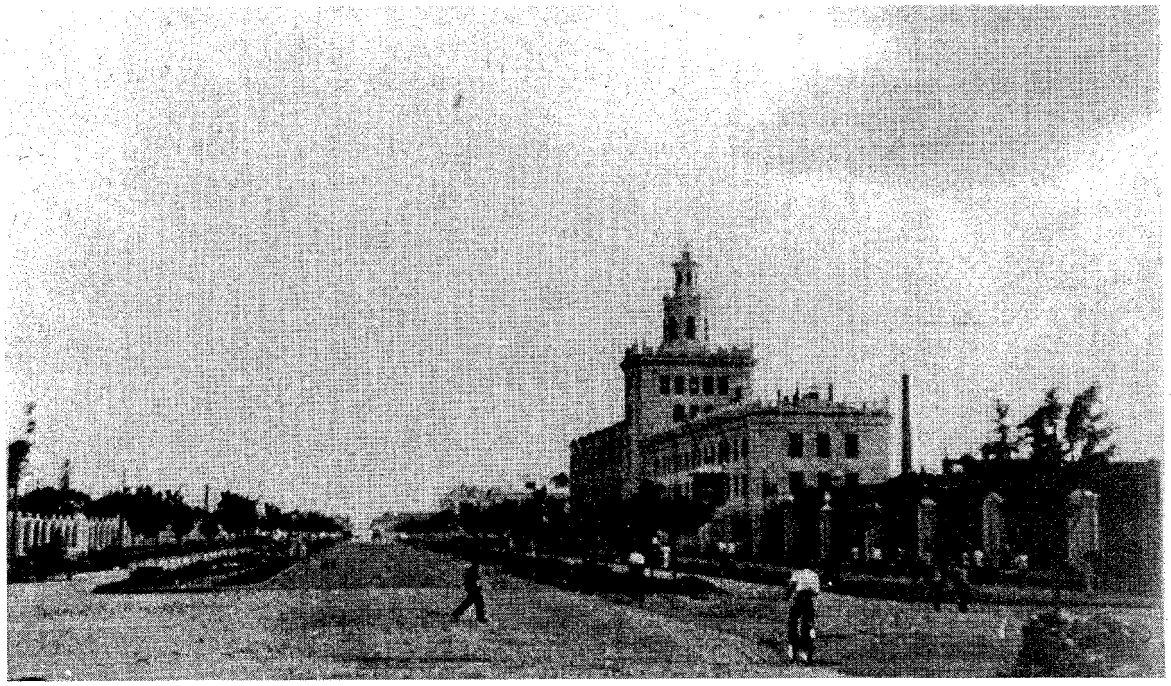


Figure 23. Buildings of the Harbin Precision Instrument Plant.

graduates with enough experience and background to render really effective service in either clinical medicine or research.

Physicians — The actual number of Western-style physicians with the MD degree or its equivalent is in doubt because official figures do not distinguish between fully trained MD's and those who practice medicine with considerably less training. The number of medical graduates trained in Communist China during the period 1927–58 is approximately as follows:

YEAR	NUMBER OF GRADUATES
1927–47	9,489
1948–49	3,000
1949–57	34,500
1958	3,000
Total	49,989

An attrition of 7,000 over the whole period 1927 to 1958 gives a 1958 total of 43,000 physicians with a physician to population ratio of about 1:15,000. This total also includes the physicians associated with the six Army Medical Schools under the Chinese People's Liberation Army. The figure of 70,000 Western-type physicians that is often encountered in reports on China probably combines either the 43,000 graduate physicians plus approximately 20,000 "doctor's assistants" and other subprofessional practitioners, or the 43,000 physicians plus some twenty-odd thousand traditional doctors practicing in Western-type medical institutes.

Professional Research Personnel — An assessment of present Chinese Communist medical research personnel is difficult due to the failure of the Communists to indicate any breakdown of the total number as to experience or degrees. Although no disciplinary breakdown can be made at this time, a published Chinese total figure of 3,000 workers in all categories of medical research has been given as of 1958 and can be considered reasonable in the light of all existing evidence. About one-twentieth or 150 of these 3,000 are estimated to be trained to the PhD level.

