U.S. - P.R.C. Scientific Cooperation:

An Assessment of the First Two Years

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Executive Summary

A. Findings

Relations in science and technology figured prominently in the process of U.S.-China normalization, and came to symbolize improving Sino-American relations in the post-normalization period. Government to government relations in science and technology have expanded rapidly since January, 1979, and now are being conducted under the terms of 14 bilateral agreements (excluding the agreement for exchanges of students and scholars). In many areas, substantive scientific collaboration has already occurred. In others, careful plans for cooperation have been made, and the stage is now set for substantive work. Due to the political commitments to it from both governments and the growth of genuine rapport between scientists in the two countries, in most respects the program of S & T cooperation has been remarkably successful to date.

For the Chinese side the relationship in S & T is seen as an important part of the developing political relationship as well as an opportunity to upgrade its science and technology. Chinese scientific development was interrupted by the Cultural Revolution just as major new advances in research were occurring in the West, advances due in part to the revolution in research instrumentation. Access to the U.S., therefore, provides not just access to industrial technology, but also to the technology of research itself, or how one "does science" in the advanced industrial world.

There have been a number of changes in China since the agreement was signed, yet scientific and technological development is still a high priority in the national development effort. In spite of severe national budgetary cutbacks and a renewed emphasis on applied research, the Chinese side is committed to maintaining its activities with the U.S. in most fields. Except for high energy physics and some areas of space technology, the Chinese regard the content of the program as appropriate for their needs, and appear to be protecting budgets for cooperation with the U.S. accordingly.

Although the scientific levels of the two countries are in most fields uneven, many of the Americans who have participated in the program have found it scientifically exciting. The program affords access to unique natural and social phenomena, and American participants have also found that their Chinese counterparts are both cooperative and thoughtful collaborators, and conscientious and hardworking in their dedication to improve their work. One experienced scientist who spent six weeks of field work in China as part of one of the agreements, reported that the program was the best cooperative program he had ever participated in. Another, who participated in the most ambitious of the projects to date, reported that on the basis of his field experience in China, he expected to redirect the next 10 years of his career to collaborative work with Chinese colleagues.

The activist approach to S & T cooperation pursued by both sides during the last two years has created some problems (discussed below), but it has also produced a number of scientifically

worthwhile projects that are already "off the ground." While this activism has not escaped criticism from some quarters, it is likely that a more cautious approach probably would have meant less substantive achievements to date. The approach followed has also led to the desired goal of creating a web of relationships between the two countries, and the two governments in particular. Officials on both sides are now obligated to consider the interests of the other in developing domestic plans and programs, and the record of both sides in discharging this obligation, in general, has indicated that real progress has been made in overcoming 30 years of mutual isolation, hostility and misunderstanding.

In spite of considerable success during the first two years of the program, certain problems are now evident. Four in particular are notable. First, the U.S. side has not organized itself adequately to take full advantage of the relationship. The lack of imaginatively devised liaison between the government and the private sector to advance the interests of both is one manifestation of this problem. The loss of a considerable amount of policy useful information generated by the program about China is another.

Second, frustrations on the U.S. side over Chinese treatment of proposals by American social scientists for research in China under the student and scholar program is creating some resentment among Americans who have actively supported closer U.S.-China relations. There is a danger that this resentment could poison the climate for the conduct of the S & T bilaterals as well.

Third, the financial foundation for the program was never satisfactorily laid and complaints about finances are common to both sides. The Chinese note that in comparison with co-operative programs which they conduct with other OECD countries, the U.S. approach has been particularly stringent. In the face of the current severe budgetary austerity in both China and the U.S., the shaky financial foundation of the program is the biggest immediate threat to its continuation and development.

Finally, after the activist pursuit of improved U.S.-China relations during the Carter administration, the U.S. now seems to be a bit unclear about just how relations with China serve its interests and about how S & T fits into the larger relationship. In contrast, the Chinese side seems to have a better sense of where it hopes the U.S.-China relationship will go and of the important role S & T cooperation can have in building the overall relationship over the long run. While the S & T relationship cannot substitute for political understandings, it plays an important part in developing the political relationships on the basis of those understandings, in the Chinese view.

B. Recommendations

The credibility of any recommendations pertaining to S & T cooperation with China is contingent upon their being in phase with current assumptions about China policy more generally. The latter are somewhat unclear as of this writing. Furthermore, the austerity budgets both sides are adopting seemingly limit the possibilities for major new initiatives. These recommendations proceed from a recognition of budgetary austerity, but also

from the assumptions that regaining momentum for the improvement of U.S.-China relations is in the national interests of both sides, and that there is more potential for contributing to that goal in the S & T relationship than has yet been realized.

The recommendations resulting from the study, therefore, are as follows:

1. The U.S., at a high level, should indicate its commitment to the continuation of the program at least at current levels, and should insure that adequate resources, especially travel funds, are available.

2. The U.S. Government cannot possibly anticipate all the resources in the U.S. that might be available to support U.S.-PRC S & T cooperation. It is therefore desirable to make greater efforts to involve non-governmental parties in the bilaterals in order to facilitate the matching of opportunities with resources.

3. The U.S. should explore ways of taking fuller advantage of the opportunities for benefits afforded by the program. This is particularly true in the areas of commercial opportunities and opportunities for expanding our knowledge of China, its S & T and economy. Again, this will involve greater involvement of non-governmental parties. More detailed suggestions are found in Section VI.

4. The U.S. must clarify its export controls policy as it affects China, and insure that the workings of the export controls machinery are consistent with policy.

5. The U.S. should explore with the Chinese imaginative new ways of funding program activities. Assuming that the U.S. decides that its relationship with China is of value to it, modest concessionary financing should be explored. Another alternative deserving consideration is the establishment of an endowment fund for S & T cooperation with contributions from both sides (including perhaps, the U.S. private sector).

6. The pursuit of recommendation 5 under present conditions will be politically difficult. It is therefore desirable to broaden public awareness of the program, its achievements and promise for future mutual benefit. It is also important for the Chinese side to deepen its understanding of the importance of there being non-governmental constituencies in the U.S. supporting expanded S & T ties.

7. China's efforts to reform its R & D system provide an opportunity for new collaborative initiatives. The Chinese are currently stressing the development of applications oriented contract research, an approach to research management not unfamiliar to the U.S. Mechanisms should be sought that would make the extensive experience of the U.S. with this type of research available to the Chinese in a manner that would be mutually beneficial.

The S & T relationship with China has already produced scientific and foreign policy benefits to both sides. By staying the course, those benefits are likely to multiply. This is particularly so as Chinese S & T overcomes the effects of the Cultural Revolution. The relationship with the U.S. offers the Chinese an opportunity to accelerate that process, and as they do,

the benefits to the U.S. from access to demonstrated scientific talent as well as unique natural and social phenomena will increase. In the process, if the programis properly managed, further progress in the building of good will between the two countries can be expected. Given the different social systems of the two countries, the development of political and economic relations of long term viability will take time and will involve disappointments and irritations. It is precisely for these reasons that a program with demonstrated capability for building a fund of good will, among other achievements ,deserves sustenance.

While it is neither possible nor desirable to limit U.S.-PRC S & T relations to the bilaterals, the latter have served as an important bridge between the two scientific communities and the technical agencies of the two countries. It is important to keep the bridge in good repair for a few more years at least, while individuals and groups on both sides discover new and perhaps more viable modes of interaction.

Contents

I. Scope and Approach of Study

On January 31, 1979, President Carter and Vice-President Deng Xiaoping signed an Agreement Between the Government of the United States of America and the Government of the People's Republic of China on Cooperation in Science and Technology (hereafter "the umbrella agreement"). The signing was followed by an exchange of letters between Dr. Frank Press, Director, Office of Science and Technology Policy (OSTP) and Vice-Premier Fang Yi, Minister in Charge of the State Scientific and Technological Commission (SSTC) in which it was agreed that the understandings on the Exchange of Students and Scholars (October, 1978), on Agricultural Exchange (November, 1978) and on Cooperation in Space Technology (December, 1978) would become part of the umbrella agreement. Sugsequently, twelve protocols to the umbrella agreement have been signed, making a total of 15 intergovernmental bilateral agreements in various areas of science and technology. Since the student and scholar exchange program was the subject of a separate study done for the International Communications Agency by Dr. Ralph Clough, this study has concentrated on the remaining 14 bilaterals. However, some attention was given to the relationship between the bilaterals and the student and scholar program.

The umbrella agreement provides for a U.S.-P.R.C. Joint Commission on Scientific and Technological Cooperation which during the Carter Administration was co-chaired by Frank Press and Fang Yi. The Foreign Affairs Bureau of the SSTC and OES/SCT of the Department of State perform the executive

Certain limitations on the scope and methods of the study should be recognized. It quickly became apparent once interviews with American officials began, that the extent of the program was greater than had been anticipated, and that mastery of all the programs' details would not be possible during the time period specified by the contract. It was not possible, for instance, to do the thorough examination of agency files that had been planned. A second limitation is that most of the interviews were conducted with U.S. government officials (scientists and administrators) and that views from university-based scientists and commercial interests were not as widely solicited. Nevertheless, efforts were made to contact some non-governmental interested parties, and some grounds for judgment about their views of the program exists.

The interviews with Chinese officials should also be seen in context. The short period of time available for the visit necessarily limited the number of contacts that could be made. All the Chinese interviewed were administrators. Some were high ranking with considerable authority over their programs. Others were representative of the foreign affairs offices of the various ministries. In only a few cases were interviews conducted with Chinese scientists. In addition, the idea of submitting to an interview with a foreign investigator was rather novel, and a number of the interviewees felt it was more important to make a formal statement of prepared remarks, than to respond in depth to specific questions. Nevertheless, the interviews provided an unusual opportunity to

solicit Chinese views of the program directly, and were quite useful.

Finally, the study draws almost entirely on unclassified materials. Although I did receive security clearance for the study, its approval came only after most of the work in Washington was completed. With the possible exception of the export controls area, it is unlikely that greater attention to classified materials would have altered my findings.

II. The Context of the Program

As noted, the program of intergovernmental S & T cooperation developed very rapidly during the last two years of the Carter Administration. Since the program was initiated, however, there have been many changes in the political and economic climates of the two countries. On the Chinese side, there have been a major reassessment of Chinese modernization policies, and some reshuffling of Chinese political leaders. On the U.S. side, of course, a presidential election has produced a new administration which has brought proposals for major changes in economic policy and budgetary stringency. Some officials who were active in promoting the program of S & T cooperation with the PRC are no longer in office.

The rapidity of the program's development can be explained in large part by two factors. The first was the perception by both sides that their respective national interests were converging in important areas of security and economic affairs. Both sides have expressed the view that cooperation in S & T

is both inherently worthwhile, and an important component in the overall relationship. A number of Chinese officials interviewed stated that the program is not a short term expedient but rather a part of a process for building a long term relationship. Preliminary evidence that the Chinese side has protected its budget for cooperation with the U.S. in the face of severe national cutbacks is one measure of Chinese interests in a long term relationship, and of the importance attached to the program in building that relationship.

While converging political interests and agreement on the importance of S & T in the overall relationship (at least during the Carter Administration) were favorable necessary conditions for the program, they were not sufficient. Substantively, the program could not have progressed as far as it has had there not been pre-normalization S & T contacts in many of the fields of cooperation. Many of these contacts were facilitated by the agreement to exchange scientists reached at the time of the signing of the Shanghai Communique. Since 1972, this agreement has been administered by the CSCPRC and the Chinese Association for Science and Technology (CAST). Other contacts were established at international organizations (e.g., WHO, WMO) and at international scientific meetings. In some cases, personal contacts contributed to mutual familiarization.

These various pre-normalization ties also contributed to the flowering of a wide range of non-governmental S & T ties. These include ties between scientific associations, formal institutional arrangements between universities and a variety of commercial relationships as well (such as the "cooperator" programs in the field of agriculture). In addition, various kinds of personal relations have resulted in exchanges of technical personnel (in this connection, it should be noted that the number of Chinese students and scholars studying in the U.S. without official government sponsorship apparently now exceeds the number of government sponsored individuals).

The existence of these numerous unofficial S & T ties raises important questions about the relationships between them and the government sponsored bilaterals. While some have been facilitated by the existence of the S & T umbrella agreement, others could undoubtedly stand on their own. In a few cases, the unofficial and the official may be in competition.

When viewed in the context of Carter Administration China policy objectives, the official and unofficial ties on balance are mutually supportive and complementary in promoting the policy goal of creating a web of relationships between the two countries. From the Chinese perspective, the two types of ties are seen as a version of "walking on two legs," and are therefore seen as complementary. More specifically,

some Chinese officials believe that the functions of the two types of ties are different. While the official relations are at times seen as relatively inflexible and cumbersome, they are necessary for certain types of projects, particularly large ones where government's role is preeminent (e.g. meteorology). The existence of the non-official ties, on the other hand, gives greater flexibility to the overall relationship. Although not mentioned explicitly by the Chinese side, it is also clear that the existence of the non-official ties in some cases opens up additional channels of communications of relevance to the official relationships.

As noted, both governments have accorded S & T relations an important place in the overall relationship. This was stated on a number of occasions by Chinese officials, and as observed above, the apparent protection of budget items dedicated to cooperation with the U.S. gives substance to these claims. On the U.S. side, the importance of S & T ties was demonstrated by the active promptings of the technical agencies by the Carter White House to establish relations with PRC counterparts. In one sense, the S & T relationship with China was the forerunner of other innovative approaches to the use of S & T as instruments of foreign policy, as seen in the Carter Administration's subsequent initiatives toward Africa, Latin America and Japan. But while these initiatives were innovative, the overall conception of the requirements of S & T in foreign policy was incomplete.

In the China program, for instance, while most of the technical agencies were effectively mobilized to make contacts and sign protocols with PRC counterparts, there were at least three subjects that pertained to program effectiveness where unanswered questions remained. These were the budgetary foundation of the program, export control policy, and coordinated action with commercial interests in the interest of export promotion activity. This is not to say that the Carter administration did not have positions on on these matters. It is rather to say that in launching what was an innovative approach to the use of S & T as instruments of China policy, all of the implications of doing so were not fully appreciated. While urging agency participation in China programs, the White House also adopted a stringent "benefiting side pays" approach to program financing, which in some cases has limited agency activities somewhat. Although some of the export control issues were recognized early on in the program, and although initiatives were taken in 1980 to liberalize export controls affecting the PRC, the resistance to change of those closest to the export control machinery was underestimated. Although export promotion was considered to be an important part of the program, there is little evidence of systematic effort to involve those concerned with export promotion in the design and execution of the program. These questions will be discussed further below.

A. Science and Technology in Chinese Modernization

One of the expectations of the U.S. Government in letting this contract was that an assessment would be made of the impact of the bilaterals on Chinese modernization efforts. The Request for Proposals issued by the State Department specified that among the topics to be addressed in the study would be Chinese perceptions of the S & T relationship, how the relationship influenced Chinese S & T development efforts and whether the relationship contributed to the formation of a web of U.S.-PRC ties in S & T that would ensure the continued progress towards a close U.S.-PRC overall relationship. More specifically, the RFP was concerned about the appropriateness of S & T content of the agreements for Chinese needs and of the modes of cooperation being pursued, and whether the relationship would contribute to an unintended Chinese dependency (whether unwanted or desired) on the U.S.

