A Case-Study Approach to US-China Scientific Research Exchanges

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Introduction

The purpose of this paper is to use the three scientific fields of acupuncture, earthquakes, and esophageal cancer to determine how, or if, Sino-American research exchanges influence the development of opinion leaders in the Chinese scientific community. Participants in the US-PRC scientific research exchanges were interviewed by the author in spring 1983. At the same time, two stages of scientific research exchanges had emerged: (1) the incentive stage, in which the US and China developed a rationale to move beyond "scientific tourism"; and(2) the interactive stage, when Chinese and American scientists began to build a bilateral community within which Chinese opinion leaders had a distinct role. These two stages are described for each of the research areas of acupuncture, earthquakes, and esophageal cancer in this paper.

The Political Context of US-China Scientific Exchanges

Between 1972 and 1979, trade, cultural, scientific, and technological exchanges between the United States (US) and the People's Republic of China (PRC) supported the development of a diplomatic relationship. These bilateral exchange relationships initially were established by Premier Zhou Enlai and President Richard Nixon to create a positive environment in 1972. Exchanges in science and technology (S & T) subsequently became a central focus in China's new modernization policy and complemented the US-PRC diplomatic relationship. Also, unofficial visits by American citizens (in particular, Chinese Americans) played a significant role. Many Chinese-American scientists became particularly involved in debating the future of Chinese modernization and were a vital force in early Sino-American scientific exchanges.(1) By 1978, Vice-Premier Deng Xiaoping and President Jimmy Carter used the S & T relationship as a rationale for normalizing diplomatic relations; while other political issues (i.e., Taiwan and Soviet relations) were de-emphasized.

After a decade of isolation from international scientific research, China was anxious to encourage a multitude of exchanges. It focussed primarly on becoming an international actor. The US was hoping to develop contacts with the Chinese scientists, believing that these scientists would be politically influential in China in the near future. An American organization, the "Committee for Scholarly Communication with the PRC" (CSCPRC) encouraged the Chinese interest in international S & T and the American scientific and scholarly interests in China. The CSCPRC delegation visits that occurred between 1972 and 1979 explored the potential for long-term cooperative research relations which were than developed in governmental bilateral agreements after normalization.

Sino-American bilateral agreements which were concluded after diplomatic relations were established in 1979 broadened the scope of the scientific exchanges originally set forth by the CSCPRC. Whereas the CSCPRC sought to maintain a student and scholarly exchange programme of 25 Americans and 25 Chinese per year after normalization, the S & T bilateral agreements exchanged over 260 Americans and 370 Chinese in one and one-half years. The CSCPRC's earlier contacts with Chinese scientists and administrators contributed to the success of the bilateral S & T agreements.(2) Unlike the CSCPRC exchange program, the US and PRC governments were responsible for the conduct of S & T exchanges under the bilateral agreements. A "Joint Commission of US-PRC Science and Technology" had been established to direct S & T activities under the bilateral agreements in 1978. The agreements were topic specific, and the related projects were administered by participating American and Chinese scientific research institutes.(3)

A major point of conflict between the US and PRC in these bilateral exchanges was funding. The US advocated a strategy whereby the country who benefits from a particular research project pays the bills. The PRC challenged the US to define the benefits of the bilaterals. For example, the Chinese wondered who benefited when scientific data was collected in China but analysed with American technology in the US.(4) Since the bilateral agreements have been linked to the rationale for establishing US-PRC diplomatic relations, conflicts such as the one just described introduce the potential for straining the overall Sino-American relations.

In 1984, the "US National Science Foundation" (NSF) began to evaluate its Sino-American S & T exchange programme and found that, despite the bureaucratic delays, the exchanges were "successful".(5) However, President Carter's relationships with China's future generation of leaders - was not evaluated by NSF. PRC and US exchange administrators and participants assumed that Chinese scientists first needed training in Western research methods before a cadre of opinion leaders would emerge.

Incentives for Acupuncture Research Exchanges (Stage I)

In the early 1970s, acupuncture was perceived as symbolizing change in the US-PRC political relationship. The American public became interested in China and Chinese culture after President Nixon's return from China in 1972. NEW YORK TIMES journalist James Reston reported his observations of what the Chinese had called a "new" kind of Chinese acupuncture that integrated Chinese and Western medicine. According to Reston and others who visited China in the early 1970s, the PRC had begun to use acupuncture as an anesthetic in surgical operations as part of a national health programme to upgrade the Chinese people's standard of living.(6) As a result of these reports, Chinese acupuncture became an extremely popular subject in the US. It was around this time that John Bonica, a leading anesthesiologist from the University of Washington, observed: "During the past six months, more articles have appeared in the news media on acupuncture than on all other medical topics combined."(7)

Acupuncture appealed to the American interest in Chinese exotica, an interest whetted too by political developments in the ongoing dialogue concerning normalization. In the inaugural issue of the American Journal of Chinese Medicine, E. Grey Dimond summarized the growing positive sentiment regarding US-PRC relations as it related to Chinese medical Science:

> "All of us in the West remember a China in which missionary physicians and organizations presented their version of medicine to China; all of us knew a China that was invaded, a China that was occupied, a China in civil war. Our dilemma is that when we speak of "normalization", we think back to the days of our going there to teach and their young coming here to learn. That form of normalization is not going to occur."(8)

It is ironic that this is just what has occurred again. While Chinese pre-1949 medical practices as part of Mao's nationalistic assertion, the effort was overcome by the dominant Western mode of medical practice which surfaced when American medical delegations went to China to investigate Chinese medical practices in the 1970s.

Members of the American medical community were expecting a closer look at Chinese medical practices in the 1970s. They participated in a high-level delegation visit in 1974 in order to determine if acupuncture was a likely topic for cooperative research between the US and China. The US National Institute of Health (NIH) already had begun its own investigation of Chinese medicine and had sponsored a number of well-attended conferences. Two books had been published as a result of these conferences in 1973. The NIH, the American Heart Association, and the Veteran's Administration awarded 36 project grants for case, controlled studies on acupuncture and

the mechanism of pain. When the high-level delegation visited China in 1974, its major objectives were to determine the effectiveness of acupuncture of surgical operations, examine possible mechanisms for pain, and observe the Chinese organization of medical care.(9)

But the American delegation participants did not reach a consensus on whether Chinese acupuncture really worked, let alone consider the scientific question of the possible mechanisms for pain. In some cases, American scientists were biased against acupuncture before they had an opportunity to observe it first hand, in other cases, the American scientists who did not have a negative bias were unable to determine if the Chinese had ever conducted case-controlled experiments on the effectiveness of acupuncture in blocking pain. The American delegation had attempted to evaluate acupuncture anesthesiology systematically by using a grading system to measure the patients' psychological and physiological conditions during surgery. But their attempt did not provide conlusive evidence on the effectiveness of acupuncture, or determine whether it was analgesic or an anesthetic. The American scientists generally agreed, however, that American patients would never accept acupuncture in surgery.