China is just beginning its postgraduate training in science and technology, and it is unlikely that any more than 5,000 additional workers will be trained to the PhD level in all scientific disciplines by 1967. Twenty-five percent or 2,000 of these scientists are expected to be in medical research, and this figure added to the present 150 PhD level investigators will come to approximately 2,200 by 1967.[9 16 23 25 29 30 35 36 42 43 45–50]

Possible additions to this total figure are the expected expansion and transfer of the clinical psychology group from the AS to the AMS; and the establishment of an "Organization for the Psychology of National Defense" in the Chinese People's Liberation Army by 1962. Because there is no indication of how many of the existing research personnel are qualified psychologists or psychophysiologists, no figure can be added to the expected 1967 total for medical research personnel. The following table summarizes and compares 1958 medical manpower figures with 1967 estimates.*

CATEGORIES	1958	1967
Western-style physicians	43,000	100,000
Medical research workers	3,000	5,000
Doctor's assistants	20,000	35,000
Western-style physician : population ratio	1:15,000	1:8,300

China does not have the medical manpower capability to cope with a national health emergency arising either from armed attack or from a large-scale natural catastrophy. Even with the increase in medical manpower expected by 1967, China will still not have adequate manpower to deal with national emergencies because of the expected population increase and the continuing unfavorable physician-to-population ratio. Research activity will increase sharply as well-trained investigators become available.

CHINESE COMMUNIST FACILITIES AND EQUIPMENT FOR MEDICAL RESEARCH

Facilities

Facilities for medical research presently include some ten departments, six institutes, (and three separate laboratories of the China Union Medical College) under the Academy of

* Ratios are based on estimates of a Chinese Communist population of 648,000,000 in 1958 and 830,000,000 by the end of 1967.

Medical Sciences; six institutes and one laboratory of the Academia Sinica; the research institutes of the Ministry of Health; the research departments of the 34 Western-style medical colleges and their associated hospitals; and the research laboratories of the 16 comprehensive universities. These facilities represent a considerable expansion over those of 1949 and before.

The Communists are exploiting these expanded facilities for their propaganda value and are fond of presenting them in terms of square meters of floor space. Such figures are, of course, not a measure of research accomplishment as implied by the regime but are imposing on paper and represent a positive advance which has a tendency to overshadow trained manpower deficiencies. For instance, the Serum and Vaccine Institute is declared to occupy an area of 190,000 square meters without comparing this to the available area in the several pre-Communist units of which it is composed. Similarly, a new building for the Hupeh Medical College is said to occupy 28,000 square meters, and the 50 new buildings of the Academy of Medical Sciences occupy some large and equally vague space, but all of this space contains only some 3,000 effective medical research personnel with any advanced training.

With sufficient money, China could build the necessary facilities to accommodate an ideal medical research and training program at least by 1967. She has the manpower to do the building and the intelligent young people to be taught but is limited by an insufficient number of trained teaching and research manpower in basic medical sciences adequately to staff such facilities. Until the medical educational system catches up with the needs of the economy, the full potential of new medical research facilities cannot be realized.

Equipment

The expansion of Chinese medical research facilities in anticipation of future manpower increases has necessitated the development of a Chinese clinical and research equipment industry. At the present time, China is producing increasing amounts of nonprecision equipment such as drying ovens and sterilizers and is trial producing some precision equipment. However, most of the precision equipment, such as centrifuges, electrophoresis apparatus, electron microscopes, and the like, are imported from both Bloc and Western countries and even the imports are not keeping up with the demands. The lack of this precision equipment is another one of the several reasons for the dearth of first-class medical research coming out of China.