These are unquestionably issues of considerable importance. An adequate approach to them, however, requires that they be seen in light of earlier Chinese modernization efforts and of what is known, and not known, about Chinese policy making procedures. The former is important for assessing the prospects for Chinese modernization, and logically precedes both the questions of the role of S & T in that modernization, and of the contributions the U.S. might make toward Chinese S & T development.

Attention to policy making is especially important for dealing with the appropriateness question. While it is clearly desirable and analytically possible to approach this question

without reference to the authoritative determination of what is appropriate, behaviorally, the appropriateness of various forms of science and technology and S & T cooperation is politically determined. That is, something is appropriate because a powerful actor says it is.

For the student of modern Chinese history, it is difficult to escape a sense of deja vu in witnessing post-Mao modernization policies and changes in policies. For over 100 years, China has been seeking to modernize and to find the right formula for combining foreign assistance, domestic institutional change and ideological and cultural adjustment to reach the goal of modernization. Along the way, the particulars of the original objective of creating a strong "modern" China have at times been lost in the clash of competing interests, each seeking to promote its own vision of the means to be used. Significantly, however, the development of modern science and technology has been common to all statements of the modernization objective. This history has been characterized by efforts both to "go it alone" to the fullest extent possible during some periods, while in others there has been a willingness to rely on foreign assistance from the West, and during the 1950s, from the Soviet Union. Various approaches to institutional change were tried both before and after 1949, and of course the most profound institutional change, the Chinese Revolution itself, was justified in part in the name of modernization.

While it clearly would be an overstatement to observe that the more things have changed, the more they have stayed the

same, it nevertheless seems to be the case that there inheres in Chinese society qualities which make it difficult for any leadership group to maintain a sustained commitment to modernizing policies.

The reasons for this are largely unknown. To the extent that they are known, they are exceedingly complex. Without attempting to analyze these reasons in detail, I will attempt instead briefly to characterize the difficulty and suggest how it affects U.S.-PRC relations.

It has been suggested recently by a Japanese wag that whereas Japan is an economic animal, China is a political animal. While such aphorisms are no substitute for analysis, there is something suggestive about the remark. It suggests an image of a resource-poor, island-nation Japan having as its national purpose the commitment of energies to the creation of wealth through domestic and international commerce in which its investment decisions (both narrowly economic and social) are based on the criterion of market competitiveness. On the other hand, the remark suggests the image of a huge, continental, inward-looking China which must expend its material and symbolic resources on maintaining political integration. In addition, in keeping with a sense of historic grandeur but with a recognition of national humiliations during the last hundred years, resources must also be diverted to the task of laying a foundation for a capability to project power abroad. Consistent with these primary political purposes is the maintenance, in both historical and contemporary China, of political bureaucracies

as the means for effecting these purposes. In keeping with the principle of "goal displacement," however, bureaucracies come to develop interests of their own. One important result is that resources must be allocated to satisfy those interests, and the maintenance of bureaucratic loyalty becomes confused with the maintenance of political integration. A second consequence is that the political bureaucracies suppress initiatives for establishing alternative means for maintaining political integration. Thus, the protection of bureaucratic interests has precluded the legitimation of relatively autonomous groups in society (especially economic and professional groups), and of the widespread use of "market" exchanges. While discussions of markets in China normally focus on commodity markets, of greater importance perhaps has been the retarded development of factor markets and markets in ideas. The currently discussed economic reforms in China are of considerable significance in this regard.

Some historians of China see bureaucratic dominance as having frustrated the chances for a scientific revolution in China. According to this view, the former impeded the development of a powerful entrepreneurial class, and the failure of the latter to emerge is seen as one of the key reasons why a scientific revolution did not occur. Without attempting to evaluate such a thesis for pre-modern China, it is clear that in contemporary China, modern science is developing in the absence of an entrepreneurial class. Indeed, in some areas, Chinese scientific achievements have been most notable. However,

if the analysis above is sound, the continued development of science and technology will be paced by state interests rather than by scientific or market criteria, and will occur in a highly bureaucratic environment. One should expect, therefore, that the character of Chinese scientific development will be significantly different from that of the U.S. or of other nations where markets have both economic and metaphorical significance. This is not to deny the universality of scientific knowledge. It is rather to call attention to differences in the behavior of the Chinese scientific community, in science policy, and in the relations of science to the society in general and to the economy and the military in particular.

Thus, with reference to science policy, unless there is dramatic progress in implementing current economic reforms, Chinese science policy should be seen as being driven by the requirements to meet the twin purposes of maintaining political integration and preparing for the projection of power abroad, rather than by calculations of maximum scientific and economic returns on investments. Given the high degree of integration between economy and polity and the low degree of autonomy for professional communities, it could not be otherwise. At present, in spite of the fact that economic modernization is seen as the preeminent task of Chinese society, the ever present challenge of political integration precludes the sustained pursuit of what would appear to be economically "rational" measures to promote modernization. Thus, a liberalized labor market for

scientists and engineers would almost certainly produce a more efficient allocation of this valuable but scarce "good." Proposals for such a change founder, however, on the rock of bureaucratic resistance and the fear that a reform of this sort would be system threatening.

B. Perspectives on the Chinese policy process

Within this bureaucratic system, however, our knowledge of who determines what are appropriate S & T objectives and how, is unfortunately limited. Regrettably, it is considerably less than it should be for devising sound policies for interacting with China. At best, we can propose certain hypothetical models of Chinese political behavior and policy making processes.

It is interesting to note that some U.S. officials interviewed for this project reported that Chinese inter-ministerial conflict, or the lack of inter-ministerial cooperation, seemed to affect the smooth implementation of some of the agreements. Such observations would seem to be consistent with a "bureaucratic politics" interpretation of policy making. In this view, policy is the outcome of the pulling and hauling of, and turf battles and coalitions between and among different agencies. The interests of scientists and technologists are expressed in the process through the bureaucratic systems to which they belong.

There are reasons to believe, however, that a bureaucratic politics model is not fully representative of the Chinese

policy process. One reason is that the bureaucratic politics model presumes a certain commonality of interests among organizational members and that organizational leaders are closely linked to the activities of subordinates whose interests they represent. It is thought, by some students of contemporary China, however, that Chinese organizational leaders are remarkably ignorant of, and/or unconcerned about, the problems of implementation faced by subordinates, and that anticipated strong chains of command are in fact relatively weak.

A second reason for doubting the validity of the bureaucratic politics model is that the model seems to require an assumption that the procedures and norms of formal organization are fairly well institutionalized, i.e., that they are accepted by organizational members and are a guide to the actions of the latter. There seems to be general agreement, however, that the Cultural Revolution years had a devastating effect on formal organizations and that as a result, organizational members came to rely on various forms of informal organization.

The breakdown of formal organization and the increased importance of informal organization has tended to reinforce historic tendencies towards personalism and factionalism in Chinese politics and policy making. A number of students of contemporary Chinese politics, therefore, have come to interpret Chinese politics in terms of factionalism models. According to this perspective, personal relations among policy actors are assumed to be of greater importance in determining behavior,

especially coalition formation, than organizational affiliation or position. Thus, policy positions are regarded less as rational responses to societal or bureaucratic needs than as tactical stances for purposes of alliance formation in inter-factional conflict.

It is important that this factional perspective be borne in mind in attempting to assess the appropriateness of the areas of U.S.-PRC S & T cooperation for Chinese needs. Whereas Americans may approach this question on the basis of assessments of Chinese objective conditions, it would be a mistake to assume that the Chinese do as well, if the factionalism model is correct.

There is a danger in overstating the importance of factionalism in Chinese decision making, however. On the basis of comparative political analysis, one would expect that the importance of factions would vary with the type of policy at stake. That is, the type of political behavior in policy making is somewhat contingent upon the type of policy being considered. Without attempting to develop this point in detail here, one would expect that if the factionalism model has merit, factionalism might be relatively more important for explaining domestic science policy making and relatively less significant in accounting for Chinese approaches to foreign S & T relations.

There is also a danger that both the factionalism, and bureaucratic politics models underestimate rational, comprehensive or "synoptic" approaches to policy making. In spite of

the fact that formal organization and bureaucratic procedures were weakened as a result of the Cultural Revolution years, the Chinese policy making process is nevertheless formally structured to achieve centralized overviews of policy and to make centralized decisions based upon inputs from subordinate units. For example, the area of manpower development gives evidence of a synoptic approach. General policy in this area is set by the SSTC and conveyed to the Science and Technology Cadres Bureau which then reportedly devises an overall national plan. Planning figures are then related to the Ministry of Education which then attempts to reconcile those figures with Chinese domestic educational capabilities and training opportunities abroad.

Thus it may be a mistake to underestimate the importance of formal structure. While factional struggles and competing bureaucratic interests (as well as serious information problems), unquestionably compromise comprehensive decision-making based upon rational consideration of problems and alternative solutions, there may be cases where Chinese decision making proceeds more in accordance with "unitary actor" models than the proponents of either the factionalism or bureaucratic politics models are prepared to admit. Although our knowledge of how the Chinese came to determine "appropriateness" leaves much to be desired, by bearing in mind the possibility for alternative interpretations of the policy process, we should at least be able to avoid simplistic assumptions about Chinese plans and intentions.

While we are quite ignorant of the policy process, we do know a bit more about the contents of policies. We also know that there have been serious problems with the implementation of policy, with the result that Chinese policy has often been lacking in stability. This, of course, has been true of the post-Mao modernization policies on which much of the program of S & T cooperation has been based.

C. Post-Mao science policies and U.S. initiatives

It should be recalled that although many in post-Mao China clearly have had an interest in gaining access to U.S. science and technology, a great deal of the initiative for S & T cooperation came from the U.S. side. Two key events in the development of the relationship were the Brzezhinski mission in May, 1978, during which overtures to the PRC on S & T cooperation were made, and the Press mission in July, which was a response to the Chinese expressions of interest made in May. Specific agreements for intergovernmental S & T cooperation then followed later in the same year.

The U.S. side, prior to the Brzezhinski visit, had determined that an economically progressive China, able to meet its own basic needs--particularly in energy and food, was in the U.S. interest. Officials in the Carter administration believed that it could assist China in achieving this status through cooperation in S & T. The U.S. was responding in part to new Chinese statements of domestic policy. In the overly ambitious, Chinese modernization program of early 1978,

the "modernization of science and technology" figured prominently and was often referred to as the key to the other three modernizations.

As we have seen, the U.S. also had the objective of establishing a web of relationships between various sectors in the two countries, and S & T ties could provide some of the strands. There were also expectations of substantial commercial technology transfer opportunities for American firms that could be facilitated by S & T relations. Finally, there were assumptions that a degree of stability in Chinese policy had finally been achieved after the many disruptions of the Cultural Revolution decade. A new generation of leaders would soon be emerging to carry on the modernization policies. This new generation was expected to have strong technocratic orientations, and could perhaps be expected to develop interests in close S & T relations with the U.S. if mutual understandings between the two sides were reached.

In the S & T policy area, the Chinese at the National Science Conference in March, 1978, established what seemed to be a well-considered and long term program for scientific development. Included in this program was the identification of eight priority areas of research. It was to these areas of priority--agriculture, energy, materials, space, lasers, computers, high energy physics and genetic engineering--which the Chinese themselves had chosen, that the U.S. attempted to respond. The U.S. was clearly the preeminent nation in these fields. Even though the centers of U.S. preeminence were not

necessarily within the government, nevertheless the U.S. had substantial expertise in all of them within U.S. government agencies. Initially, and at first glance, it appeared that Chinese objectives and U.S. capabilities were appropriately matched.

Following the signing of the S & T umbrella agreement, U.S. technical agencies were encouraged by the White House to seek to develop cooperative S & T relations. The agencies, however, were also cautioned to approach the funding of activities with China on the basis of mutual sharing of costs, or where that formula was inapplicable, on the basis of "benefiting side pays" (a concept the Chinese have never accepted). Since, with only a few exceptions, the technical agencies did not have access to special funding for international programs, costs were to be borne out of existing budgets. This meant that the agencies had to satisfy themselves that cooperative activities with the PRC would be consistent with their legislatively determined missions. The process of making such a determination involves the exercise of considerable discretion by agency leaders and program officers, and the agencies clearly wished to be responsive to White House encouragement of the China relationship. Nevertheless, the funding policy laid down meant that U.S. agencies did not have as a first priority the objective of responding to Chinese needs. Instead, in most cases, the U.S. and Chinese sides sought to identify areas of work that would be of mutual interest and benefit.

During the two years when most of the bilaterals were being signed (1979 and 1980), there were important changes in Chinese domestic policies and politics which were not fully anticipated when the relationship was initiated. While these do not necessarily invalidate the assumptions underlying U.S.-PRC S & T relations, it is certainly the case that the policies of early 1978, the assumptions about which contributed to the nature of U.S. initiatives, no longer obtain. Instead, China has undergone, and indeed continues to undergo, a thorough reassessment not only of its economic policies, but also of its economic structure. This process of reassessment has not been without its political implications. In addition, there have been indications of serious resistance to the implementation of certain of the S & T policies of 1978, policies which formally have not been changed.

The essence of the changes in economic policy has been to shift investment priorities from large-scale, capital intensive, heavy industry projects to agriculture, light industry and economic infrastructure. Capital construction for most areas of industry in particular has been cut back drastically. In addition, China has clearly been rethinking both its economic structure and the criteria used for making economic policy. Of considerable interest has been increasing attention given to the role of markets in commodity exchange, and market-like criteria in factor allocations. As of this writing, however, the future of reforms in economic structure remains unclear.

The implications of economic readjustment for S & T policies in China, and for S & T relations with the U.S. began to become evident during 1980. By early 1981, Chinese science policy was again reflecting a concern for applied research and for quick payoffs from investments in research. Science education was clearly receiving higher priority. The importance of some basic research was acknowledged, but the proper level of effort remained unclear.

When the research priorities of 1978 are compared with those of 1981, the big changes are in the downgrading of high energy physics, space and genetic engineering. Instead, the status of applied research relating to light industry, communications and transport, resources (especially energy and energy conservation) and environmental protection has increased. High technology fields such as computers, integrated circuits, and lasers continue to be stressed.

In addition to these adjustments in priorities, serious efforts are being made to reform the organization and financing of research. Thekey innovation is to be a widespread use of contract research. A system comprising three different types of research institutes in envisioned. One type (mainly large scale) will continue to be funded directly out of the state budget, although individuals may undertake some contract research as time allows. The second type is composed of institutes (also relatively large) which will have more freedom to select their own research projects according to anticipated market demand.

They will have access to seed money from a "Science and Technology Research Fund" to be administered by the SSTC, and will be able to sell the results of their research and retain the profits after repaying the SSTC.

The third type of institute includes those referred to as "collective" institutes. These will not have access to state funds and thus must survive on their own abilities to raise resources by selling their services. A final structural reform will be to include more research institutes that had formerly been under direct ministerial jurisdiction under the jurisdictions of the new industrial corporations.