After the delegation visit, many American medical scientists published separate reports indicating in more detail their opinions about Chinese acupuncture. It was clear from these reports that acupuncture would not become a topic for Sino-American S & T bilateral relations. Leading American medical authorities in the first official delegation were convinced that the effectiveness of acupuncture in blocking pain was psychological and that national pride and peer pressure was a factor which prevented Chinese patients from reporting pain.(10)

Whether acupuncture anesthesiology should be used in the US is however, different from the question of whether it is a viable technique for basic research on the origin of pain. Western-trained Chinese physiologists in Shanghai had conducted several useful studies using acupuncture to explore the physiological origin of pain. Their research stimulated basic research in the scientific disciplines of neurophysiology, neurochemistry, and neuropharmacology around the world. But the research did not spark a great deal of interest among the American medical community.

One reason acupuncture was not considered a serious topic for Sino-American cooperative research was because of its political implications in China. Chairman Mao had promoted acupuncture as "the integration of Chinese and Western medicine".(11) He started a national acupuncture programme in 1958 and established traditional Chinese medicine departments in every municipal-level and district-level hospital. The new Chinese leadership under Deng Xiaoping (who was purged in january 1976 and was back in power in 1977) was seeking to de-emphasize Mao's mass campaign approach. Acupuncture did not fit into the Western-oriented Chinese scientists' framework for advancing the state of research in China. Even those who conducted acupuncture-related research were anxious to go to the US to acquire skills in advanced scientific research methods in the field of physiology.

Another indicator of America's disinterest in acupuncture was the US lack of financial support for basic research. Western-oriented Chinese scientists received financial support through international organizations instead of American research foundations. While the Chinese scientists were initially interested in furthering their research on the origin of pain, they were unable to do so in the US. American laws prohibit a practice that is a basic part of the Chinese research the inducement of pain on higher-order animals.

By 1979, acupuncture had become a minor part of Chinese health care. Even though it is now used in the poorer, rural areas in place of an anesthetic for surgical operations, the Chinese have perceived somewhat self-consciously that acupuncture represents a step backward instead a step forward.

Nethertheless, the World Health Organization (WHO) maintains an acupuncture training course for foreigners in China, in which the Western-oriented Chinese researchers do not participate.

Acupuncture research exchanges did not have an institutional context within the US-PRC scientific research exchange environment. Any cooperative research that was done after the first high-level delegation was negotiated between individual Chinese and American scientists, the emphasis changed from acupuncture research to the more general topic of pain mechanism research, which interested a small number of Chinese and American basic researchers. The official Sino-American acupuncture research exchange was not successful; but we cannot end our analysis here. It is important to look at the possibility that acupuncture research contributed to the development of an autonomous Chinese scientific community and to the development of key "modernizers" (i.e., opinion leaders).

American Interactions with China's Acupuncture Research Community (Stage II)

US-PRC acupuncture research exchanges failed because of the unwillingness of the American medical community to accept the merits of acupuncture. Chinese scientists, even opinion leaders within the Chinese acupuncture community, were unable to penetrate the US defensive barriers. It was due to efforts of individual American medical scientists (mostly of Chinese extraction) that these barriers were relaxed at all. The few Americans who encouraged Sino-American acupuncture research exchanges focussed primarily on providing a context in the US for acupuncture research.

According to one American scientist who participated in the 1974 CSCPRC delegation to China, acupunture research is a fairly limited topic for scientists who are interested in studying the nature of pain. He said that American scientists generally agreed not to pursue acupuncture in China for two reasons: (1) Americans did not know enough about acupuncture to be able to determine its physiological effects and (2) other types of experiments yielded more useful results by isolating certain types of pain.(12)

This American scientist, who had studied with internationally recognized pain research theorists (i.e., Wall and Melzack), and is an accomplished researcher himself, estimated that only about 10% of the 1,800 pain researchers in the US had even investigated Chinese acupuncture. Pain research has a specific function in American medical science, where "research" primarily involves testing the effectiveness of particular drugs. It is for this reason that acupuncture research is scrutinized by the American pain research community. And in the vast majority of cases, acupuncture research is ignored.

The same American scientist also discussed the way the CSCPRC delegation avoided the issue of developing US-PRC acupuncture research exchanges. The American scientists basically decided to wait until the US and China had established diplomatic relations before deciding on a bilateral research programme. But once diplomatic relations were normalized five years later, acupuncture research had disappeared from the national agenda. Within this five-year period, American medical scientists primarily had satisfied their curiosity about acupuncture in countries other than China (including England, Japan, and Canada).(13)

One Chinese-American anesthesiologist had a different perspective than the US basic researchers on the failure of US-PRC acupuncture research. Having travelled to China one year earlier than the CSCPRC delegation, on a delegation especially organized for Chinese-American scientists, he immediately recognized that the Chinese approach to medical practices in general contrasted with the American approach. He believed that the two approaches had different (and conflicting) premises:

> "In the US, anyone can be a doctor. You don't have to care about people or even have talent. But in China, people notice if you are good. In fact, the PRC has a preliminary screening process, so that once a Chinese enters medical school there is no question that he will be a successful doctor."(14)

Another Chinese-American scientist, who conducts basic research on the origin of pain, came to a similar conclusion. This scientist felt that the American medical community was unwilling to recognize the benefits of Chinese medicine:

> "In 1971, James Reston (a New York Times journalist) politically discovered acupuncture. But traditionally there has been a feeling, especially among the early American missionaries to China, that Chinese are third-class citizens. Now that Beijing has integrated acupuncture and Chinese medicine into China's medical schools, Americans have redefined acupuncture in their own society as a form of wholistic medicine."(15)

But wholistic medicine does not extend very far into the American medical community, either in research or in practice. Furthermore because of its exotic appeal, acupuncture is not considered within the realm of science. The notion that Chinese are "third-class citizens" has made Chinese scientists particularly self-conscious, to the point where they abandon acupuncture and favour Western scientific research and medical practices. To assert its position in the international scientific community, China downplays the role of acupuncture in Chinese society.

It seems that Chinese-American scientists may be the primary proponents of Chinese medicine in the US. Their support raises a new set of issues on the validity of acupuncture research:

> "In 1972, the underworld of acupuncture practioners surfaced. I had trained about 1,000 of them. My objective at the time was to convince Americans of the validity of acupuncture. Without the help of acupuncture practioners, the US does not have a medium with which to accept Chinese culture. Acupuncture researchers also serve this vital function."(16)

But this Chinese-American scientist failed to recognize that political objectives of the PRC in first promoting and then de-emphasizing acupuncture research. Chairman Mao wanted to establish a unique role for China in the international community and used acupuncture as a medium to achieve this objective; while Vice Premier Deng subsequently wanted to improve the quality of S & T in China in order to achieve modernization and de-emphasized acupuncture because it set China outside of the international community.