China's medical equipment industry has recently been placed under the First Ministry of Machine Building in order to expand operations and to try to gain a measure of self-sufficiency by the end of the 12-year plan in 1967. The Peking Medical Instrument Factory trial manufactured over ten kinds of electronic medical research equipment in 1958 and has trial manufactured some 29 types of precision instruments. The factory is now producing portable X-ray units and low voltage X-ray units for research. The Tientsin Medical Equipment Factory claims to have produced the world's first electronic time setter for use in the protection of patients undergoing various types of "electronic therapy." This factory has also trial manufactured the first Chinese X-ray electronic regulator and the first Chinese precision electronic thermometer. The National Shanghai Precision Medical Machine and Instruments Factory and the Cheng-ta National Factory manufacture X-ray equipment which is said to be superior to the Japanese models from the point of view of installation and ease of repair. The Nanking Pharmaceutical Institute produced over 400 kinds of apparatus for their own needs during 1953–56 but is admitted to be presently self-sufficient only in glassware. The Chang Chun Optical and Precision Apparatus Research Institute presently is producing a limited number of glass electrodes, polarimeters, and microscope prisms. These industries are just getting started and very few precision instruments are beyond the trial production stage.

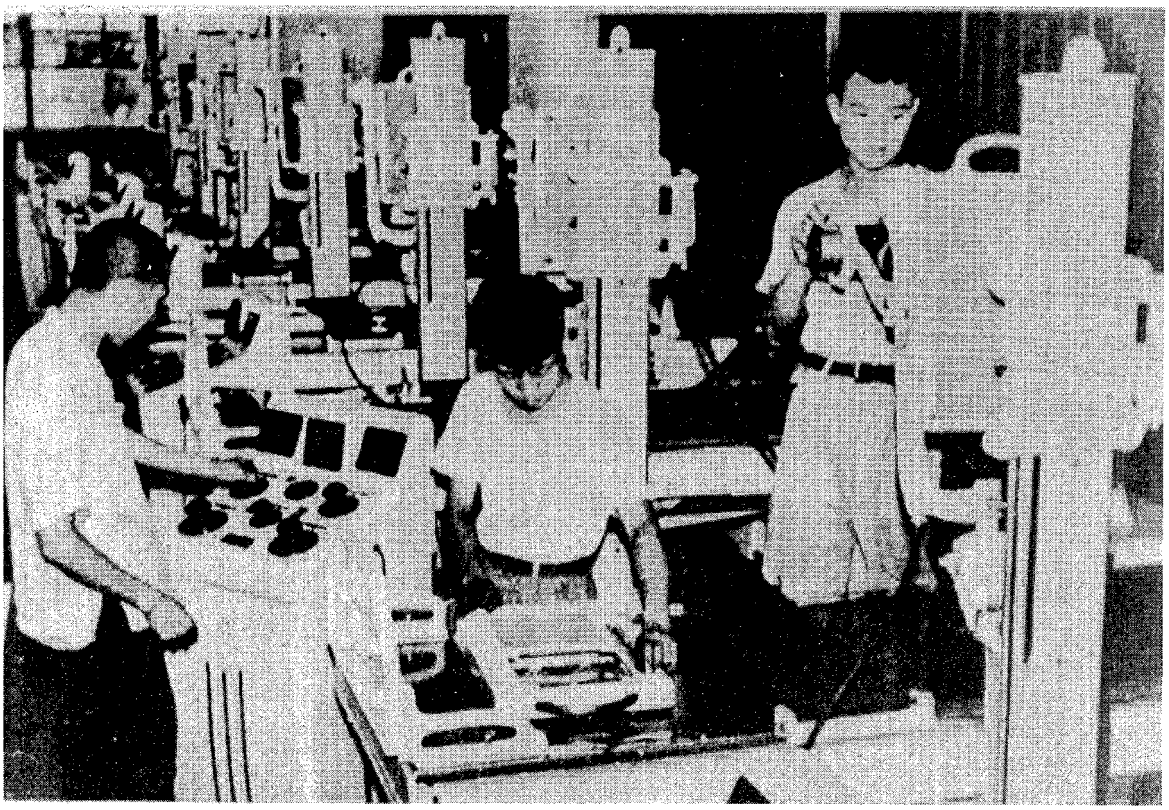


Figure 24. X-ray machines manufactured at the Shanghai Medical Precision Instruments Factory.