The two biggest casualties of these changes in policy for U.S.-PRC relations have been in the space and high energy physics areas. In early 1981, the Chinese formally informed the U.S. of what had been evident for some time, namely, that they were dropping plans to purchase a U.S. communications satellite. During 1980, the Chinese also expressed their chagrin at the price tag of a Landsat D ground station they had hoped to procure in the U.S. Although they have not formally announced their intention to cancel plans for the station, they have let it be known that they have investigated the possibility of purchasing one (with lesser capabilities in NASA's view) elsewhere. In the high energy physics area, what had initially appeared to be only slippages in the schedule for the construction of the Beijing Proton Synchrotrom (BPS) had by early 1981 turned into what was in effect a cancellation of the project.

A number of the other bilaterals, however, do not seem to be substantially out of phase with current Chinese economic and research priorities. This is particularly true in the fields of agriculture, meteorology, earth sciences and earthquake prediction, health and environmental protection work. The status and priority to be accorded metrology and oceanography are more uncertain, although the Chinese are prepared to go forward with the cooperative program in marine sciences. The future of the Dalian management training program would seem to be very much in phase with current Chinese interest in upgrading the quality of managers and administrators, and the Chinese side has committed scarce capital construction funds to the expansion of facilities at Dalian. The hydropower agreement would seem to be consistent with current Chinese emphasis on energy development, and in spite of the constraints imposed on the capital construction budget, there are indications that both small and medium, and some large scale hydro projects, will go forward. Concessionary financing is also being sought for the larger projects.

The character and viability of the U.S.-PRC S & T relationships may be subject to a more indirect effect from current Chinese policy readjustments. As noted, there are clear signs that once again, the political leadership is insisting that the technical community be more attentive to the practical applications of scientific knowledge. Unlike the past, however, when insistence on practicality was prompted by ideological

as well as economic reasons, and the means chosen were highly disruptive of professional life, the current concern seems to be motivated primarily by economic considerations. Indeed, current discussions of S & T policies reflect the cost-benefit mentality of the accountant. As we have seen, the mechanism of choice for linking research and production seems to be that of the research contract between industry and research institutes, rather than the Cultural Revolution mechanisms of seconding professional personnel to factories and farms and insisting that research institutes run their own factories.

But while there are signs that approaches to the practical applications problem are more discriminating than in the past, the shift of policy to emphasize practicality does raise an issue that could have an impact on U.S.-PRC S & T relations. This can be seen by looking at questions of funding. Although there does not seem to be any marked decline in the science budget, neither has it expanded as many in the scientific community have been advocating. One motivation for the emphasis on practicality in research may be to enable the state to avoid making additional investments in S & T from the national budget. Instead, research institutes would be expected to pay as much of their own way as possible through the sale of their own services.

There is a danger that this approach to funding may result in the neglect of basic research, and what might be termed "balanced scientific infrastructure." These, of course, were the aspects of the national science program which were most damaged

by the Cultural Revolution, and which various science reform efforts of the 1970s (particularly those of 1977 and 1978) were intended to rectify. While the '77-'78 reforms clearly ran the risk of unleashing (and perhaps did unleash) too much basic research, excessive attention to applications now could be a recipe for continued scientific underdevelopment, regardless of short term economic benefits.

China has long had a problem of deciding what proportion of its scientific effort should go to basic research. Seemingly, throughout the history of the PRC, if applied work was not consistently emphasized as a matter of policy, many in the scientific community would drift into projects of personal interest, but of no apparent applicability. In the past, the political authorities have tended to overreact to the proclivities of the scientists to the point where research routines were disrupted in the name of "service to production." It has been rare that the proposition that "a community rich in basic scientists is needed as a basis for success in applied science" has been seriously entertained by the political leaders.

A degree of shortsightedness in the past has also been evident in policies affecting scientific infrastructure development. By scientific infrastructure, I refer to the services and facilities that provide inputs--instruments, information services, reagents and supplies, and most importantly, properly trained people--into the research process. It is notable that in the collection of expert assessments on Chinese science found in Leo A. Orleans (ed.), Science in Contemporary China (Stanford

University Press, 1980), infrastructure-related problems are frequently mentioned as the most serious obstacle to progress. These include such problems as overly specialized scientific training oriented toward specific practical problems, unreliable supplies of reagents and instruments, underdeveloped computer applications and data analysis techniques, no tradition of recasting practical problems into the terms of basic scientific questions from which innovative advances could be made, and a weak tradition of interdisciplinary work. These difficulties, which are traceable to problems in the educational system, the scientific instruments industry and in organizational and administrative arrangements for research strongly influence the strategies and techniques of research. Many of the problems are caused by a failure to recognize that "the modernization of science" requires investments, the returns from which will take time. It is still too early to tell whether the current return to practicality in research will exacerbate these difficulties.

These issues of domestic Chinese science policy pertain directly to relationswith the U.S. U.S. scientists and science administrators interviewed for this project, while their assessments of Chinese activities in different fields vary, have in common the observation that the most likely contribution the U.S. can make to Chinese scientific development is to expose China to contemporary ways of doing science. This observation, which is consistent with the assessments contained in the Orleans volume, is based on the belief that the ways of doing science in the West have changed dramatically in the last 15 years. This

of course, was the period during which Chinese science was most disrupted at home and most cut off from international science. One of the main contributing factors to the changes in the West has been the rev olution in instrumentation. However, the revolution in instrumentation cannot be brought to China simply by bringing instruments. The revolution in instrumentation has instead altered ways of thinking about research and devising research strategies. Western observations of Chinese science at its best usually characterize it as theoretically good, but lacking in "hands on" experimental sophistication. As a result, even though the theoretical content may be up to date, the way of thinking about scientific problems is more reminiscent of Western practice of 15-20 years ago than that of today.

A number of the Americans interviewed expressed the belief that through cooperative programs, the Chinese could catch up in this realm of research techniques and strategies relatively quickly, and that once they did, the prospects for mutuality of scientific benefits from cooperation would improve markedly. Thus, for some agencies,there was a sense that current participation in the bilaterals was a type of investment in obviously capable scientific talent which could be expected to yield returns in the not too distant future.

There is clearly a danger that a return to emphasizing practicality in Chinese research could threaten the ability of the Chinese scientific community to make the necessary financial, institutional and intellectual investments needed to

bring research techniques and strategies up to world standards. In addition, the more promising opportunities to benefit from cooperation with the U.S. could be lost. Finally, excessive attention to applications probably would result in science that will be less interesting to Americans, and thus dampen enthusiasm for U.S. - PRC collaboration.

It is by no means certain, however, that the renewed attention to applications will result in excessive emphasis on practicality. And indeed, there are indications the Chinese are taking the problems of scientific infrastructure development quite seriously. The best evidence suggests that, instead, policy makers are grappling with what the appropriate mixes of basic vs. applied work and research vs. infrastructure development should be. Of concern to us here is that in terms of both science policy priorities and in terms of the persuasions of the policy actors currently most influential, the conditions for U.S.-PRC S & T relations have changed somewhat. The change need not be regarded as for the worse, however. A positive interpretation of it is that it has been a step toward greater realism on the part of the Chinese, which might be especially fortuitous given current U.S. budgetary stringency and unresolved issues of export control policy. Nevertheless, it may require that some of the assumptions underlying the U.S. approach be reexamined.

Two areas in particular may need some rethinking. In light of the discussion above about the policy process and policy changes, and in contrast to our assumptions of the

'78-'79 period, there is a need for greater patience and understanding while the Chinese attempt to master reforms in their economic and S & T systems. At the same time the U.S. should also be aware of its role as a "reference case" in Chinese policy deliberations. This implies the possibility that the study of the institutional settings for S & T may become a more important factor in the bilaterals than had been thought originally. It also implies that some in China will use "the U.S. as reference case" to promote change, with the risk that antipathy toward the U.S. relationship will develop among those resistant to change.

D. Chinese S & T relations with other countries

Chinese foreign relations in S & T with industrialized nations are not limited to the U.S. Programs of cooperation have been established with Australia, Japan, France, West Germany, the United Kingdom, Sweden and others. The program with the U.S., however, differs in two important respects. First, it is far more extensive and in most fields it is also more specific and intensive. Second, the U.S. takes a much harder line on cost sharing than do other countries. This is particularly true when "exchanges" are really tantamount to training for PRC personnel. In most cases the costs of such "exchanges" are borne by the PRC's partner, whereas with the U.S., these costs are charged to the PRC.

In some cases, the accounting stringency of the U.S. has caused some resentment, and most of the Chinese officials went

to great lengths to make the case for benefits flowing to the U.S. from the program. On the other hand, the PRC officials seemed to appreciate the "absorptive capacity" of U.S. scientific and educational institutions, the high quality of work done in the U.S., the working relationships with Americans, and the commitment of the U.S. side to insuring that the program was substantive. Although little hard data was available on the relative amounts spent by the PRC on the program with the U.S. in comparison with those of other countries, the impression received was that the U.S. program was unquestionably the largest item.

Foreign collaboration is also conducted with international organizations such as WHO, WMO and the UN Environmental Program (UNEP). In meteorology, for instance, China is an important regional center for observations and forecasting, and has also provided training in agro-meteorological forecasting to individuals from other LDC's on behalf of WMO. International organizations, especially UNDP (and in the near future, the World Bank), are also assisting the PRC in scientific and technological development, and the U.S. is in some cases involved in these relationships. For instance, U.S. technical counsel is being offered in UNDP-PRC discussions on the establishment of a marine data center and a Tiros receiving station.

Although the implications of the U.S.-PRC S & T relationship for the Western Pacific region were not an explicit subject investigated in this study, it is clear that a number of the bilaterals could have regional significance. The programs in

earthquake prediction, agriculture, meteorology, oceanography and fisheries and medicine come readily to mind. The further maturation of the bilateral relationship is probably necessary before it can serve as a foundation for multilateral regional initiatives. However, the possibilities for opportunities for some regional cooperation in the future should not be overlooked.

III. The Program Described

As indicated above, the U.S.-PRC S & T relationship has developed very rapidly and is quite extensive. Some effort is made in the following discussion to indicate the quantitative dimensions of the relationship, although summary statistical data on the program were difficult to come by. Approximately 765 Chinese and Americans, scientists and administrators, have participated in exchanges under the program during the first two years. (According to Chinese estimates, some 350 Chinese came to the U.S. and some 420 Americans traveled to China. According to my calculations, Chinese coming to the U.S. outnumber Americans to China 415 to 350.) Many of these, of course, were part of exploratory delegations that led to the signing of the protocols.

The dollar costs of the program to the U.S. presented in the following table are also imperfect estimates.

Costs to the U.S. Side by Agency (approximations)

Agency	FY 79	FY 80
EPA	$ 7,500	$ 55,000
USGS (2)	121,000	50,000
NBS	7,500	14,000
NASA	50,000	45,000
DOC	50,000	100,000
NSF	--	79,000*
NOAA (2)	184,000	611,000
DOE (2)	10,000	120,000
USDA	90,000	500,000
HHS	72,500	135,000
Totals:	$592,500	$1,709,000

It is still too early to predict what the total dollar costs of the program will be. While some costs will undoubtedly increase as activities expand, others will decline since the expensive exploratory delegations should no longer be necessary.

This section of the report represents an effort to capture the extensiveness and diversity of the program. The discussion is organized according to the chronology of the agreements.

A. Agriculture

Contacts between the agricultural sciences communities of the two countries predated normalization. Notable among

* Does not include $750,000 in support of programs administered at the NAS

these contacts were four agriculture related exchanges conducted under the CSCPRC mechanism. These included delegations on agricultural science and research, farm machinery, citrus fruits and wheat and vegetables. Momentum for a government to government agreement was building, therefore, when Secretary Bergland visited China in November, 1978, and signed the Understanding. Following normalization, the Understanding on Agricultural Exchanges was formally included under the S & T umbrella agreement by an exchange of letters between Frank Press and Fang Yi. The USDA is specified as the lead agency on the American side, and although not specified in the agreement, the State Agricultural Commission has been acting as the lead agency on the Chinese side. However, the program has also involved the Ministries of Forestry, Agricultural Machinery, State Farms and Land Reclamation as well as the Ministry of Agriculture and its Academy of Agricultural Sciences.

Under the authority of paragraph 3, of Article 10, of the S & T agreement, the two sides agreed at a preparatory meeting in Beijing in January, 1980, to establish a U.S.-PRC Working Group on Agricultural Cooperation in Science and Technology. The Working Group has now met twice (January, 1980, and December, 1980) and the minutes of its deliberations serve as the work program for the following year.

Considerable movement of personnel has occurred since the program began. Exchange visits have enabled both sides to learn about each other's capabilities and needs. Both sides also now look forward to longer term cooperative research

activities. Nevertheless, both sides have expressed satisfaction with the exchange visits that have occurred. These include:*

1979 - Reciprocal visits

germplasm

biological control of insect pests

animal science (one half complete)

1980 From PRC

tractor testing (5)

soil and water management (6)

economics and statistics (14)

research associate program (5) (one-year stay)

biological pest control (3) and agent introduction

germplasm: cotton (6)

forestry (8)

grain storage and handling (6)

soil tillage and equipment (5) testing

agricultural education (15)

lab. equipment (8)

Total: 81

animal science and health (7) (from 1979)

forestry (8)

biological control: stem (3) borers in corn, sugar cane, and rice

aquaculture (2)

agriculture education (14)

plant germplasm: wheat, (4) soybeans, forage grasses and vegetables

biological control: para- (1) sites and predators of pests on citrus, deciduous fruits and field crops

biological control: use of (2) viruses

plant germplasm: vegetables (3)

economics and statistics (14)

erosion control and water (6) management

Total: 64

*Numbers in parentheses indicate the number of participants.

Plans for 1981

From PRC

Forest Tree Seed Management and Testing (4)

Processing of Forest Products (3)

Small Watershed Management (3)

Agrohydrology (2)

Management Extension of Agricultural S & T (6)

Saline and Alkaline Soil Improvement (5)

Medicinal Plants (3)

Soil Tillage (2)

Tobacco Improvement (3)

Resistance of Crops to Insects through Crop Breeding (3)

Economics and Statistics - I (3)

Economics and Statistics - II (3)

Agricultural Economics (3-4)

* Biological Control by Entomogenous Micro-organisms (3)

* Beef Cattle Breeding (4)

Total: 50

Total Man-Months: 58

From U.S.

Agricultural Machinery Management Utilization (6)

Soil Management and Productivity (6)

Germplasm: Medicinal Plants (2)

Soybeans: Germplasm and Biological Control (6)

Forest Genetics and Tree Improvement (6)

Survey of Taxonomic Study of Natural Enemies of Crop Pests (2)

Agricultural Economics and Statistics (3)

Agricultural Economics and Statistics - I (3)

Agricultural Data Processing and Remote Sensing - II (3)

Economic Specialists (3-4)

Water Use and Management (6)

Integrated Pest Management - Trees (6)

Total: 52-53

The following are contingent on the availability of funds:

Human Nutrition (6)

Root-knot Nematodes (2)

Biological and Integrated Weed Management Systems (3)

Animal Health (5)

Fresh Water Fish Disease Control and Eradication (3)

Plant Quarantine (3)

Biological Control by Entomogenous Micro-Organisms (3)

Total: 25

Total Man-Months: 24

As indicated above, both sides now seem ready to move towards cooperative research programs of longer duration than study tours. The 1981 program calls for cooperative research efforts in three areas: tree improvement, sediment research and saline alkaline soil.