But the Chinese-American scientist's objectives in the US was to set standards which would legitimate acupuncture and, as a result, would attract Americans to Chinese culture:

> "In 1973 and 1974, an exchange programme through NIH helped to elevate the status of acupuncture research. There was also a legal front which was a world movement (through WHO) to set standards and maintain credibility."(17)

He failed to address the issue that the American scientific community would not become involved in legitimatizing the status of acupuncture.

The "Bulletin of Concerned Asian Scholars" (Volume 1, 1978) maintains that acupuncture is a controversial subject in the American medical community:

> "If the AMA recognizes the medical effectiveness of acupuncture, it will legitimize the practice. If the AMA scorns it as folk medicine, than the AMA will have no jurisdiction to regulate it."

But this controversiality is neutralized because the organizations which are established to promote acupuncture have not maintained their own credibility. For example, in its offices in New York and Illinois, the Pan-American Health Organization (PAHO) which has supported traditional Chinese medicine also engaged in illegal activities and has been unable to maintain its own credibility:

> "Acupuncture centers that are established are often not legitimate and are a front for covert political activities. They are not organized for the purpose of providing a medical education."(18)

These acupuncture research centers have effectively taken acupuncture off the American public agenda. Ironically, the PRC acupuncture research programme suffers even though it does not deal with the American-based acupunture research centers.

In order to discuss the way the Chinese acupuncture community has had a positive affect on modernization, it is necessary to discuss its major opinion leader, Bang. (19) His (self-imposed) function in the Chinese scientific community was to introduce the scientific method to Chinese scientists. He has been very successful in this capacity, having trained a number of Chinese scientists in the field of physiology. Bang is in a field of study which is flexible enough to allow for an integration of the Western and Chinese context of science. The fact that American science does not use acupuncture to conduct scientific research on the origin of pain has provided Bang with the opportunity to develop the uniquely Chinese research.

Research on the origin of pain focusses on the development of scientific theories, and the Chinese physiological community readily accepted the fact that the Chinese research was not going to occupy a central position in the international community. With these assumptions clearly delineated Bang has been able to develop research in China. The pressure to "perform" in the international scientific community is not as intense as in other fields.

Bang was stimulated to use acupuncture in physiological research in the 1960s, when acupuncture was introduced as an anesthetic in surgical operations in China. Having studied in the US (at Yale Medical School in the 1940s), he had learned how the West conducts scientific research. He did not return to China until 1956, at a time when many Chinese felt that Chairman Mao was having a positive influence on modernizing China.

Even though Bang did not return to the US (as an exchange scholar) until 1980, he travelled extensively between 1956 and 1982 to other countries. Among the places he had travelled to conduct scientific research are Moscow (1956), Romania (1958), Cuba (1964), Western Europe (1974-75) Sweden (1977-78), Budapest, Pisa, Panama, Edinborough, and Kyota (1980-82).

The fact that Bang was allowed to travel to these various places indicates that he occupies a central position in the Chinese scientific community: the political leadership in the Chinese Communist Party allowed him to pursue research abroad and he used these opportunities to develop Chinese research. His attitude about the research in China reveals most clearly his tendency toward fulfilling the position of modernizer/opinion leader:

> "It is difficult to single out one scientist (either Chinese or American) who is the most sophisticated in conducting scientific research. Science is a collective achievement. One has to have new techniques and new ideas. One person cannot create something from nothing."

Bang came to the US NIH in 1981 as a Fogarty scholar to do "independent" work on pain physiology. He was not involved in a US-PRC exchange programme, though he had previously received an international award in Boston in 1980 for his work on acupuncture. He received a scholarly appointment for one year at NIH, and cleverly arranged this appointment so that he could come to the US for four months for three years.

Bang has a very broad view of American education. Unlike many Chinese who come to the US to study science (and only science), Bang insists that Chinese must first learn the cultural and historical aspects of American science before they progress to the second step of focussing on a particular area of scientific research. For example, he encourages his niece, who is studying in the US, to major in history and litera-

ture - even though she wants to study computer technology.

Bang is not the only scientist in the field of pain research who is influential in China. One of his former students "left the nest" of Bang's research institute because he disagreed with Bang's orientation to acupuncture and pain research. This scientist, Gai, developed his own power base in China and has more influence in the traditional Chinese medical community. But Gai has limited overseas experiences. For this reason, this conflict between Bang and Gai is at a fairly low level: Bang is willing to accept criticism of his own research orientation.

Incentives for Earthquake Research Exchanges (Stage I)

In the 1970s, American scientists lauded Chinese earthquake research as a "showpiece of high science". President Jimmy Carter's science advisor, Frank Press, believed that the Chinese earthquake research programme was so well directed that the PRC would be the first in the world to discover successful techniques for predicting earthquakes.(20) This presented an incentive for the American scientific community to establish contacts with the Chinese.

American scientists were particularly interested in the Chinese earthquake research because of developments which occurred in their own communities in the 1960s. American geologists and geophysicists had developed laboratory techniques for measuring physical changes prior to an earthquake based on a well-articulated plate tectonics theory. Also, American seismologists and earthquake engineers had provided a national research focus by conducting joint research projects on a related area called strong ground motion. After the San Fernando earthquake in 1971, American scientists who studied various aspects of earthquakes coordinated their interests in earthquake research and received a significant amount of funding from the US government under the "Earthquake Hazards and Reduction Program" by 1977.