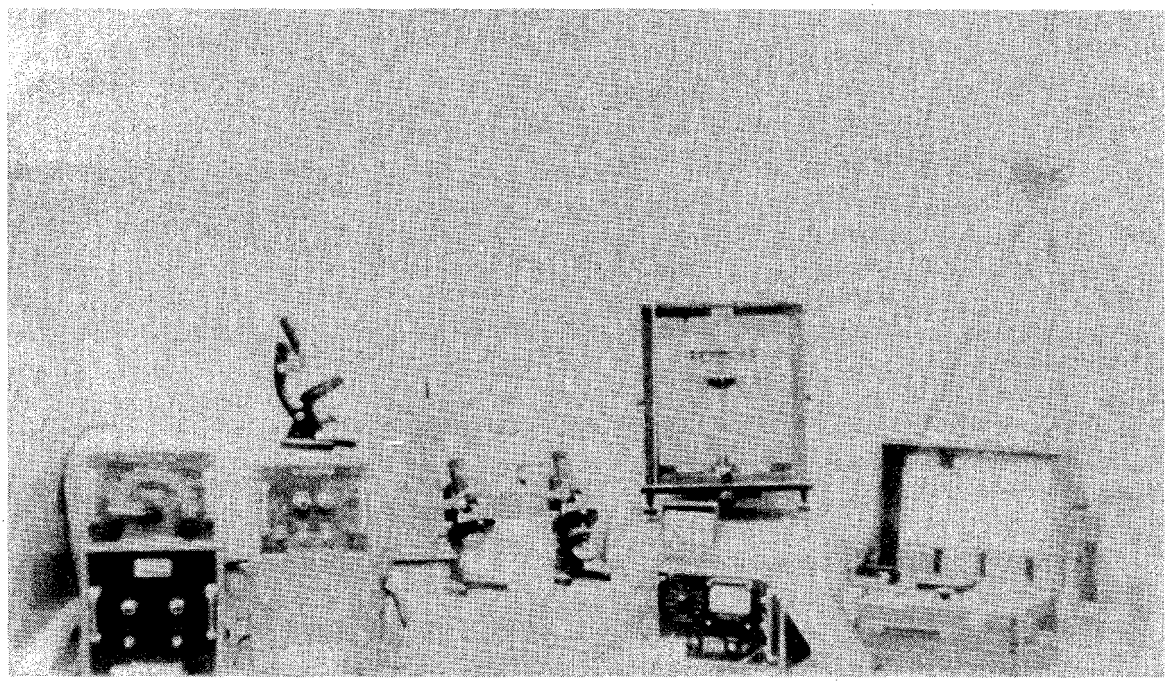


Figure 25. Exhibition of Chinese manufactured microscopes, balances, and transits at the 12th International Fair, Casablanca, May 1957.

Education is currently receiving very high priority; therefore, the manufactured and imported medical equipment is used first to equip the universities, medical colleges, and institutes engaged in teaching with instruments adequate for undergraduate student purposes; secondly, to equip graduate programs sufficiently to teach research methods; and finally to equip completely all research installations with adequate amounts of the latest research equipment. As is true in all countries, research institutes currently conducting high priority investigations get the most and best equipment. Since 1956, visiting scientists have reported that most of the leading medical schools appear to have sufficient equipment for teaching purposes but that research equipment is generally scarce. Only the China Union Medical College and a few other institutes under the Academy of Medical Sciences have sufficient equipment to conduct creditable research in the medical sciences.

As in the construction of facilities, the Chinese can, with sufficient effort, produce copies of the best research equipment and become self-sufficient by 1967. However, unless present equipment priorities shift from atomic energy and other industrial problems, it will be far more expedient for the Chinese to become self-sufficient in nonprecision equipment with the production of only that precision equipment which cannot be economically imported. The need for the most expensive and complicated equipment will become apparent only when enough experienced investigators are available to use it and this will not be before 1962–64.