A third component of the agricultural agreement pertains to training and the exchange of visiting scientists. Although some activities had been occurring in this area in 1979 and 1980, it received more focused attention at the December, 1980, Working Group meeting. Four programs have been tentatively identified.

(1) Chinese Agricultural Participant Program - This is to be a PRC funded program with USDA acting to facilitate placement in appropriate U.S. universities. Thirty-one individuals have been identified for participation, and the PRC is currently reviewing the availability of funds for this project.

(2) University Fellowship Program - U.S. agricultural universities, working through the National Association of State Universities and Land Grant Colleges and the International Science and Education Council's Standing Committee on Training (ISEC/SCOT) have identified 20 training opportunities for PRC agricultural scientists. These range from six months to a full degree program. USDA's Office of International Cooperation and Development will serve to facilitate this program by communicating training opportunities to China, receiving credentials of Chinese candidates and assisting in placement.

(3) Foreign Research Associate Program - This program provides

opportunities for Chinese scientists to work in USDA Science and Education Administration laboratories for 12 months, on projects of mutual interest. USDA provides laboratory space, supplies, materials and instruction when necessary. The Chinese side pays all travel and living expenses. The PRC intends to send 16 scientists under this program in the following fields:

Veterinary Diagnostics (1)

Poultry Disease and Protection (1)

Identification and Classification of Natural Enemies of Crop Pests (1)

Nutrition and Physiology of Fruit Trees (1)

Effects and Analysis of Pesticide and Insect Residue (1)

Plant Tolerance to Environmental Conditions (1)

Storage, Preservation and Utilization of Germplasm (1)

Viral Disease of Crops (1)

Fresh Water Fishery Nutrition (1)

Forest Resource Inventory and Management (4 persons)

Forest Fire Protection (3)

(4) Agricultural Scholar Exchange Program - This would be a reciprocal exchange program. It is currently only in the talking stage.

The evolution of these exchange programs seemingly requires a modification in administrative arrangements, and both sides have agreed to discuss the establishment of a sub-group on Training and Scholar Exchange Programs under the auspices of the Working Group at the latter's next meeting. These training opportunities have been facilitated by the International

Science and Education Council, a joint body composed of representatives of USDA and from the National Association of State Universities and Land Grant Colleges. The existence of ISEC is one of the unique features of USDA's approach to cooperation with China which sets it apart from activities in other agencies. In addition to facilitating training opportunities, ISEC also provides a point of liaison between USDA and agricultural higher education community in developing activities with the PRC of interest to the American agricultural science community.

An unusual feature of the Understanding in agriculture is the explicit mention of the U.S.-PRC interest in agricultural trade. In this regard, USDA with its Foreign Agricultural Service and "cooperator" program is unique among Federal agencies in being able to link organizationally S & T cooperation activities with trade promotion. In consequence, the Understanding has not only led to the cooperative activities described above, but has facilitated interactions between the Chinese and U.S. agricultural trade association "cooperators." During 1979, an initial cooperators team visit in March was followed by separate visits of teams from the National Association of Animal Breeders, American Seed Trade Association and the Western Wheat Associates. Three Chinese delegations visited the U.S. under cooperator auspices. By the end of 1980, approximately seven other commodity groups also had activities with China including the American Soybean Association, the Holstein-Friesian Association of America, the National Association of Swine Records, the National Renderers Association, the Tanner's

Council of America, the U.S.A. Dry Pea and Lentil Council, Inc., and the U.S. Wheat Associates. The cooperators also have contributed to the hosting of Chinese delegations coming to the U.S. under the bilateral.

A final feature of the agricultural agreement which sets it off from other agreements is that unlike most other agencies having cooperative S & T agreements with China, USDA has a budgetary line item for international S & T cooperation. In FY 1980 and FY 1981 this line contained approximately $1.4 million, of which approximately $500,000 was committed to PRC activities. In addition, the Foreign Agricultural Service allocates funds for cooperator exchanges. (Funds for cooperator programs come in part from the private sector.)

As can be seen from the above, activities under the agricultural agreement are many-faceted, involving U.S. agricultural universities and commodity trade associations as well as the USDA itself. Indeed, agricultural programs with China reflect structurally the far-flung activities of the government-industry-university U.S. agricultural establishment. This fact created managerial difficulties within USDA, and a sense that the program with China was proceeding without sufficient attention to planning, clarifying objectives and coordination.

An informal working group on China was set up by the Department in 1979. It is chaired by Dr. Quentin West of the Office of International Cooperation and Development (OICD), the lead office within USDA, and also includes representatives of the Foreign Agricultural Service, the Science and Education

Administration, the Economics and Statistics Service, the Animal and Plant Health Inspection Service, the Forest Service, the Soil Conservation Service, the International Science and Education Council, and the WFAOSB. In spite of the existence of the Working Group, by December, 1980, there was still the feeling that the program was not being as well managed as it should be. As a result, in January, 1981, activities within OICD were reorganized and strengthened. Dr. Thomas Kelly has assumed the leadership of the China Program and is assisted by two international affairs specialists, one China area specialist and one secretary.

The view from Beijing on the implementation of the agricultural agreement is positive and enthusiastic. Although cooperative programs with other countries exist, that with the U.S. is viewed as most effective in part because the governmental agreement is complemented by a variety of commercial, educational and "people to people" ties. The PRC officials interviewed felt that the program with the U.S. fit nicely with their own domestic activities, and they have adjusted their planning activities to accommodate the program.

Prior to meetings with the U.S. side, the Agricultural Commission consults with the S & T officers in each of the ministries under its jurisdiction (who maintain active ties with relevant research institutes), with the Ministries of Light Industry, Food, Cereals and Pharmaceutical Industry, as well as with the STC in order to prepare for the integration

of the cooperative program with the domestic program. In the process, U.S. needs and interests are also considered.

The impact of the PRC economic readjustment is not expected to be major. Resources have already been allocated for completion of the 1981 cooperative program. Formally, agriculture enjoys a higher status in the new economic policy, and education and science are regarded as central to agricultural development. As an indication of this, the expansion of facilities for these two activities is continuing.

Thus far, there seems to be a fair degree of mutual benefit in the agricultural program. With the key position of agriculture in current PRC modernization policies, there are a variety of benefits accruing to the Chinese side as a result of access to U.S. agricultural S & T. The U.S. side benefits as well, however, in a variety of ways, most notably in access to flora unique to China (information on 806 varieties provided thus far) and to the germplasm of Chinese plant varieties, in access to Chinese experience with biological pest control, and indirectly through the linkage between S & T cooperation and trade which both sides recognize. In the biological control area, for instance, two agents used in forestry pest management which the U.S. has only recently begun to study have been used in China for twenty years.

Both sides are eager to move towards more substantive joint research. As noted, the first such projects are included in the 1981 work plan. The prospect for the future development of collaboration is promising. A potential problem in the

program, however, is the maintenance of enthusiasm among American scientists for it. While the enthusiasm thus far appears to be high, few American scientists have demonstrated a desire for a long term commitment to cooperation with China, for instance, by wanting to spend a longer period of time (e.g., one year) doing research in China. The language barrier is one deterrent. It is important for the maintenance of the enthusiasm of U.S. scientists that the Chinese make additional efforts to accommodate the wishes of American scientists to have access to the physical sites at which germplasm is collected and biological control techniques are used.

During the past few years, USDA has initiated a new approach to international S & T activities. The dedication of a budget line, the establishment of ISEC and efforts at closer liaison with FAS and the cooperators represents an integrated yet extensive approach to science, international cooperation and trade promotion which is intended to serve both the government's interests and those of its two main constituencies. To date, the most extensive use of this approach has been with China, as the commitment of 1/3 of OICD's budget to PRC-related activities signifies. While it is still too early to evaluate it seriously, the approach deserves more attention than it has thus far received.

B. Space

Discussion with China for cooperation in space began during the Press mission to China in July, 1978. NASA

Administrator Robert A. Frosch was a member of that delegation. A Chinese space delegation visited the United States in November and December of 1978 at which time the Understanding on Cooperation in Space Technology was signed by Dr. Frosch on behalf of the U.S. and Ren Xinmin on behalf of the PRC. The document recorded an "understanding in principle" that "under suitable conditions" the PRC would purchase from the U.S. a satellite broadcast and communications system. The satellite would be launched by NASA, and placed into geostationary orbit by a U.S. contractor. With the same "suitable conditions" caveat, the Chinese also recorded their intention to purchase from the U.S. a Landsat ground station that would be capable of receiving information from "the Landsat now under development" (i.e., Landsat D). As with the agricultural and high energy physics agreements, the space agreement was subsumed under the umbrella S & T agreement by an exchange of letters between Frank Press and Fang Yi, following normalization. As with agriculture, international activities at NASA are facilitated by a special budget line.

A Joint Commission was established following the signing of the agreement. At its January, 1980, meeting, a Memorandum of Understanding was signed between NASA and the Chinese Academy of Sciences (Center for Space Science and Technology) on the conditions for direct reception of Landsat data. The MOU contains a clause which enables NASA, in consultation with CAS, to terminate its activities under the MOU if construction of the ground station is not under way within 15 months of the signing.

NASA's role in these two projects has been mainly to facilitate Chinese contacts with U.S. private vendors, and in the case of the ground station, to manage the complex export control issues raised by the proposed Landsat D procurement. NASA has performed these responsibilities to date. On the satellite project, it was able to put the Chinese in touch with two candidate systems consultants and four hardware manufacturers. A complex, drawn-out process of export control policy adjustment has opened up the way for the ground station purchase. However, reassessments of Chinese economic policy have resulted in the indefinite postponement of the communications satellite project and some uncertainty about the future of the Landsat purchase.

In spite of difficulties with these two projects, explorations continue for further areas of cooperation. The Academy of Space Technology proposed 13 additional areas of cooperation in technology at the January, 1980, meeting. Discussions on cooperation in fundamental aeronautics with the Chinese Aeronautical Establishment have progressed to the point where delegations were exchanged during 1980, and a draft protocol and annexes have been prepared. NASA has expressed an interest in extending the relationship to two areas of its basic science interest (geodynamics and meteorology). Discussions are in progress on geodynamics and it is believed that cooperation in this area could be effected by a letter agreement.

Approximately 35 Americans have traveled to the PRC in connection with the agreement, and some 35-40 Chinese have

come to the U.S. However, the problems of developing and nurturing a viable program of cooperation in space have been numerous. An enormous amount of time has been given to the export control problems associated with the ground station procurement, and those on the U.S. side, including private vendors, have been keenly disappointed by the cancellation of the communications satellite.

NASA is now in the position of dealing with at least three different Chinese organizations (the Academy of Space Technology, the Academy of Sciences, and the Chinese Aeronautical Establishment). It was not possible to meet in Beijing with representatives from all these organizations. Instead, contacts were limited to discussions of the LANDSAT project. The Chinese gave evidence of continuing interest in this procurement, but they are clearly wary of the price of U.S. equipment and the effects of inflation on that price. They believe that they can produce comparable equipment outside the U.S. (which is denied by NASA), although they prefer to buy from the U.S. They have stated that funds have been protected for the purchase, but that they have little flexibility (although they have some) to go beyond what has already been budgeted. They would, in short, be prepared to make the purchase if the price were right.

Preparation for the project is under way. A network of remote sensing users is partially in place and is being further developed. It involves various government ministries, universities and a special institute for remote sensing in CAS. In

addition, efforts have been made to identify a suitable location--free from radio interference--and a site 100 km. from Beijing has been tentatively selected. The site, however, is inconvenient for the users, and as a result, a second site for the data processing center within the city is being proposed. NASA objects to this plan since it would greatly complicate the export control process, and recommends that the two stations be combined. NASA recommends that the Chinese consult the Italians about the radio interference problem. The Chinese report that they have done this, but that they remain unconvinced. NASA has proposed sending a team to the PRC to assist with this question.

The Chinese also expressed concern about the 15 month clause in the MOU, since in principle the MOU could become a dead letter after April. The Chinese strongly urged that in light of the disagreement over the purchase price, as well as the longer than expected clarification of the export control situation, the 15 month deadline be relaxed.

C. High Energy Physics

Perhaps more than in any other agreement, contacts between U.S. and Chinese high energy physicists were already developing positively prior to normalization. High energy physics (HEP) is an exceptionally international discipline, and the Chinese HEP community had perhaps the greatest number of opportunities for foreign contacts during the 1970s of any group of Chinese scientists. Western HEP delegations had been to the PRC during

the 1970s, and Chinese delegations visited major facilities abroad. In addition, there was a network of personal ties between the U.S. and PRC HEP communities, many of which involved Americans of Chinese ancestry. Once normalization was decided upon, the two HEP communities and their bureaucratic patrons were prepared to quickly conclude an agreement and move towards its implementation.

The instruments of the cooperative agreement in HEP are slightly different from those in other fields. Instead of one general protocol and one or more implementing annexes, the HEP agreement is founded on an "Implementing Accord" signed on January 31, 1979, between the Department of Energy and the Science and Technology Commission. The accord contains provisions for the U.S. to assist the PRC in the design of a 50 GeV proton synchroton (the Beijing Proton Synchroton) on a best effort, full cost recovery basis. It also provides for training for high energy experimental physicists, assistance in formulating a research program for HEP, and the sharing of administrative experience in establishing a major research center. The accord provides for the establishment of a Joint Committee (JCHEP), and Dr. James E. Leiss, Associate Director of the Office of High Energy and Nuclear Physics of the DOE and Dr. Zhang Wenyu, Director of the Institute for High Energy Physics (IHEP) of the Chinese Academy of Sciences (CAS) were named as co-chairmen. Annual cooperative work programs decided upon at the annual meeting of the JCHEP provide the details of collaboration. The only formal "annex" to the agreement, the "patent annex,"

spells out mutual understandings on matters relating to intellectual property rights.

The agreement provides for participation of the five major DOE contractor laboratories--the Stanford Linear Accelerator Center (SLAC), the Lawrence-Berkeley Laboratories (LBL), Fermilab, Argonne National Laboratory (ANL) and the Brookhaven National Laboratory (BNL). The Directors of these laboratories sit on the JCHEP.

Because of pre-normalization contacts, implementation of the accord began almost immediately after its signing. In anticipation of the signing, a delegation of Chinese physicists visited the national labs in mid-January, 1979, and then convened in Washington with the contractor lab directors and DOE officials from January 29-31. At this meeting each of the labs spelled out in considerable detail what they were prepared to contribute to the agreement individually and jointly, and preliminary administrative arrangements were settled. The minutes of this January meeting served as the basic reference document for the first meeting of the JCHEP in June, 1979, at which the work program for 7/79-6/80 was agreed upon. Of the 28 items agreed to in the 1979-80 work program, 11 had been completed and 9 were in progress as of November, 1980. Of the remaining 8, 7 are being carried out as part of the 1980-81 program along with 4 new items. One of the original items was canceled by mutual agreement. As the program has evolved, the main division of responsibilities among the 5 U.S. labs for design assistance and review is as follows:

ANL - magnetic field measurements, polarized ion source

BNL - RF Linac, RF for main ring, beam transport, beam extraction, polarized beam

Fermilab - ion sources, high voltage column, beam injection, ring magnets, low level RF, booster synchroton, superconductor, magnets

LBL - accelerator control, ring magnet power supplies, health physics

SLAC - magnet assembly and testing, technical data laboratory, health physics.