The American scientists became interested in Chinese earthquake research after hearing favourable reports by seismological delegations from New Zealand, Canada, and Japan. American seismologists, geologists, and earthquake engineers focussed their initial interest on the well-publicized prediction of the Haicheng earthquake which occured in China in 1975. In 1976, the CSCPRC sent a seismological delegation to China with the particular purpose of observing the Chinese system for collecting earthquake data. American scientists were impressed with the Chinese earthquake catalogue that had been compiled from 3,000 years of historical records. The catalogue essentially doubled the world's data base on earthquake characteristics. Also, American scientists were impressed that the Chinese had been using several other unique techniques to predict earthquakes, including geomagnetic fields, ground temperatures, and animal behaviour.(21)

In the first delegation visits to China, American scientists were interested in learning how the Chinese earthquake programme had developed. The central research discipline from which the Chinese earthquake research evolved was geology. Traditionally, geology was the most popular scientific discipline in China and had an extensive manpower base which included professionally-trained geologists and untrained scientific workers. When scientific research was organized nationally after 1949, the Institute of Geology was the only scientific research institute which remained intact. Many of the Chinese geologists who interacted with American earthquake delegation participants had been involved in the reorganization of the "Chinese Academy of Sciences" (CAS) and subsequently influenced China's S & T modernization policies.(22)

The Chinese earthquake programme also had a research base in geophysics. In the 1960s, American scientists had determined that Chinese geophysical research was "highly theoretical", which was a diplomatic way of saying that it often did not adhere to basic principles of scientific methodology. In China, geophysical research was published by scientists who did not collect data out in the seismically-active regions, and who instead developed a number of undocumented theories.(23)

But in the course of the delegation visits, American scientists discovered that Chinese geophysical research had made significant strides that had not been reported in the international scientific literature. And in fact, Chinese geophysicists had received support from the PRC government and direction from the USSR in 1950s, and had build severals seismological stations throughout China.

The Chinese earthquake research programme flourished under the encouragement of Zhou Enlai in the 1960s. The programmes were started in reaction to the damage which resulted from the earthquake of 1966 in Heibei Province in which 20,000 people were killed. Because of this tragedy, earthquake prediction became the national focus. Under the national programme, geologists, geophysicists, and "barefoot scientists" were involved in compiling data on the various characteristics of earthquakes, refining 3,000 years of records about earthquakes from history books and other literary works, and collecting information from previously-established seismological observatories. These activities were coordinated under the "State Seismology Bureau" (SSB) in 1971. (24)

The CSCPRC-sponsored delegation visits allowed American and Chinese scientists to identify particular topics of mutual interest for bilateral governmental exchanges. The scientists agreed that the Chinese earthquake research needed to be improved with modern technology and standardized research methods. Also, scientists wanted to establish clusters of seismological stations throughout China (called seismological networks) as soon as possible in order to increase the world's data base. Because of the nature of field research, American scientists maintained that five years of data would have to be gathered (using standardized techniques) before it would reveal trends about the earth's seismic activity. Data that was collected in 1979 would not yield scientific results at least until 1984. A Sino-American "trade off" was conceptualized in such a way so that Chinese scientists would be given an opportunity to become familiar with Western scientific methods and technology, and American scientists would be able to begin several of their own research projects in China.

The research area that originally attracted US scientists to China, earthquake prediciton, became less important by 1979 because the Americans felt that the data that the Chinese had collected previously was not sufficiently standardized. Bilateral activities began to focus on collecting data that would be analysed in the West and on earthquake engineering (i.e., developing methods for protecting people and buildings during earthquakes) because the US already had developed measurement techniques for these kinds of projects. The result of this research shift was that the extensive employment of Chinese "earthquake workers" (i.e., data collectors who had no formal scientific training) on a massive scale that had been created twenty years ago was virtually ignored.

Sino-American cooperative research tended to be limited in the context of governmental bilateral agreements. The agreements did not encourage the development of Western scientific research methods in the Chinese scientific establishment. While American scientists in the CSCPRC delegation visits had perceived that the Chinese earthquake research programme was well established, they later discovered that it was also intensely bureaucratic. Transferring technology from one research institute to another, establishing a communication system among various field research centers, and ensuring access to data as well as reliability in the data collection process proved to be formidable, if not impossible, tasks.

Sino-American earthquake research interests were articulated in the CSCPRC delegations and specific projects were established within the bilateral framework. The "US National Science Foundation" (with the United States Geological Survey) and the "Chinese State Seismology Bureau" coordinated research projects. These agencies negotiated ongoing data collection projects which are subject to renewal within a specified time period. The earthquake projects, though limited in scope, were sucessful.

American Interactions with China's Earthquake Research Community (Stage II)

American scientists observed different roles played by the PRC exchange coordinators and exchange scholars. American scientists believed that exchange coordinators were easier to talk with than the exchange scholars, because the exchange scholars tended to isolate themselves in the US and did not participate in scientific discussions with the American scientists.(25) However, American scientists defined their interactions with the PRC exchange coordinators in a rather narrow fashion. They used the PRC exchange coordinators to organize joint research projects and did not place the PRC exchange coordinators in the context of the Chinese scientific community. As a result, American scientists were unable to identify Chinese scientists who were "effective" scientific administrators or research supervisors and experienced difficulties in acquiring Chinese earthquake data for the bilateral projects.

One American scientist recognized this problem and pointed out that it was necessary to develop relationships with Chinese scientists who had different kinds of authority in the PRC scientific establishment. (26) While American scientists were relatively successful in reviewing earthquake data collected by PRC research institutes, they were unable to obtain other vital information, including aerial photographs and topographical maps. The Chinese explained that, for security reasons, the general population of Chinese did not have access to this information. Apparently, the Chinese distinguish between data that belongs to the "state" and data that belongs to the research institutes.

American seismologists agreed that Chinese scientists were motivated to develop cooperative research projects, and it was for this reason that interactions between US and Chinese scientists were relatively successful as a bilateral protocol. One American seismologist notes:

> "For the Chinese, earthquakes are the last remaining natural disaster in China. They are really serious in their research efforts, so when dealing with foreigners on this issue, they set aside the political tripe and are very open. But it is also clear that the PRC government is waiting for the opportunity to take credit for the Chinese earthquake research."(27)

This comment suggests that, while the Chinese scientists are interested in developing earthquake research, they do not act independently.

Other American scientists have noticed that the PRC government is not the only "interest group" that scrutinizes the Chinese earthquake research:

> "Part of the reason our work was limited in the PRC had to do with national, provincial, and county level research institutes. There seemed to be a contest between the SSB and the provinces (escpecially in Lin County an Sichuan Province). The competition for recognition is fierce between the county and the province and between the province and the national institute."(28)

American scientists discovered that even knowing how to avoid governmental regulations would not alleviate problems in conducting research in China. After spending several months in China researching earthquake prediction, one American scientists discovered that the Chinese earthquake researchers and their supervisors had edited the earthquake prediction data, deleting information that they believed to be irrelevant.

These kinds of problems compelled American scientists to devise strategies for separating their research activities in China from those of the Chinese earthquake research institutes. They installed their own instruments in China and employed American technicians to monitor the data. One wonders if this strategy will eventually perpetuate differences between American and Chinese scientists and limit the

scope of Sino-American earthquake studies projects. Conflicts will occur if Chinese scientists resent the American scientists' presence in China, especially if the Chinese cannot derive personal benefits from the "joint" projects in China.

But one Chinese-American scientist pointed out that certain Chinese scientists were better at communicating with American scientists and with their Chinese colleagues. He noted that there were differences between PRC scientific administrators:

> "Both Drs. Mu and Ao were educated in the West in the 1940s and 1950s, but Mu is a much better administrator than Ao. As a result, Mu's research institute runs very smoothly. Mu has a high standing in the Chinese Communist Party and is able to decide on the future of his research institute. On the other hand, Ao doesn't have a very assertive personality. His institute is controlled by the dangweishuji. It's a shame that Ao isn't more assertive because his research institute has a lot of internal money that could be used to develop China's own labor-intensive research techniques."(29)

This comment implies that Chinese scientists who are assertive have a high standing in the Chinese Communist Party and, as a result, are not accountable to the research institute's dangweishuji (i.e., political department). In this context, it would seem that Chinese scientists who are party members are in a better position to be opinion leaders. They have a political tool for compelling Chinese scientists in the research institute to listen to and act on their recommendations. They define Chinese "modernization" of S & T on a policy level.

The Chinese-American geophysicist's comment about Mu and Ao is also important because it illustrates the notion that personal disposition (i.e., assertiveness) affects the way exchanges develop both within the Sino-American exchange context and within the Chinese earthquake community. It seems appropriate to assume that Mu is consistently more influential than Ao; just as one expects certain Chinese scientists will always be more interested in developing relationships with American scientists than other Chinese scientists.

While professional communication skills such as reading the scientific literature, publishing scientific research, and analysing the work of others enables Chinese scientists to interact with Amnerican scientists, these skills have limited value with respect to administering US-PRC joint research projects. Chinese scientific administrators have to explain the Western context of science to the Chinese scientific workers if they are to be incorporated into the joint research projects. The possibility exists that Chinese scientists like Mu and Ao have a degree of administrative and political expertise that they use to distribute responsibilities in the research institute. The fact that they have Western educations is more of a liability when they interact with the non-Western trained scientific workers.

A research problem discussed by an American geophysicist (who is fluent in Chinese) illustrates this point. In the course of her research project in the PRC, she discovered that the Chinese data on ground-water levels and animal behaviour (i.e., measures for earthquake prediction) were incorrectly recorded by the scientific workers in a provincical seismology bureau brigade. When this "error" was discovered, the Chinese research supervisor was obviously embarrassed, but at the same time did not seem to know how to direct the field workers not to make the same mistake. Scientific workers did not unterstand the importance of replication in scientific research.(30)

Furthermore, their attitude was "I collected the data, and that should be enough proof that it is correct". When confronted with mistakes, the scientific workers acted as if they had been personally attacked. Their response was "Ni weishemne bu xiangxin wo?" (Why don't you believe me?) One important question in this regard is whether Chinese research supervisors or scientific administrators have any incentive to place themselves in the unpopular position of trying to change the Chinese data collection process, and whether this incentive comes from within themselves or from their immediate supervisors.

Formal channels for scientific communication in the West are scientific journal publications. While China also has its own scientific journals for earthquake research, they are not used as a medium for debating and developing research:

> "Individual scientific researchers do not take credit for their own work. In fact, there seems to be an absence of criteria. Good papers (i.e., those that adhere to the scientific method) stand beside bad ones."(31)

While American geophysicists view their role in Sino-American exchanges as socializing Chinese scientists to critically evaluate research, the Chinese peer review system does not support this socialization process:

> "Chinese publish journals in their individual work units (danwei) and are unwilling to criticize each other's work. They don't know the scientific method and don't unterstand why they have to justify their research. As a result, two of the same studies are conducted by different scientists yield different results - with no apparent explanation."(32)

What appears to occur is that a Chinese scientist submits an article for publication; the article is reviewed by scientists and lay persons in the research institute, and if it passes the review process, then it is published. However, the Chinese scientists do not expect that their articles will be critically evaluated once they are published.

Another component of scientific communication is the usage of informal channels such as conversation between Chinese scientists. Since the formal channnels of scientific journals appear to be inoperative, perhaps Chinese evaluate research in small groups. But Chinese scientists only develop professional relationships with those in their immediate environment in the research institute. Furthermore, professional relationships in earthquake research occur primarily between students and their teachers and not in peer groups. For example, one Chinese-American geophysicist stated that PRC scientists cannot study abroad without recommendations from their mentors.

However vast inequalities do exist. The Chinese government has instituted a series of national examinations for those who wish to study abroad. As one Chinese earthquake exchange scholar from Tianjin describes, the exams are a cosmetic component of the selection process:

> "I was tested in a national exam organized by the SSB in 1980 in English, math, physics, and geodicity (my research speciality). But my research institute wouldn't let me go abroad. I couldn't get recommendations from my professors. So, I asked two other Chinese scientists who had been exchange scholars to the US to recommend me. (One of them was particularly influential. He had also studied in the Soviet Union). While I was still in China, a Chinese-American scientist's wife tutored me in English. (I've also studied German and Japanese). Finally in 1982, at an international symposium in Beijing, I met three USGS scientists. They were instrumental in arranging for me to come to the US. But this occurred three years after I passed the national exams."(33)

It seems that this Chinese scientist extended the "Chinese" skill of developing relationships (fazhan guanxi) in his interactios with American scientists. However, the relationships that he developed with American scientists were used primarily to circumvent the Chinese bureaucratic obstacles so that he could study in the US. He had been unfortunate within the context of his research institute.

Other Chinese scientists had the good fortune of having mentors who encouraged them to study abroad. In particular, one famous plate tectonics scientist sent several of his students (including his daughter) to the US.(34) The Chinese system of informal communication is based on connections within the research institute. The enterprising Chinese scientist is the exception. Very few Chinese scientists go out-

side of the research institute to develop contacts. Several American earthquake scientists stressed that Chinese exchange scholars do not communicate with Americans concerning their research projects, or even their objectives, in the US.

One question that is not answered is the extent to which Chinese scientists develop professional relationships with each other. One American scientist noted, from his discussions with the Chinese, that Western-trained Chinese scientists "do not associate with" non-Western trained scientists. If this is the case for the majority of Chinese scientists in earthquake studies, then it would seem that interactions between Chinese in one research institute would be extremely disjointed.

Even though communication in research institutes is disjointed because of two different types of conflicts - conflicts between scientists and scientific workers and conflicts between Western-trained and non Western-trained Chinese scientists - some Chinese scientists manage to play "key" roles in Sino-American research exchanges. But American scientists only identify "key" PRC scientists in terms of those who have Western scientific training, because they do not interact with any other kinds of Chinese scientists. As one Chinese-American geophysicist pointed out, having a Western education does not ensure that Chinese scientists know how to make themselves understood to the scientific workers. In earhtquake studies, in which there are thousands of scientific workers available to either collect data or cause trouble, a hierarchically-organized scientific community is needed. In theory, non Western-trained Chinese scientists could function as "para scientists." It is on this grassroots level that Chinese earthquake research could develop in significant ways.