In addition, all five labs are providing advice on facilities construction, administration and experimental apparatus and research experience.

As of the beginning of 1981, more than 120 Chinese scientists, engineers and administrators had come to the U.S. as part of the program, with about 55 Chinese, as of that time, working in the U.S. on the PBS project. To coordinate Chinese activities in this country, a Chinese HEP liaison office has been established at Fermilab with a director who had at his disposal $1 million in foreign currency the first year, and slightly more during the second.

In spite of the fact that both sides have expressed satisfaction with the development of the program it has not been without difficulties and, as of this writing, its future is very much in doubt. One of the major problems on the U.S. side has been with export control policy and procedures. This subject is discussed further in a separate section, but it should be noted here that in spite of high level policy changes druing

the Carter administration designed to liberalize controls on exports of sensitive technologies to China, the policies have not been implemented at the working level. As a result, export license applications have not been approved to the irritation of both the Chinese and DOE and its contractors.

There has also been some minor misunderstanding concerning DOE prohibitions against use of DOE funds to support Chinese scientists who have been determined to be contributing members to research teams led by DOE contractors. The prohibition resulted from DOE efforts to enforce a strict interpretation of the "full cost recovery principle." However, this was a source of irritation to the Chinese--the rule does not apply to nationals of other countries--and DOC has accordingly changed its policy. According to guidelines issued by DOE on January 12, 1981, Chinese scientists in DOE labs are to be treated in the same manner as scientists from other communist countries. In addition, however, DOE has also instituted a new regulation requiring "IA-473" forms for visitors to DOE facilities. The IA-473 procedures are not directed specifically at PRC scientists, but will affect them. It is important that both the new 1/12/81 guidelines and the IA-473 requirements be explained to the Chinese authorities in Beijing, since their knowledge of these at present is unofficial (largely from PRC scientists in the U.S.) and incomplete.

On the Chinese side, the BPS project required a degree of inter-agency coordination that seems to be somewhat out of character for the Chinese government. This led to an approach

to project management which the American side believed did not take full advantage of the assistance provided. The biggest problem, however, which now seems insurmountable in the short run, is Chinese funding for the project.

To the surprise of many foreign observers, the BPS project and high energy physics generally was given a prominent place as one of China's eight priority fields of research when the national science plan was unveiled in Marcy, 1978. Its inclusion as a priority field reflected the high degree of interest in and commitment to HEP shown by various Chinese political leaders, reportedly including Mao Zedong and Zhou Enlai before their deaths, and Deng Xiaoping and Fang Yi in the post-Mao era.

In spite of this high level support, there were indications of dissent within the scientific community over the HEP priority status. By the time the implementing accord was signed, the PRC had begun the process of reconsidering its ambitious economic plans of early 1978, a process which has become an extensive, soul-searching and politically unsettling rethinking of the economy as a whole, and which continues to the present. At the time of the signing of the accord, it did not appear that general economic retrenchment would interfere with U.S.-PRC scientific and technological cooperation. However, by the first meeting of the JCHEP, Zhang Wenyu reported that economic readjustment was forcing the construction schedule to slip and that components which the Chinese had expected to procure abroad would be made in China instead (The U.S. side had been

encouraging this latter course and applauded this decision). Zhang stated, however, that the project still enjoyed strong support. At the second meeting of the JCHEP, the Chinese indicated that they hoped to complete the BPS by 1987 with construction stretched out--with segments completed sequentially rather than in parallel as originally planned--in order not to overburden the economy.

Unfortunately, by early 1981, word was reaching the U.S. informally that the BPS project has been canceled. It is clear that in the last two years, the project has come under increasing scrutiny by an increasingly budget-conscious government. Reportedly it survived cancellation efforts on prior occasions during this period, but has not survived the most recent effort.

As an alternative to the BPS, the Chinese are considering the construction of a smaller machine on the grounds of the IEHP. In March, 1981, two Deputy Directors of IHEP came to the U.S. to consult with U.S. counterparts. The futures of both PRC high energy physics and collaboration with the U.S. in this field thus are unclear as of this writing.

D. Metrology and Standards

The Protocol on Cooperation in the Fields of Metrology and Standards between the DOC and the State Bureau of Metrology was signed on May 8, 1979, and an accompanying annex came into effect on the same day. Responsibility for implementing the agreement on the U.S. side rests with the National Bureau of Standards. Responsibility on the Chinese side is divided between the SBM and the State Bureau of Standardization.

The annex provides for an exchange of visits of the Directors of NBS and SBM, for PRC scientists to work in NBS labs, and for lectures in China by NBS scientists on the following topics: the establishment, management and technical operation of a standard reference materials program, the metrology of microwave and electronic sciences and engineering, the metrology of microwave and electronic sciences and engineering, the metrology of cryongenic sciences and engineering, the development and application of guidelines, protocols and standards for computer software and networking, the establishment, management and technical operations of an analytical chemistry program, the determination of absolute physical quantities, and the utilization of applied mathematics in metrology.

A number of these activities have been carried out. NBS Director Ambler visited China in May, 1980, and plans have been made for a return visit by SBM Director Li Leshan in the spring of 1981. During 1980, four Chinese were placed in NBS labs (analytical chemistry (2), thermodynamics and molecular science, and radiation research), and one has already returned home. Three NBS scientists have traveled to China for two week lecture tours. In addition, NBS sent a laboratory visitation team to China in October and November, 1980, in order to gain greater familiarity with PRC activities in metrology and physical science research. The team represented expertise in the fields of optical physics, nuclear radiation, time and frequency, radiometry, microwave measurements, surface physics and mechanical engineering. Approximately $20,000 was expended on these activities during 1980.

Negotiations have been completed for activities during 1981 and a second annex is to be signed during Li Leshan's visit in late April. Included in the 1981 program are some lecture visits to China by NBS personnel, and extended stays in NBS labs for up to four PRC scientists.

While the Chinese side is generally satisfied with the progress of the program to date, there have been some irritations. Furthermore, since further cooperation will probably involve training of PRC scientists at NBS, financial difficulties may become serious. Both SBM and SBS have programs with other countries, and they find the financial arrangements with these more to their liking. Chinese scientists are making long term stays in both France and West Germany, for instance, and on a receiving side pays basis, are receiving monthly allowances of 2,000 francs and 1,200 marks respectively. An agreement with the United Kingdom calls for a simple 100/person/day mutual exchange. In light of this experience, U.S. insistence on "benefiting side pays" is viewed as burdensome, and in the context of current economic readjustments, a real obstacle to cooperation. In addition, the Chinese believe that their people have made contributions during their stays at NBS, and thus should be compensated.

Thus while the preeminence of NBS is recognized, the Chinese may increasingly go the Europeans for training. However, cooperation with the Europeans in problematic since the Chinese scientists are usually less proficient in German or French than English. Of six PRC scientists now in Germany, four were

originally slated to go to the U.S. The NBS has made four guest worker positions available to the Chinese side during 1981, but because of funding limitations, only two people can be sent, and these will be paid for by the Ministry of Education.

The Chinese side also noted an unevenness in the exchange of delegations. According to their calculations, by the end of 1980, they have received and paid for 24 U.S. visitors while the U.S. has only received and paid for eight.

A second area of complaint is the denial of access to the NBS microwave laboratory in Boulder, Colorado. The Chinese believe that they had explained to NBS Director Ambler that their interest was purely civilian, and that Dr. Ambler knew the backgrounds of the two Chinese involved. The NBS has looked into this problem; it was raised by the Chinese with Dr. Press, but the DOD has persistently opposed the presence of <u>any</u> foreign scientists at the Boulder facility.

A final area of irritation pertains to cooperation in the metrology of electronic devices. Apart from the microwave issue involving the Boulder facility, the Chinese side believes that the U.S. has resisted the full implementation of the electronics section of the agreement by ignoring Chinese interest in the metrology of large scale integrated circuits. In particular, they are anxious to have Dr. Julian French visit China. At the time of the signing of the agreement, they wished to include LSICs in the agreement. According to their account, they were dissuaded by the American side from doing so, but there

was an unwritten understanding that "electronics" would include LSICs. Although there are no plans for Dr. French to go to China, his associate, Murray Bullis, is to go during 1981. NBS is willing to discuss its work in LSIC metrology with the Chinese, but has decided that foreign scientists will not be permitted access to NBS facilities concerned with LSIC work.

Two other considerations affect the prospects for collaborative research of mutual interest in the near future. First, the English competence of the first group of PRC "guest worker scientists was a problem, and the NBS is quite concerned that this be solved. Second, as with other agreements, the Chinese work of greatest interest to the U.S. side may be in institutions (e.g., CAS) other than the one with whom the agreement was signed.

E. Management of Science and Technology

The Protocol on Cooperation in the Fields of Management of Science and Technology and Scientific and Technical Information between the Department of Commerce and the Science and Technology Commission was signed on May 8, 1979. An annex spelling out initial activities became effective with the signing of the protocol. The responsibility for implementing the agreement on the U.S. side resides with the DOC's Office of Productivity, Technology and Innovation (OPTI) and the National Technical Information Service (NTIS).

Activities in the S & T information area call for the establishment of a relationship between NTIS and the Institute

of S & T Information of China (ISTIC). This has been accomplished. NTIS has sold ISTIC publications and subscriptions to the Government Reports Announcements and Index. These materials are being made available to China at the U.S. domestic price, a 50% reduction of the normal price for overseas buyers. In addition, ISTIC sent a team of four to NTIS for nine weeks of training during 1980. ISTIC is facilitating NTIS acquisition of Chinese materials. Finally, NTIS has established a working agreement with the China National Publication Import Cooperation, the organization in China with the main responsibility for acquiring foreign books, periodicals and government documents.

Activities in the management of S & T area have resulted in one of the most interesting joint projects of all the U.S.-PRC S & T agreements. One of the interesting features of these activities is that they are occurring outside a formal specific agreement. The annex specifies that Dr. Jordan Baruch, then DOC Assistant Secretary for Science and Technology and the head of OPTI, would lead a delegation of management experts to China. This trip occurred in November, 1979, and involved extensive discussions with Fang Yi (representing the STC) and Vice Premier Kang Shi'en, Chairman of the State Economic Committee. Out of these discussions came a proposal for the establishment of a training institute for Chinese managers, officials and university professors. The proposal was then refined by DOC and was presented to the STC at the first meeting of U.S.-PRC Joint Commission on Science and Technology in January, 1980. The Chinese side was enthusiastic about the idea, and it

was decided to establish a National Center for Industrial Science and Technology Management Development (or Dalian Management Training Center: DMTC) on the grounds of the Dalian Institute of Technology.

After an initial visit of an American team to China in June, 1980, classes at Center began on August 18, 1980. The project has involved the U.S. side providing a faculty of nine drawn from U.S. business schools to offer courses in accounting and financial management; management of production, operations and technology; organization and personnel management; managerial economics, statistics, and decision-making tools; data management and information systems; strategic planning, policy analysis and formulation; and markets and enterprise development. There were 120 official students and 60 unofficial "auditors" in the first session. The student body was drawn approximately equally from among enterprise managers, government officials and S & T managers, and university professors.

The program also involved the U.S. providing five "case writers" who were to develop with Chinese counterparts case materials from Chinese managerial experience to be used for instructional purposes (along with U.S. case materials). Control Data Corporation provided a computer and two of its employees to assist in computer training and utilization. Xerox, Texas Instruments, RCA and Wang also contributed equipment to the program. Overall direction of activities on the U.S. side was in the hands of OPTI's Director of Far East Programs who was resident in Dalian.

During the first year, two thirds of the costs of U.S. participation were covered by the PRC, which reportedly has assigned the project high priority. (The costs to the U.S. during the first year were between $40,000 and $50,000). The State Economic Commission has been designated the lead agency on the Chinese side, but the STC and the Ministry of Education are also actively involved.

Reportedly the first session at the Center was quite successful. Both Japan and West Germany have watched the program carefully, and wish to emulate the Dalian concept elsewhere in China. They are reported to be prepared to contribute resources to meet the bulk of the costs for their projects. The PRC accordingly requested that the U.S. increase its contribution to the 1981 effort from 1/3 to 1/2 of the costs.

In March, 1981, a U.S. team composed of two DOC officials and three of the 1980 "faculty" traveled to Beijing and formulated plans with PRC counterparts for 1981. The second "term" is to begin May 4 and last for 28 weeks. During the first 6 weeks, the Chinese faculty will teach basic subjects, to be followed by 20 weeks of instruction by the American faculty. A final 2 weeks of the term will involve special projects directed by the Chinese faculty. The U.S. has agreed to finance one half of the international travel and one half of the salaries of the American participants, estimated to be approximately $150,000.

The Chinese side clearly has considerable interest in this project. One measure of their commitment to it is their

decision to proceed with the construction of 9,000 square meters of living and teaching space at the site in spite of the national policy of cutting back capital construction. However, any attempt to assess the impact on the Chinese side would be premature. I was told that both the contents of the 1980 courses and the teaching methods used had a definite impact on the thinking of the Chinese participants, but that it was too soon to know how successful the Chinese participants have been in adapting what they have learned to Chinese conditions. The expansion of management education in Chinese institutions of higher education is now being considered.

U.S. participation in the Dalian Center is an innovative and potentially very significant contribution to Chinese modernization efforts and to U.S.-PRC relations. It is difficult to evaluate the program seriously, however, since to date the DOC has supplied very little documentation of its activities. As noted above, the establishment of the Center and the U.S. role in it is not specifically mentioned in either the protocol or the annex. As a result, it is not possible to know what the commitments and implicit understanding of the two sides are. The case materials, which were intended to be a key part of the instruction program, have not been made available, and there has been no written detailed report on the activities to date.

Thus, there are potential problems with the program. DOC has reported to DOS that U.S. teaching faculty will be required at DMTC for the next 3 to 5 years. It is by no means clear

who will pay for these services. If the U.S. side is expected to pay, the benefits to the U.S. side need to be spelled out in considerably more detail than has been done to date. Reference to Japanese and German interests in having their own centers is not in itself a justification for U.S. participation. The Chinese side believes that the U.S. has benefited from learning about PRC management practices in greater detail as a result of the access afforded to the case writers and first year's faculty. This access, incidentally, is regarded as extraordinary by the Chinese, and reportedly required extraordinary efforts to arrange.

One of the problems with the program is that those who had this access neither had any prior knowledge of Chinese management nor any special professional commitment to the study of Chinese management or the PRC economy (there are Americans who both have some knowledge of these matters and who have made life long commitments to increase that knowledge). In addition, when I asked in Beijing whether further case studies would be done, I was told that the American faculty will probably be too busy for that purpose, although there may be some opportunity for such work in Dalian. It would appear that future access to Chinese factories will not be expanded and may in fact be reduced. Thus one of the benefits to the U.S. was not protected while at the same time U.S. contributions to the program have increased.

While the DMTC program thus far has been successful, its viability over the longer run requires attention. Three areas

in particular need further consideration. The first is the funding and management of the program on the U.S. side. The possibility of moving the program out of DOC (perhaps to a consortium of business schools) should be explored as should the possibility of total or partial private sector funding. Second, the possibility of including U.S. industrial and R & D managers (or retired managers) as members of the faculty should be explored.

Finally, efforts should be made to include Americans who have specialized professional competence in and demonstrated professional commitment to the study of Chinese management, administration and economic development.

F. Marine and Fishery Science and Technology

The Protocol on Cooperation in the Field of Marine and Fishery Science and Technology was signed May 8, 1979, between NOAA and the PRC National Bureau of Oceanography. Annex 1 to the protocol, which makes mention of discussions with the PRC National Bureau of Aquatic Products and CAS as well as NBO was signed on the same day. As with other fields, there had been some prior contact between the two sides as a result of CSCPRC sponsored activities and through international organizations.

The protocol provides for the establishment of a joint Working Group, and the Annex outlines an initial program of work consisting of three categories of projects: Category I included activities for which specific commitment could be made

at the time of the signing. Category II includes activities which have been agreed upon "in principle." Category III projects are those which both sides wish to explore further before agreements are reached. Category I designations from the time of the signing to the present include (1) marine data exchange; (2) marine sedimentation processes; (3) aquaculture; (4) tuna fisheries activities; and (5) marine environmental services. Activities to date have been mainly in the first three areas. Detailed specifications of work are spelled out in the minutes of the Working Group.

In the data exchange area, there has been an exchange of delegations (U.S. to PRC in November, 1979; PRC to U.S. in October, 1980) which has been focused on the initial objectives of learning about each other's systems and helping the PRC establish a National Oceanographic Data Center (NODC). A proposal for further cooperation is now in draft which calls for (1) U.S. advice and training in support of the establishment of the NODC; (2) an exchange of data; (3) an exchange of scientific literature. The implementation of items 2 and 3 should not be problematic, but progress on item one will probably be slow since an effective center requires considerable interagency coordination in China, and will also require funding (possibly from UNDP for facilities and hardware acquisition).

In the aquaculture area, there was an exchange of delegations in 1980. There have been discussions of follow on activities and of establishing a joint study panel on aquaculture. The future of these discussions is uncertain at this time.

in the annex are unlikely to yield activities until late 1981 or 1982. These include marine environmental services (Category I), marine instrumentation and buoys (II), marine environmental monitoring and prediction (II), numerical computer modeling (II), sea-air interaction (II), and marine metrology and standards (moved from III to II). Exchanges are to begin in 1981 on biology of fish resources species (II), which is to be coordinated with the activities in aquaculture.

The proposal for the marine sedimentation study was very much of an American initiative. While the Chinese clearly have a long term interest in sedimentation problems in the Changjiang estuary and while they have collected much data on the phenomenon (which is being made available to the U.S. side), it is not clear that they were planning any major sedimentation dynamics study prior to the U.S. initiative. Evidently they felt that a positive response to the initiative would give them an opportunity to learn first hand about American oceanographic research strategies and to have access to American technology. They therefore agreed to the project. Although there was initial disagreement between the two sides about the choice of stations for observations, the project could not have gotten as far and as fast as it has, had it not been for the active support of the NBO.

The program to date may have cost the Chinese side more than had been anticipated. In spite of the fact that it now occupies a spanking new building in Beijing, the NBO is finding it difficult to raise the necessary funds to support the two

cruises planned for 1981. They estimate that these will cost approximately $1 million for operating expenses, and they now have a shortfall of some $400,000. (Some on the U.S. side believe that at most the cruises should cost no more than $500,000). It was suggested by the Chinese that even the $6000,000 that has been allocated has not been easy to raise and has had to come out of other NBO programs. (I also received the impression that progress in the fisheries area may be slowed by a lack of funds as well.)

The NBO has approached NOAA with a proposal that the U.S. help defray the costs of 1981 cruises. The basis for this proposal is the wording found in the minutes of the June, 1980, Working Group meeting which reads in part, "...if only one side provides ships, the expenses should reasonably be shared by both sides." NOAA has thus far refused on the grounds that it is contrary to NOAA practice to pay operating expenses for the ships of other countries, and that this position was made clear to the PRC side at the June meeting. As a result, there is some question about whether the cruises can in fact be conducted. There is room for negotiation, however, since the Chinese side is not insisting that NOAA make up for the entire shortfall, nor that NOAA's contribution need be in the form of money. As of this writing, a compromise is being explored in which NOAA would provide forms of training assistance as part of its contribution to the project.

There have been and continue to be irritations on both sides in implementing the protocol, but these have been manageable so far. As noted, there was some confusion about the area

chosen for the first cruise (the Chinese side believes that they accommodated U.S. wishes); the Chinese believe that they have not received a formal presentation of U.S. data and analysis from the first cruise (not all of the data held by the U.S. is in a form to be transmitted), and in the fisheries area the Chinese feel that since they have received six Americans in China and sent only four of their own people to the U.S., they would like to right this imbalance. In spite of these minor problems, the rapport between the two sides in sedimentation project has improved dramatically in the months since the cruise (except for the funding question). The rapport between the scientists of the two sides in particular is excellent. There is general satisfaction with the program.

Although the marine sedimentation project was first proposed by the U.S. side, and may have given the Chinese some problems in integrating it with their own activities, it is now viewed as a project that has benefited the Chinese side (access to instrumentation and U.S. ways of doing oceanographic research; the frank criticisms and suggestions provided by the U.S. oceanographers) and is attracting international attention. The U.S. side believes it is a first rate scientific opportunity that is producing very exciting results.

In the marine data area, the PRC side hopes that cooperation with the U.S. will facilitate support from UNDP for the establishment of a marine data center, and hopes that the U.S. will try to convince UNDP of the importance of this project.

The NBO is beginning to develop relations with other countries as well. Both France (under a formal S & T agreement)

and the Netherlands have expressed interest in cooperative oceanographic studies. Japan is eager to develop cooperation and was to send a research vessel to China in late March, 1981. The program with the U.S. is the most extensive thus far. The fact that it is more structured and focused accords with Chinese preferences.

Although it is difficult to provide specifics, one senses after conducting interviews with both sides that the program in the marine sciences area is one that would benefit from greater attention to the quality of communications between the two sides. In particular, an effort should be made to generate more information concerning the longer term interests of the two sides in cooperation, and the constraints on present and future cooperation felt by both.

G. Atmospheric Science and Technology

Prior to the signing of Protocol on Cooperation in the Field of Atmospheric Science and Technology on May 8, 1979, contacts between the two meteorological communities had been established via the WMO, where both the U.S. and the PRC sit on the executive committee, and through a visit to China by a delegation from the American Meteorological Society in 1974. In addition, various types of personal contacts existed between the two sides. Since the signing, 37 Americans have gone to the PRC and 25 Chinese have come to the U.S. under the provisions of the agreement.

The protocol between NOAA and the Chinese Central Meteorological Bureau (CMB) spells out general principles for cooperation

and provides for the establishment of a joint working group. On the same day that the protocol was signed, two annexes were also signed. Annex 1, like its marine sciences counterpart, establishes three categories of projects ranging from those on which firm agreement exists to begin implementation, to those still in the talking or exploratory stage. The Category I areas included in Annex 1 were numerical weather prediction, meteorological satellite (metsat) data, mesoscale observations and research, and meteorological data and information. Annex 1, category I activities have been implemented. During 1979 and 1980, delegations were exchanged in all areas.

Annex 2 of the protocol committed the two sides to a cooperative program to establish a joint upper air sounding facility in China, in which the U.S. side would provide equipment and some training in China, and the Chinese side would provide for the site, continued operation of the station and costs of NOAA personnel. The implementation of this annex has gone smoothly and the facility has been in operation in China since June, 1979.

The second meeting of the Working Group was held in Beijing in September, 1980. At the conclusion of this meeting, two additional annexes were signed. Annex III records understandings concerning the implementation of Annex I. It provides for the reclassification of the following areas as category I for implementation during 1981: climate monitoring, climate modeling and numerical prediction, ground-based remote sensing, and tropical cyclones. In addition, projects were added to categories II and III.

Annex IV is intended to lay the foundation for training and participation in operational and research activities for Chinese meteorologists at NOAA facilities. Seven Chinese are to be involved for approximately one year in environmental satellite applications to weather forecasting (4), and in the fields of UHF Doppler Radar and boundary layer atmospheric sounding applying ground-based remote sensing technology. It is to be funded jointly with the Chinese covering the costs of the first six months, while the second six months will be funded by the U.S. side.

Meteorology is by nature an international activity and for this reason alone, NOAA officials are enthusiastic about expanded collaboration with Chinese counterparts. In addition, the American side is impressed with both the staff and operation of the CMB. In addition to the relationship provided for by the protocol, NOAA is participating in a WMO sponsored, UNDP founded project to help China upgrade its meteorological capabilities.

From the Chinese perspective, cooperation with the U.S. is part of a multifaceted involvement in international meteorological activities, but one which has special appeal. The appeal comes in part from the access to U.S. technology, training opportunities and forecasting experience afforded by the agreement. But in addition, China feels that the many geographical and climatic similarities between the two countries provides a special basis for cooperation. While the Chinese are quite satisfied with the progress of the program, certain of their perceptions warrant attention.

The CMB believes that both sides, but particularly the U.S., should not become excessively concerned with short term balance of benefits, but should instead keep the long term implications in mind. Because of the nature of the field, with its implications for a variety of activities in which the two countries have interests, cooperation in meteorology tends to contribute to the overall U.S.-PRC relationship. Bilateral cooperation also benefits multilateral efforts to improve, understand and predict meteorological phenomena. Thus China is a regional center for weather data collection and dissemination. Daily data transmissions are made to Japan and West Germany, for instance. China has also provided agro-meteorological training to individuals from other LDCs under WMO auspices. The bilateral-multilateral relationship is also evident in PRC interest to procure a Tiros ground station through partial UNDP funding. During the first phase, Chinese personnel are to receive training in the U.S., the costs of which are to be borne by the PRC. Some 300,000 yuan is to go for first phase activities. The actual procurement is expected to involve $1.5 million (most of which will come from UNDP). China would like to buy the equipment from the U.S., but cautions that the decision will depend on the competitiveness of the bids from U.S. firms.

It is clear that the internationally active CMB places special value on its relations with the U.S. Its relations with Dr. George Benton, former NOAA Associate Administrator, were highly appreciated and it is eager that his replacement be named. While the U.S. relationship is valued, the Chinese

also note that U.S. funding of the program is especially stringent. In its relations with Japan, for instance, 10 Chinese are being trained in Japan in numerical weather prediction on a receiving side pays basis. Training in Europe will also be covered by the Europeans. The funding arrangements with the U.S. for the participation of the seven trainees/researchers in NOAA activities during 1981 are acceptable. However, the precise formula should be reviewed once the U.S. has a better understanding of the contributions that can be expected from the Chinese participants.

CMB has not been unaffected by budget cuts. While its ability to conduct international activities out of its yuan budget will probably improve somewhat, activities requiring the expenditure of foreign exchange will be more constrained. It is unlikely that this will affect activities with the U.S. during 1981, however.

The impact of budget cuts at NOAA as of this writing are a bit uncertain. Ceilings have been placed on travel expenditures, and in the competition for travel funds, travel essential for NOAA operations will have highest priority. Funding for PRC trainees under Annex 4 may not be as firm as it was expected to be.

H. Medicine and Public Health

Cooperation in the fields of medicine and public health is being conducted under the terms of the Protocol for Cooperation in the Science and Technology of Medicine and Public Health signed on June 22, 1979, between the PRC Ministry of

Public Health and the Department of Health and Human Services (then HEW). As with other agreements, there had been pre-normalization contacts between the two sides. In this case those contacts included a relationship that had developed at WHO.

The protocol specified seven areas for initial cooperation (infectious and parasitic diseases, cancer, cardiovascular diseases, public health and health services research, medical information science, immunology, and medical genetics) and eight additional areas for subsequent cooperation (reproductive physiology and family planning techniques, pharmacology, industrial hygiene and environmental health, organ transplantation, burns, microsurgery, biomedical engineering and mental health). During Minister Qian Xinzhong's visit to the U.S. in June, 1980, mental health, food and drugs (including pharmacology) and family planning were added to the list of initial areas.

The protocol also provides for the establishment of a Joint Committee, the first meeting of which occurred immediately following the signing of the protocol. The deliberations of the Joint Committee are recorded as annexes to the protocol which also serve as the programs of work for the two sides. Annex 1 spells out specific topics for cooperation in the original seven areas; it names Chinese and U.S. coordinators for those areas, and designates the Bureau of Foreign Affairs of the MPH and the Office of International Health of HHS as the administrative agents for the agreement.

Annex 2, which was agreed to at the second meeting of the Joint Committee on November 20, 1980, spells out in some detail the program of work for 1981, and planned exchanges of personnel. The latter includes the following:

Area	From PRC	From U.S.	Duration	Purpose
Infections and Parasitic Diseases				
1. Viral Hepatitis B		1-2 epidemiologists	2-4 wks.	advise on study design and lab diagnosis
		1-2 virologists		
	1-2		1-3 mos.	study preparation of Hepatitis B vaccine
2. schistosomaisis and malaria		3	3-4 wks.	consultation
	1 (entomologist)		1 yr.	training
	1		6 mos.	visit to private centers
	1		3 mos.	consultation of purification of schistosome antigens
		6-8	10 days	workshop
		4	3 wks.	workshop
Cancer	4		1 yr.	visiting fellows (tentative)
		4	1 mo.	evaluate progress of binational research on esophageal cancer
Cardiovascular Diseases	2		1 yr.	joint research
	2-3		unspec.	discussion of program
		4	1 mo.	planning
Public Health and Health Services				
1. Health Services Research		4-6	unspec.	workshop
	unspec.		3 wks.	planning of descriptive study in U.S.
	up to 4		1 yr.	training
		2-3	3-5 mos.	descriptive study of Ye County

Area	From PRC	From U.S.	Duration	Purpose
2. Environmental and Occupational Health	4-6	4-6	unspec.	planning
	2-3		3-4 mos.	short term testing, environmental toxicology and asbestos and metal epidemiology
Biomedical Information Sciences	2		unspec.	assist in NLM cataloguing of Chinese collection
	2		unspec.	training
Immunology	2-4		unspec.	training
	3-5		unspec.	planning
Human Genetics	unspec.		unspec.	workshop
	1-2		1 year	training
Reproductive Physiology and Family Planning Techniques		4	unspec.	planning
Mental Health	2		1 yr.	training
		unspec.	4-8 wks.	planning
Food and Drugs	unspec.		1 mo.	exchange
		unspec.	unspec.	planning

Since epidemiology underlies many of the areas above, and because it has been particularly characteristic of Chinese medical and public health studies, there is interest in making a special initiative to develop a "core" epidemiological training program in China.