Incentives for Esophageal Cancer Research Exchanges (Stage I)

The US and China began discussing cancer research in CSCPRC delegation visits as early as 1972. The visits focussed primarily on comparing and contrasting American and Chinese medical practices. However, little attention was given to developing cooperative research projects until 1974. At this time, at the 11th International Cancer Conference in Italy, the Chinese announced their finding that gullet cancer in chickens was related to esophageal cancer (EC) in humans.(35)

Several nationally-organized activities had encouraged the development of EC research in China, including mass mobilization campaigns, health conferences, and studies that used communes as units for research projects. In the course of these activities, Chinese scientists focussed on the correlation of dietary habits and the incidence of EC. Gullet cancer was discovered in chickens of Lin County (Henan Province) residents who had subsequently moved to other geographical regions, taking their chickens with them. While their chickens died of gullet cancer, chickens belonging to other area residents remained healthy.

The CSCPRC did not send an American delegation to investigate the Chinese research until 1977, at which time the Chinese were able to provide further information on EC. The American delegation also discovered that the Chinese were conducting extensive research on EC as well as on other types or regional cancers (including nasopharyngeal, liver and lung cancers).(36) The most important findings came out of studies that began in Lin County in 1959, in which European research techniques were used to detect EC in Lin County residents.(37) Historical records dating back 2,000 years noted dysphagia syndromes among the inhabitants of Henan Province. What was called the "hard of swallowing disease" had been endemic in Lin County for generations. Because scientific research had discontinued during the Cultural Revolution, information about EC was not collected and analysed until the 1970s.

The American CSCPRC delegation discovered that EC research had been institutionalized under the "Chinese Academy of Medical Sciences" (CAMS) in Beijing, and that CAMS scientists had begun to systematically collect cancer mortality rates in various localities throughout China. CAMS had sponsored a national health conference in which medical scientists discussed the possibility of a national cancer research

programme.And by 1958, cancer research institutes had been established in major cities including Shanghai, Beijing, Guangzhou, Hangzhou, and Taiyuan. A 181-county survey of 50 million Chinese initiated the national research effort. A survey in 1965 found that Lin County residents ate food at higher temperatures that people in other geographical regions, which indicated to Chinese scientists that the occurance of EC might be directly related to dietary habits. This was the first substantive clue.

American medical scientists on the CSCPRC delegation had never pursued the large-scale epidemiological research that was being conducted in China. From their own experiences they had concluded that field work (including epidemiological research) did not yield accurate results.(38) However, the results of Chinese research compelled even the most skeptical American medical scientists to take a closer look.

American medical scientists soon realized that the Chinese had not only conducted field research on a mass level, but they also had begun the process of identifying potential causative factors of cancer. PRC scientists had collected data from local centers on the deaths caused by cancer of the esophagus and studied the pedigrees of high risk families. In 1973, the Chinese had already begun to create maps on the mortality rate of 90% of all of the households in China. These maps amazed American medical scientists and contributed to their interest in cooperative research.

American medical scientists in the CSCPRC delegation experienced difficulties in encouraging Chinese scientists to discuss their research because of the other "scientific tourism" acitivities that the Chinese had arranged. The scheduled visits to various cancer research centers and hospitals, the presentation of the national programme of early detection, early diagnosis, and early treatment, and the meetings with "barefoot scientists", limited the amount of time American scientists could spend on the substantive aspects of the Chinese EC research. The informal and often unplanned discussions that occurred in the midst of these acitivities produced unexpected results. For example, as an afterthought the Chinese displayed a national retrospective survey of cancer mortality of 800 million people!(39)

The CSCPRC delegation members returned from China with a number of plans for cooperative research in China. In turn, key Chinese scientists sent comprehensive reports about the PRC research to American scientists. The head of the "Cancer Research Institute" in Beijing wrote one study on the development of cancer research in China from 1940-1975; and a Chinese-American scientist was allowed to survey Chinese scientific and medical journals which produced another comprehensive report.(40) These studies used slightly different but comparable sources to trace cancer research in China. More importantly, they verified that EC research actually had been conducted on an institutional level for over 20 years.

The possibility that the combination of epidemiological and labratory research on EC would reveal a great deal about the causes of cancer attracted only a handful of American medical scientists because Americans were not accustomed to basing their research on mass surveys. Some Americans developed research projects independently in China and sent their own technicians to conduct field surveys. But even these scientists viewed their research in China as peripheral to their professional research activities in the US which did not use the mass survey technique as extensively.

Many of the American scientists who had participated in the CSCPRC delegation visits subsequently offered Chinese scientists an opportunity to learn advanced scientific research methods in the US. The "National Cancer Institute" (NCI) developed a small scholarly exchange programme in which Chinese scientists participated. The NCI scholarly exchange programme was not Comprehensive enough to benefit aspiring Chinese scientists; but then, most of the Chinese scientists who participated in the EC exchange programme came to the US primarily to negotiate Sino-American cooperative research projects and not to conduct their own reseach.(41) They returned to China with foreign credentials (which would guarantee them professional advancement in China), but whithout scientific expertise.

While the CSCPRC delegation participants generally saw opportunities for bilateral research, the programmes were coordinated between the US "National Cancer Institute" and the PRC "Ritan Cancer Research Hospital", and were not specifically included in the Sino-American governmental agreements. In a sense, the EC research exchange contains elements of cooperative research activities found in both of the other case-study areas (i.e., earthquake and acupuncture exchanges). Like the earthquake programme, EC exchanges had developed intergovernmental support for bilateral research, and, like the acupuncture programme, it attracted scientists who were willing to acknowledge the indigenously Chinese medical approach. While the Chinese medical approach was subsequently discarded by American and Chinese scientists in the case of acupuncture, it is still being examined and negotiated in EC research. So far, programmes for training Chinese medical scientists in EC research under the NCI programme have had limited success.

American Interactions with Chinas's Cancer Research Community (Stage II)

Unlike earthquake research exchanges, EC research exchanges have one primary PRC scientific administrator, Ms. Ci was politically appointed by Zhou Enlai to establish channels in the PRC for bilateral research projects. She has a vital function because the US and China do not have a formal agreement for EC research activities. EC research exchanges are slightly more complex because they are not institutionalized. US-PRC EC research is coordinated between individuals and not by governmental agencies.

As a result, the Chinese EC research community has its own unique problems. The major problem is that Ci has to oversee research projects in many different PRC research institutes. She has to distribute responsibility to several research directors and administrators. Conflicts were immediately apparent to American scientists interested in bilateral research.

One American scientist who participated in the 1977 CSPRC delegation trip to China noticed that the Chinese were very cautious about discussing the Chinese cancer research with American scientists.(42) While the Chinese were anxious to begin with "serious" discussions about their own research, and asked questions to demonstrate that they were familiar with international cancer research, Chinese scientists were not sure how much information to provide about their own cancer research programme. One American scientist believed that individual Chinese scientists were inconsistent (and sometimes contradictory) in answering questions about their research because they wanted to defer to Ci.(43) The reader will realize in reading further that American scientists also responded favourably to Ci's authority.

The American delegation which went to China in 1977 to investigate EC research was aware that Ci was a primary contact. American scientists used Ci to verify answers given to them by PRC scientists about EC research. The Americans generally perceived that the Chinese had not anticipated questions about cancers other than EC. One American scientist who was the CSCPRC delegation chairman recalls two instances that mystified the American delegation:

> "In Shanghai, we had very little communication with the main person in charge of liver cancer. But we were able to ask him if there was any ongoing research in China that looked at the relationship between hepatitis-B and liver cancer. The PRC scientists said that he didn't know of any research on this topic. But because we doubted his word, we asked Ci. Ci said that she was positive that there was a relationship between the hepatitis-B virus and liver cancer because of research that had been conducted along the Yangze River. During the Cultural Revolution, programmes were started where peasants drilled wells and barefoot doctors were instructed to place a purifier in the water. Within five years, there was a significant drop in hepatitis."(44)

The American scientist felt the Ci's answer was proof enough that research on the relationship between liver cancer and hepatitis-B was conducted in China. But it is entirely possible the the Chinese scientists had not been involved in the barefood doctors' acitivities and did not relate the water purification campaign to their own research of liver cancer.

However, the CSCPRC delegation chairman recounted another incident which clearly illustrates that PRC scientists deferred to Ci:

> "During the delegation visit, we asked a PRC surgeon who had received his education from the University of Michigan and had treated Edgar Snow for cancer in the PRC if there was any occupational cancer in China. The PRC surgeon flatly said no. Members of the American delegation gave him examples to illustrate their meaning, and he still denied the existence of occupational cancer. But we were skeptical about his answer so we posed the question to Ci. Ci said that Zhou Enlai had been aware of the high incidence of lung cancer in the tin mines in Yunan Province and had appointed various scientists to investigate the problem. As it turned out, the PRC surgeon who had denied any knowledge of occupational cancer in China was in charge of the Yunan province programme!"(45)

The American delegation interpreted these inconsistencies as the inability of Chinese scientists to reach a consensus on the kind of information that should be given to foreigners. Ci was the ultimate authority in both respects of monitoring Chinese scientists' activities and being "credible" to American scientists (as the individual who was able to direct the Chinese research on cancer so that it receives priority in the PRC policy elite groups).

The American delegation directed its interest in Chinese epidemiological research to Ci. But in contrast, the "Sloan Kettering Cancer Foundation" developed relationships with individual Chinese scientists and did not focus exclusively on epidemiology.(46) In 1979-80, Sloane Kettering gave three awards to PRC scientists who had conducted high-quality cancer research. Even so, Ci remained the primary contact for American scientists who pursued bilateral research projects in China. While the "Chinese Association for Science and Technology" (CAST) was responsible for coordinating details of US-PRC cancer research exchanges, Ci authorized participation of Chinese scientists in many geographical regions in China.

In attempting to establish an intergovernmental programme with the "Ritan Cancer Research Institute", US "National Cancer Institute" project coordinators observed that conflicts occurred between Ci and other Chinese scientists:

> "There is some kind of competition between the "Institute of Virology" and the "Cancer Research Institute" in Beijing. The director of one of these institutes has been trying to develop projects with the US competition (i.e., Japan and France), while also wanting to be involved in the US-PRC research programme. Ci (one of the research directors) is trying to prevent him from coordinating US-PRC research projects. The conflict seems to have blown over ..."(47)

The combination of competion between research institutes on the one hand, and incompetent scientists (due to inadequate training) in the various research institutes on the other hand, has a dramatic effect on the development of cancer research in China. By and large, American scientists simply assume that the Chinese language seriously impedes US-PRC cooperative research; but a formidable problem is conflict among Chinese scientists and research institutes.

It is important to note that the field of cancer research is intensely competitive even in the international scientific community. NCI coordinators perceived that Ci was trying to separate US-PRC research from research which was conducted with other countries in China. It seems that Ci perceived that the US government has a large cancer budget (i.e., cancer research can be considered a focus of S & T policy in the US, while it is not necessarily as high of a priority in other countries). Compe-

tition that generally exists in biomedical research was intensified in China. It then becomes important to analyse how this "built-in" competition that is played out in China affects the ability of the PRC to modernize its own research.

One American scientist maintains that the Chinese "creativity" has a potential scientific benefit:

> "It is interesting that the Chinese are now saying that they don't believe their own research on esophageal cancer. I know that many of my colleagues in the US also feel that the EC research should be abandoned because of the recent developments in liver cancer. But liver cancer research in China is under the domain for the research institute in Shanghai, and doesn't have anything to do with Ritan's EC research. For some reason the Chinese strengths are being abandoned which is too bad because the Chinese have a special talent for observation (i.e., a good basis for emidemiological research). In order to be a good researcher, you don't have to have extensive training in the US. You need to be able to think in a certain way. Chinese are even better at this than the Japanese, because the Chinese naturally pay attention to details. Perhaps it's because they live in a structured environment. Chinese are very aware of the norm and notice any departure from it."(48)

That the Chinese are losing confidence in their own research is related to the fact that most American scientists cannot appreciate the Chinese talent for "field research". Liver cancer (an alternative research topic) is conducted in the laboratory and does not require field research, including mass surveys of dietary habits and data collection of cancer mortality rates. The American scientists (just quoted) implies that the Chinese cannot adapt to the US research environment because it is too unstructured. It then seems logical that most Chinese scientists who come to the US tend to isolate themselves just as they do in their own cultural and institutional context to a large extent.

The US-PRC EC research programme has not flourished because the Chinese have high expectations for becoming a primary actor in the international scientific community and will not achieve this role by developing epidemiological research. Epidemiological research is not as important in international science as laboratory research. Chinese scientists are hopeful that if they adopt Western scientific methods and Western research topics they will increase their status in the international scientific community. Chinese scientists generally do not read their own research publications, even though they do publish articles in these journals on a regular basis.

Pressures from outside of China have adversely affected the development of a Chinese scientific community in EC research. The level of competition which existed in the international biomedical community dictates the development of biomedical research in China.