A considerable amount of contact under the agreement has now taken place, and both sides have expressed considerable satisfaction with progress to date. The stage is now set for longer-term, more substantive relations. Two problems loom, however. First, although the agreement is with MPH, there is considerable biomedical research going on in the Chinese Academy of Sciences, some of which may be of interest to the American side. It remains to be seen whether there will be effective coordination between MPH and CAS, although representatives from MPH interviewed in Beijing stated that coordination is good. The second more serious problem is funding.

Although the status of medical research and education is improved somewhat under current PRC policies, and although the completion of projects with the U.S. that have already been agreed to will not be a problem, PRC budget constraints may make the continued expansion of the program uncertain. The Chinese side is generally quite satisfied with the program to date. They believe that it meshes harmoniously with their own domestic program (although the current increased emphasis on applied medical research may hamper the development of those areas of the program in which U.S. interest is in basic research), and that access to Chinese research, health experience and unique

health problems offer many benefits to the U.S. The Chinese side is, however, irritated by the stringent approach taken by the U.S. on funding. They noted in particular that the per diem provided to the two individuals assigned to the National Library of Medicine was quite inadequate. Again, the divergence of U.S. practice from that of other countries (Japan, France, West Germany) with whom the PRC cooperates was noted.

Severe budget cuts in HHS also introduce uncertainty into the future of the program. Although cooperative activities with the PRC may continue to be a high priority in HHS's international programs, the scale of the latter will be trimmed. Reportedly the Office of International Health will be cutting its staff from 57 positions to 10 by the end of October, 1981, and the longer term future of the office is uncertain. It is not clear how informed the PRC side is about these developments in HHS, and it may be desirable to alert them of possible reductions of American commitment to the program.

I. Hydroelectric Power and Related Water Resource Management

Although high-level communication between China and the U.S. on cooperation in hydropower development predates the establishment of diplomatic relations, it was not until Vice President Mondale's trip to the PRC in August, 1979, that an agreement to cooperate was signed (8/28/79). The protocol identifies the U.S. Department of Energy, the Bureau of Reclamation (later renamed the Water and Power Resources Service), the Corps of Engineers and the Tennessee Valley Authority as the participating

agencies on the U.S. side. As the program has developed it has also involved the Chinese Ministry of Communications and the Trade and Development Program of the U.S. International Development Cooperation Agency. Because of the multi-agency nature of participation, both sides agreed to name national coordinators. This function has been lodged in the Department of Energy on the U.S. side, and in the Ministry of Electric Power on the Chinese side.

Uncertainties over funding arrangements (to be discussed below), delayed the implementation of the protocol, and it was not until March, 1980, that the implementing annex was signed during the visit to China of the American hydropower delegation led by David Freeman. The Annex provides for cooperation, technical assistance and exchanges of personnel with the potential for deep American involvement in China's ambitious hydrodevelopment plans. The activities provided for in the Annex can be summarized as follows:

Article 1. Cooperation in planning for multi-purpose use of the Hongshui (Red) River. Responsibility on the U.S. side rests with WPRS (although this is not stated in the Annex).

Article 2. Cooperation in the Longtan hydroelectric power project on Hongshui River, between the Corps of Engineers and the Ministry of Electric Power.

Article 3. Cooperation on multi-purpose development technology related to the Sanxia (Three Gorges) project on the Changjiang (Yangtze). Again, clear agency responsibility is not spelled out in the Annex, but the lead role for this article resides with WPRS.

Article 4. Cooperation on power grid technology. The ministry of Electric Power and the Bonneville Power Administration are named as the participating agencies for this article.

Article 5. Cooperation on the Ertan hydroelectric power project on the Yalong Jiang. The participating parties are the WPRS and the MEP.

Article 6. Cooperation on the regulation of the Changjiang estuary involving the Corps of Engineers and the Ministry of Communications.

Subsections under each article spell out responsibilities in greater detail.

Activities to date under the Annex have included the visit of a COE team to study the economic feasibility and engineering design of the project under Article 2.1; a visit to the U.S. of a Chinese team to study the multi-purpose use of the Tennessee and Colorado rivers under Article 3.2; a visit of Chinese under Article 1.2 to study multipurpose planning of the Columbia River; a COE team to the PRC to study problems of regulating the Changjiang estuary under Article 6.1; and a Chinese team to the U.S. to review design alternatives for Ertan under Article 5.2. A WPRS group is to go to China during the first half of 1981 under Article 3. A planned visit to BPA under Article 4 has been suspended because of a disagreement over funding arrangements.

The objectives of the hydro protocol are ambitious; the bureaucratic processes entailed in the organizational arrangements are complex, and the implications for U.S.-PRC relations are far-reaching. Unfortunately, a foundation for adequate

funding of the project was not laid at the outset, and uncertainties and disagreements over financial arrangements have plagued the implementation of the Protocol. Under U.S. policy guidelines, none of the participating U.S. agencies are able to fund their participation out of their own budgets, except for the activities spelled out in Article 6 of the Annex where the COE has determined that its participation will be beneficial to its overall ability to carry out its legally mandated missions.

As a means to advance the objectives of the agreement, a high level decision was reached in the Carter Administration to use funds from the Trade and Development Program to enable implementation of parts of the Annex to proceed. Approximately $417,000 has been set aside for this purpose by TDP for 1980 and 1981 of which only a small percentage has been spent.

The TDP is intended to provide seed money for projects that are expected to produce commercial gains for the American private sector 50-100 times the original investment. It was necessary therefore for the Carter Administration to secure from the PRC a statement of intent to the effect that the U.S. private sector would enjoy commercial opportunities in follow on design, engineering and construction work.

The private sector, however, has serious misgivings about the entire hydro agreement. The reasoning of representatives of the private sector is that China has the construction experience and know how to do much of the construction work itself. The comparative advantage of the U.S. is in the design engineering and construction management areas, i.e., those areas where U.S. expertise is being offered by government agencies via the protocol.

The issue of Chinese and U.S. government interests, and U.S. private sector interests is discussed further below.

The Chinese side has expressed considerable satisfaction with the program to date. Hydropower development is being accorded high priority in current PRC economic policy despite cuts in capital construction in the overall budget. The PRC appreciates U.S. expertise in hydro development and feels that the two countries have many similarities in their water resources. The Chinese now wish to move toward more specific substantive programs (e.g. rock mechanics, soil mechanics, fish ladders) and are anxious to begin discussions on activities for 1982 and beyond (since the current agreement only provides for activities in 1980 and 1981).

On the other hand, the U.S. approach to funding stands as an obstacle to further cooperation and to the completion of the items in Annex 1. The failure to specify financial responsibilities in the agreement, and Chinese rejection of the "benefiting side pays" formulation has already led to the postponement of the implementation of Article 4 (the BPA visit). Article 2.2 calls for 6-10 Chinese to visit the U.S. for 6-12 months. Article 9 also specifies that 50 Chinese will come for 6-12 months. The Chinese now claim that these individuals are seasoned engineers who can be expected to contribute to U.S. activities and that therefore their expenses in the U.S. should be borne by the U.S. side. As in other programs, the Chinese side points to experiences with other countries where in-country expenses have been covered by the host country, in spite of the

fact that the U.S. is the only country with whom the PRC has a formal agreement. Twenty-nine Chinese trainees, for instance, were hosted by Hydro-Quebec. Reportedly, Chinese who have been received for training by U.S. private firms have been paid salaries after an initial settling in period.

Unresolved problems of funding training activities, problems with the financial foundation for the program more generally, and the need to begin to plan activities beyond 1981 suggests the need to rethink the hydro agreement. In particular, the relationship between the U.S. government and the private sector needs attention. There has been no evident cooperation between the two; instead the relationship is characterized more by antipathy and mistrust. While the program was conceived originally on the U.S. side as one that would facilitate commercial opportunities, to date this seemingly has not been the case. In particular, the possibilities of the private sector sharing some of the short-term costs for the completion of annex one should be explored. In return, the voice of the private sector in future programmatic initiatives should be guaranteed.

J. Earthquake Studies

The Earthquake Studies protocol was signed in Beijing in January, 1981. While the signators are the USGS and the Chinese State Seismological Bureau, the agreement also provides for participation by the NSF on the U.S. side and by the State Capital Construction Commission on the Chinese side. Seven annexes have also been signed dealing with premonitory phenomena, intraplate active faults, earthquake engineering and hazards

mitigation, deep crustal structure, rock mechanics, very long period seismographic studies and exchanges of data and films of seismographs (this latter annex involves the active participation of NOAA).

In both the U.S. and China, earthquake prediction work has been accorded special status in public policy. The SSB has been designated the lead agency of the Chinese program while the USGS is the lead agency of the U.S. Earthquake Hazard Reduction Program. Both sides enjoy special budgetary allocations for their work. USGS's main responsibility is in the prediction area, while NSF has responsibilities in the area of fundamental research in support of prediction and in earthquake engineering. The latter parallels the responsibilities of the Chinese SCCC. In short, there is a convenient organizational congruence to the earthquake studies program.

The organizational congruence is matched by a high degree of congruence of interests as well. China is in effect participating in an ongoing U.S. program by offering data and access to geological structures that would not otherwise be available. The U.S. is in effect participating in an ongoing Chinese program by offering China advanced instrumentation to improve data collection and enhance data analysis capabilities. Work on the program which involves the participation of U.S. university scientists is now under way, and seems to be going smoothly. According to one senior U.S. university scientist who recently returned from six weeks of field work in Yunnan province, the program with China is the best cooperative program he has ever

seen. The science is very exciting and the Chinese counterparts have been extraordinarily cooperative and are making a serious commitment to the program, as evidenced by their construction of special residences for foreign visitors.

The PRC budgetary cutbacks should not affect the SSB's program significantly, and its financial base for cooperation with the U.S. may actually have been strengthened. Indeed, the SSB seemed to be anxious to push forward with the program and seemed to have the resources to do so. However, they would like to have a better idea of USGS interests and intentions, and in this connection they expressed the desire to know who the new U.S. "representative" (i.e. USGS Director) will be. In keeping with the spirit of Article 5 of the protocol, they believe that more high level "representative to representative" communication should occur, and that these representatives should meet once each year.

K. Earth Sciences

The Earth Sciences protocol which provides for cooperation between the USGS and the Chinese Academy of Geological Sciences of the Ministry of Geology was signed in Beijing in January, 1980. As of this writing, no annexes to the protocol have been signed, although there is rough agreement between the two sides on some 17 items (20 projects) of cooperation, 11 of which USGS was prepared to initiate for 1981. These include application of remote sensing techniques to mineral exploration and sedimentary basins; basin analysis techniques to petroleum

exploration; relation of volcanism to tectonism and metallogenesis; uranium deposit exploration and analysis; coal basin exploration and analysis; petroleum geology of carbonate rocks; ground water hydrogeology in arid regions; geothermal gradient effects on oil and gas formation; genesis, classification and distribution of karst; debris-flow and landslide processes and classification; geological and hydrological conditions of hydrothermal systems.

Since no annexes have been signed, the only real progress made in implementing the protocol has been the establishment and meeting of the Joint Working Group (as stipulated in Article 5 of the protocol). The organizational participation in the earth sciences agreement is complex, and therein lies the delay in reaching final agreement on the annexes. On the U.S. side, five offices of USGS are involved (Energy Resources, Earth Resources Observation Satellite Program, Geochemistry and Geophysics, Water Resources and Environmental Geology). On the Chinese side, the agreement involves the Ministries of the Coal Industry, Education, Geology, the Petroleum Industry and the Second Ministry of Machine Building as well as units from the Chinese Academy of Sciences.

USGS had a large number of pre-normalization contacts with China, and thus, its personnel were prepared to move quickly towards cooperative relations with the PRC once the opportunity presented itself. After the Press mission, and just prior to normalization, the USGS proposed a geoscience community to geoscience community, non-governmental agreement. The Chinese

response to this initiative was positive, but involved a great deal of inter-bureaucratic negotiations among Chinese agencies. As a result they were rather chagrined when after normalization the U.S. proposed inter-agency agreements with separate Chinese ministries. Since by this time the Chinese were already well into their own internal coordination, they have since taken the position that there be only one main agreement providing for a series of projects (to be agreed upon in annexes) in which the various interested Chinese units could participate. The U.S. accepts this formulation, but disagrees with what has been the Chinese view that the annex should include precise work schedules for all 17 items.

Administrative coordination on the U.S. side has been a major factor in delaying the signing of annexes. Since much time has elapsed since the original USGS initiative, and the contingencies facing USGS office chiefs have changed, it has been necessary to reclarify the extent of their commitments to the program.

The Chinese side believes they enjoy good relations with USGS, but they are concerned about the lack of progress on the annex. They believe that the original 17 item program represented a good balance of benefits (as well as a balance of bureaucratic interests) and therefore would like to see a signing soon. The Chinese seemed to be sympathetic to the idea of signing an annex with all 17 items included, but with the time tables and personnel commitments for some items left vague. That is, while they are eager to sign, they are prepared to stretch out the implementation of the annex.

The Ministry of Geology is the lead agency for coordinating earth science work within China. In the field of international cooperation, however, the lead role is played by the SSTC. I sensed that the SSTC was therefore as anxious to move forward with the signing as was the Ministry of Geology. I was told that the PRC has been cooperating with a number of other countries including West Germany, France, the U.K. and Australia. In the Chinese view, the implementation of these has gone quite smoothly in comparison with relations with the U.S.

It should be noted that there have also been some contacts between USGS and the PRC in earth sciences outside the protocol. These include a remote sensing specialist who attended a UN/ Academy of Sciences seminar on marshland use in September, 1980, a three-week visit in October, 1980, of a USGS glaciologist, an exchange of delegations of coal specialists and the attendance of six PRC scientists at a USGS course on carbonate rock.

The delay in signing the annex is unfortunate, since its implementation seemingly holds significant benefits for both sides. Since the delay is related in part to a lack of action on the part of some U.S. officials, it may be desirable to give this program higher level attention in the U.S. than it has received so far.

L. Environmental Protection

After an exploratory visit to China by EPA officials in 1979, the Protocol for Scientific and Technical Cooperation in the Field of Environmental Protection was signed on February 5, 1980, in Beijing. Three annexes were signed on May 14, 1980,

during a visit to the U.S. of a Chinese delegation led by Li Chaobo, head of the Office of Environmental Protection Leading Group (OEPLG). During this same visit, two other annexes (relating to preservation of nature and environmental impact statements) were discussed, but they remain unsigned as of this writing.

The areas for cooperation spelled out in the annexes are as follows. Annex 1 is concerned with environmental health research and identifies cooperative activities in the areas of air pollution caused by coal combustion, drinking water contamination and biological accumulation of pollutants. Annex 2 provides for cooperation in pollution control and identifies research projects related to fine particles from coal combustion, fluidized bed combustion, and pollution from sulphur containing materials. Environmental Processes and Effects is the general area covered by Annex 3. The annex provides for exchanges of information and personnel on topics that include aquatic effects, soil and ground water, and the modeling of air and water pollution processes. Each annex specifies the names and affiliations of project leaders for the various topics.