Conclusion

At this point in time, it is not clear whether Sino-American S & T exchanges advance the state of scientific research in China, primarily because Chinese scientists have been unable to secure an autonomous identity. An autonomous scientific community as we know it in the West does not exist in China. Chinese scientists cannot possibly confront policy-makers as a single body with respect to their international interests. Currently, their position in China is legitimatized by policy-makers and not vice versa. Policy-makers justify the scientists' participation in "international" S & T by relating it to "domestic" modernization strategies.

But it is clear that advancing the state of scientific research in China in order to facilitate China's participation in international S & T requires a proliferation of opinion leaders. The opinion leaders control the way S & T information is distributed

in the Chinese scientific establishment. They are motivated to control the influx of international S & T information into China and, in so doing, have to deal with the West. In particular, Chinese opinion leaders have to participate in scientific research exchanges. While the ultimate goal of the PRC government is to develop S & T so that it can complement and surpass international S & T, from a practical point of view, it is difficult to conceive of China becoming a modern nation without allowing a certain degree of autonomy in the scientific community and without establishing a hierarchy in that community. In short, the Chinese scientific community needs opinion leaders who will set standards for scientific research and consistently control the way Western S & T is distributed throughout China.

Footnotes

(1) "Science, Technology, and Nongovernmental Exchange", report to the US House of Representatives, Committee on Foreign Affairs, Subcommittee on National Security Policy and Scientific Developments. Washington, D.C.: US Government Printing Office, 1974: p. 145.
(2) Richard P. Suttmeier: US-PRC Scientific Cooperation: An Assessment of the First Two Years. Report to the US Department of State contract No.751-000372, June 1981.
(3) Initially, exchanges were planned in the following fields: agriculture, atmospheric S & T, environmental protection, high-energy physics, medicine and public health, and space.
(4) The PRC was reluctant to engage in joint ventures as a strategy to acquire US technology (in contrast to other developing countries). See Jon Sigurdson: Technology and science in the PRC. New York: Pergamon Press, 1980: p. 44-46.
(5) Dr. Otto Schnepp, the first US Science Attaché to China since normalization, conducted the NSF study.
(6) Initial reports were made by Edgar Snow, in: New Republic (Vol. 164, (1971), p. 20-23 and James Reston, in: New York Times, 25 July 1971 and 22 August 1971.
(7) Proceedings of the NIH acupuncture research conference. Washington, D.C.: DHEW 74-165, 25 Feb. 1973, see: "introduction".
(8) The American Journal of Chinese Medicine, Vol. 1, 1972, see: "introduction".
(9) Acupuncture Anethesia in the PRC (Washington, D.C.: Committee for Scholarly Communication with the PRC; 1974): preface.
(10) Among the unofficial reports on file in the CSCPRC library are those by Arthur Taub, John Bonica, and Francis Foldes. All were participants in the 1974 acupuncture delegation to China.
(11) Beijing Review, 3 Aug. 1979, p.3.
(12) Interview with an American anesthesiologist at the national Insitute of Dental Health, Spring 1983, Personal file No.2A. (Anonymity is required due to the sensitive nature of US-PRC S & T relations).
(13) The reader will find later in this paper that the waning American interest was not the only factor which was involved in dropping acupuncture form the bilateral research agenda.
(14) Interview with an American medical scientist at Downstate Medical College, Spring 1983; Personal file 3A.
(15) Personal file 2A.
(16) Personal file 3A.
(17) Ibid.
(18) This scientist was a major proponent of acupuncture research in the US and had been closely involved in WHO training programmes; Personal file 3A
(19) Pseudonyms are used in order to protect the identities of Chinese scientists.

(20) Science, 194, 20 Aug. 1976, p.656.
(21) Frank Press: Plate Tectonics and Earthquake Prediction: Contrasting Approaches in China and the United States, in: Bulletin of the American Academy of Arts and Science, May 1975, p.14-19.
(22) Earthquake Research in China, in: EOS Journal of the American Geophysical Union, Vol. 56 (1975), p.846 and 875.
(23) Earthquake Research in China, op. cit., p.887; Press, p.22.
(24) Earthquake Research in China, op. cit., pp.842-843; Bruce Bolt: Earthquake Studies in the People 's Republic of China, in: EOS Journal of the American Geophysical Union, Vol. 55 (1974), p.112.
(25) Several members of the CSCPRC delegation mentioned this in my interviews with them.
(26) Interview with an American research director at the USGS. Spring 1983; Personal file 8E.
(27) Interview with an American seismologist an USGS; Spring 1983; Personal file 7E.
(28) Personal file 8E.
(29) Interview with an American Geophysicist at the University of Southern California. Spring 1983; Personal file 2E.
(30) Interview with an American geophysicist at USGS. Spring 1983; Personal file 10E.
(31) Paraphrased from interviews with American geologists, geophysicists, seismologists, and earthquake engineers.
(32) Interview with an American geophysicist at USGS. Spring 1983; Personal file 9E.
(33) Interview with a PRC exchange scientist at USGS. Spring 1983; Personal file A.
(34) Interview with an American geophysicist at Columbia University, Department of Geophysics. Spring 1983; Personal file 3E.
(35) Harold Schmeck: Chinese Study Involving Chickens Links Cancer to Food in Humans, in: New York Times, 9 Nov. 1977, p.A-18.
(36) Robert Miller: Cancer Epidemiology in China. Two Years of Progress, in: Paul Marks (ed.): Cancer Research in the PRC and USA. New York: Grune and Stratton, Inc., 1980, pp.79-83.
(37) Li Mingxin/Li Ping: Recent progress in research on esophageal cancer. New York: Academy Press, Inc., 1980, pp.23, 183 & 216.
(38) C.S. Yang: Research on esophageal cancer in China: a review, in: Cancer Research, Vol. 40 (Aug. 1980, p.1973.
(39) Robert Miller: Opportunities for joint studies of peculiarities in the occurance of cancer in China and the US (Speech at the November 1980 Meeting to the US-China Joint Committee on Health).
(40) The reports, by PRC scientists Li Mingxin and Li Ping and American scientists C.S. Yang, are cited in preceeding footnotes.
(41) Interview with an American scientific research exchanges scientists at the US National Cancer Institute. Spring 1983; Personal file 6C.
(42) Interview with an American medical scientist at the Columbia University School of Medicine. Spring 1983; Personal file 8C.
(43) The reader will note in reading further that American scientists also responded favourably to Ci's authority.
(44) Interview with an American medical scientist at the Stanford University Cancer Research Laboratory. Spring 1983; Personal file 2C.
(45) Ibid.
(46) Epidemiology is one of several orientations in cancer research. As I understand it, epidemiological research is not considered to be "pure" research by those who focus on environmentally-controlled (i.e., laboratory) research. In the US laboratory research dominates.
(47) Personal file 6C.
(48) Personal file 9C.