Although the protocol is between the EPA and the OEPLG, it also specifies that each side "shall encourage and facilitate the development of contacts and cooperation between government agencies, research institutions, industrial enterprises, universities and other entities...." Given problems of interagency coordination in China, it is not clear how effectively this provision will be carried out. Formally, progress in

coordination to date has been impressive. The majority of Chinese project leaders identified in the annexes are not OEPLS personnel. Indeed a large number of them are from the Ministry of Public Health. This fact seemingly would make the full implementation of interagency coordination all the more important for the success of the relationship. This question will be discussed further below.

To date, one Chinese scientist has come to work at the EPA Health Effects Research Laboratory in Cincinnati on water quality analysis. However, most of the progress under the protocol has involved the exchanges of planning groups, with the actual implementation of substantive activities to begin in 1981. During 1980, approximately 16 EPA officials traveled to China and 8 Chinese came to the U.S. The costs to EPA are estimated to be $55,000.

Environmental protection work is relatively new and underdeveloped in China (although some work on pollution and health effects predates the establishment of the OEPLG when such work was under the jurisdiction of the Ministry of Public Health). As in some other protocols, certain unique phenomena in China compensate for the relative underdevelopment of environmental science, and thus grounds for mutual benefit exist.

Problems in the development of the program are mainly financial. The PRC side is unhappy with the financial arrangements made for its scientist in Cincinnati, and also believes that Annex 4 (Impact Assessment) should be conducted on a receiving

side pays basis as in the first three annexes. The PRC side also complained about the unwillingness of EPA to pay for an extra day's stay by a member of one of its delegations, since they believe that they accommodated American wishes for an extension in China.

The readjustment in Chinese economic policy has actually led to a formal upgrading of the status of environmental protection work, although it is not yet clear whether this extends to environmental science. The economic reform package calls for the consolidation of enterprises and the upgrading of existing technology, and the Chinese hope to use the reforms as an opportunity to curb pollution. This approach seemingly creates opportunities for new areas of U.S.-PRC cooperation (e.g. in the multifaceted area of pollution control technology) including the possibility of greater involvement of the private sector and U.S. universities.

The Chinese were asked whether they believed progress had been made in moving forward on Annex 5 (Preservation of Nature), and responded that some progress had been made. In the interview with officials concerned with the agricultural protocol, the representative of the Ministry of Forestry was asked whether he thought Annex 5 cooperation involving black neck crane eggs would be possible and he replied that he thought that the problems had been solved.

Financial problems on the U.S. side also threaten the future of the program. EPA travel budgets have been cut by more than 50%, and funds for activities conducted within the U.S. are

becoming scarce. Activities scheduled for 1981 probably can be funded but follow on activities may be a problem. A special difficulty is the reduction of health effects research activities at EPA. This bears directly on Annex 1, a project which holds considerable scientific interest for the U.S. side. Should EPA health effects research be transferred to HHS, it may be desirable for HHS to continue the implementation of the activities under Annex 1 as a participant in the environmental agreement.

It is unfortunate that the granting of higher priority to environmental protection work in the PRC comes at a time when the EPA's ability to cooperate may be diminishing. In this situation it may be desirable to explore new forms of government-private sector relationships by which cooperation with China could be furthered. The views of environmental law firms, environmental consulting firms and universities could be more actively solicited. In addition, it would be desirable to explore how opportunities made available by multilateral organizations (e.g. UNDP, UNEP, WWF) could be more fully exploited.

M. Basic Sciences

On December 10, 1980, NSF concluded year long negotiations with the Chinese Academy of Sciences (CAS) and the Chinese Academy of Social Sciences (CASS) by the signing of the Protocol on Cooperation in Basic Sciences with the two academies. An exchange of side letters clarifies interpretations of articles 4 and 6 of the protocol. The protocol is intended to include cooperation in basic engineering and the social sciences as well as basic research in the natural sciences.

On March 19, 1981, the Joint Working Group in Basic Sciences signed an annex for the initial phase of cooperation. The subjects agreed to are archaeology, linguistics, natural products chemistry, astronomy, material sciences (ceramics, metallurgy and polymers), and systems analysis for management. The types of activities for the first year are 10-20 joint research projects and 2-4 jointly organized topical conferences. Program development seminars are planned for subsequent years.

Prior to the signing of the protocol, there had been agreement between the two sides to hold seminars in the fields of natural products chemistry and submicron electronics. The former was successfully completed in Shanghai in October, 1980. The latter was held at Cornell University in April, 1981, after lengthy coordination with DOC and DOD to insure consistency with export control policies. It too was a successful meeting.

In addition to its activities under the protocol, NSF is committing ½ of its $1.5 million China budget to support the exchange activities to be conducted under the National Academy of Sciences-CAS agreement and the Program of Advanced Study and Research in China or "National Program" under the student/scholar exchange agreement. As discussed under the Earthquake Prediction protocol, NSF has participated with USGS in implementing Annexes 3, 4, 5 and 6 of that agreement.

The China program at NSF is a new effort and is somewhat novel in conception. The program has a separate line in the NSF budget and thus is somewhat different from other NSF international programs. Projects under the program will be researcher

initiated with program funding dedicated to support projects that by nature require Chinese collaborators. However, the addition of the NSF program now renders U.S.-PRC cooperation in basic research somewhat more complicated.

The signing of the basic sciences protocol and its initial annex raises two important questions. The first concerns the impact of the new agreement on the CSCPRC-administered National Program, and to a lesser extent, on the NAS-CAS agreement. In principle, the requirement that work supported under the basic sciences protocol be truly collaborative sets the latter agreement apart from the others. However, under tight budgetary conditions, it may be difficult for NSF to continue its support for the programs based at NAS (including the National Program). Should such support be discontinued, the effect would be to focus all natural and social science activities into NSF's realm, leaving only programs in the humanities (not funded by NSF) for the CSCPRC.

The consequences of such a scenario are potentially undesirable for three reasons. First there have been outstanding research projects sponsored by CSCPRC that were not formally collaborative at their inception, and thus might not have been fundable under NSF guidelines. The second reason follows from the first. There is a danger of losing flexibility in dealing with the Chinese side if all U.S. basic research proposals had to meet the "collaboration" guideline. It is quite conceivable that there will be projects of benefit to the U.S., which the Chinese could be persuaded to accept, for which there may not be a ready

Chinese collaborator. The requirement that there be one, therefore, could both limit the number of U.S. initiated projects on the basis of self-imposed restrictions (and thus reduce the bargaining power of the U.S.), and at the same time give the Chinese side additional leverage in refusing projects on the grounds that no suitable collaborator exists.

Finally, the possibility that all basic research activities could wind up in the NSF realm would represent the reduction of desirable redundancy in our S & T relations with China. The CSCPRC has a distinguished record of serving U.S.-PRC relations at times when the political relationship was weaker than it is today, precisely because as a non-governmental body, it has been somewhat less constrained by political trends. Having such a body, particularly one with accumulated expertise and extensive contacts with various sectors of U.S. society involved in S & T relations would still seem to be desirable as an "extra channel" that could prove quite useful in the face of some unforeseen development in the future.

A second important question raised by the basic science protocol is whether it will facilitate greater access to China by U.S. social scientists interested in field work and survey research.

U.S. experience (mainly CSCPRC experience) with the placement of U.S. social scientists for field research has been characterized by time-consuming and often frustrating negotiations with the Chinese side. Nevertheless, until now, these efforts have met with some success.

The Chinese have resisted this access for reasons that are understandable in the short run. Social science research in China, in most fields has long been neglected; Chinese collaborators of distinction are therefore not readily available, and there are genuine bureaucratic problems in trying to facilitate field research for American social scientists. These reasons are now being used to resist further U.S. initiatives in this area. Unfortunately, the least promising "window" for gaining access is the CASS. A more promising approach would be to work through Chinese universities.

It had been hoped by some that the NSF program would offer the U.S. side greater leverage on the field research question, and it remains to be seen whether it will. However, Chinese unwillingness to include work in anthropology in the first annex, as proposed by NSF, is a disappointment in this regard (although it should be noted that NSF refused certain CASS proposals as well). The social science issue may again demonstrate the importance of redundant channels for exchanges in the basic sciences area.

In spite of the fact that the interests of American social scientists may be out of phase with Chinese scholarly development, and that attempts to accommodate those interests create many bureaucratic problems for Chinese officials, it is important for the Chinese side to realize that a lack of progress in this area will result in the alienation from the program of a group from the U.S. academic community that is the program's natural constituency and should be its most vocal supporters.

N. Other Programs and Future Possibilities

In addition to the U.S. agencies participating in the above formal agreements, a number of other agencies have been in contact with their PRC counterparts and have explored to varying degrees areas of possible collaboration. These include the Department of Labor (where a modest program of exchanges of personnel and information has been in progress since March, 1980), the Federal Aviation Administration, the Department of Housing and Urban Development (where draft protocols have been exchanged), and the Nuclear Regulatory Commission (which has drafted an agreement on cooperation in nuclear safety). The Smithsonian Institution has also exchanged personnel with the PRC and has drafted an agreement for cooperation. As noted above, the NAS has formalized its relationship with CAS by the signing of a Memorandum of Understanding on January 24, 1980. The two Academies have agreed to sponsor in 1981 two symposia (on algology and nitrogen fixation), exchange scientists for laboratory visits in the fields of nitrogen fixation, marine biology, insect control and paleontology. These activities on the U.S. side are to be funded by NSF.

Three areas of energy related activities are under consideration at the Department of Energy. In the fossil energy area, there have been discussions with the Chinese which go back to Secretary Schlesinger's visit to China in October, 1978. The DOE feels it is being randomly queried for information from China, and would like to bring some order to the relationship.

It is now considering the possibility of suggesting to the Chinese that they send a delegation to the U.S. to explore the possibilities for cooperation in long-term, high risk projects, and it has solicited the views of the U.S. Embassy on this matter. The DOE also has an interest in participating in a DOC-TDP project on a coal sector study in China. The Chinese, however, have not indicated an interest in the DOC-TDP proposal.

While unquestionably there are grounds for U.S.-PRC cooperation in the fossil energy area, the U.S. government should be wary of entering into agreements without private sector involvement. The fossil energy area is a good opportunity to explore new modes of government-industry cooperation.

DOE has also had preliminary discussions with China on nuclear energy R & D. In response to a PRC initiative, the DOE has proposed a meeting of the two sides to clarify objectives and work toward a program of cooperation. No official response from the Chinese side has yet been received.

Again, this is an area with potential for both cooperation and private sector involvement. The establishment of nuclear power plants in China continues to be a live option in PRC energy policy thinking. There appears to be some disagreement within China, however, as to whether to procure a plant from abroad (reportedly the position of the Ministry of Electric Power) or to develop one indigenously (the position of the nuclear community). Cooperation in this field will also require the reconciliation of U.S. non-proliferation policies with the fact of the PRC's being a nuclear weapons state.

In the areas of fusion and nuclear physics research, a draft agreement has been discussed. Some problems exist relating to the organization of the program and intellectual property considerations, but discussions continue. It is likely that changes in PRC S & T priorities will slow cooperation in these fields.

There have also been discussions of the possibility of cooperation in nuclear physics research. Activities in this field, however, would require further clarification of policies relating to access to DOE laboratories.

Finally, a protocol in the area of water resources should be signed during the first half of 1981. It would provide for cooperation between the Water Resources Division of USGS and the Bureau of Hydrology of the Ministry of Water Conservancy.

IV. Implementation

Because of the relatively short period of time that the bilaterals have been in effect, it is difficult to develop perspective on problems of policy and program implementation. That there are implementation difficulties will be evident in the discussion below, but it is not clear how many of these are normal features of any new cooperative program, how many are due to weaknesses in the organizational arrangements for the program and how many of these are due to defects in the design of the program and in the assumptions of the underlying policy. In an attempt to bring some clarity to the incipient problems of implementation, issues affecting implementation will be classified into three categories: operational, policy management, and design.

A. Operational problems

Operational problems are those faced mainly by the individual technical agencies in the course of carrying out the provisions of the agreements. These include the following:

1. funding - This is a problem facing almost all of the agencies. Although it affects day to day operations, it is in fact more a matter of policy design, and therefore will be discussed under that category below.

2. communications - Problems of communication are of two kinds. The first involve communications between the individual agencies and the Department of State and OSTP. The second involves communications with Chinese counterpart agencies.

Agency perceptions of communications problems were by no means uniform. During the course of interviews, a few agencies complained vigorously about delays in getting "central" (i.e., DOS/OSTP) clearance for communications to China. Other agencies did not raise the issue at all, or if asked, stated that it was not a major problem. Most agencies regarded central clearance as a minor but probably necessary annoyance. Delays were usually found in the early stages of a relationship, such as in the preparation of annexes, and usually disappeared once agreements were signed and policy questions were settled.

No clear pattern of difficulties in communications with Chinese counterparts was evident either. In a few cases there were complaints about delays in Chinese responses, but in most cases, communications seemed to be remarkably good. In one case, however, where the implementation of the protocol required

a greater amount of logistic coordination than most, and where prompt communication would have made implementation easier for the U.S. side, Chinese delays were quite frustrating.

This case is instructive for two reasons. First, the project was more substantive than most, and involved more complex coordination of activities. In addition, the U.S. side perceived its Chinese counterpart agency as lacking the authority to make the varied quick decisions that would have made the project go more smoothly.

Although the Chinese side did not report any serious communications problems, there were indications that improvements could be made in some areas. For instance, there was a lack of understanding about changes in DOE regulations affecting Chinese scientists in U.S. labs. Neither the Chinese nor the U.S. SCIATT had been informed of these changes. More generally, there were indirect suggestions that the Chinese side would have appreciated knowing more about how U.S. counterparts were approaching questions of where the program might go in the future.

As the various bilaterals progress from the annex signing stages to more substantive and often more complex cooperative activities, communications requirements will increase. U.S. agencies who have not found communications to be a problem may discover that they have become one. However, counterbalancing the increased requirements presumably will be a greater mutual knowledge and familiarity that should facilitate communications. One principle to be considered in expanding programs therefore might be that programmatic activities should not exceed the capacity of communications.

Having the proper authority to make decisions and to effect inter-agency clearance and coordination are requirements for agencies on both sides if communications are to remain effective. Not surprisingly, communications also seemed to work best when program coordinators had achieved good personal rapport. Redundant channels of communication are also operating in some of the agreements as a result of greater familiarity, and these presumably are consistent with the U.S. policy objective of fostering a web of relationships between the two sides. While in general these "back channels" are desirable, some monitoring of them is necessary to insure that governmental interests and objectives are being upheld.

Another aspect of communications is the problem of language and translation services. Language differences have been problematic in two areas. First, complaints were registered from some agencies concerning the level of English language abilities of some of the Chinese scientists coming to work in U.S. facilities. Inadequate Chinese on the part of Americans presumably would also be a complaint of the Chinese, although this has not yet surfaced as a problem. The problem of English language ability will gradually disappear, one suspects, as the Chinese educational system becomes more regularized.

A second area where language differences have caused difficulties has been in the supply of interpreters for exchanges of delegations. More often than not, interpreters have come from the Chinese side, and in a few cases, this has raised questions about who should pay for them, or how they should be

counted in arriving at numerically equitable mutual exchanges. As budgets get tight on both sides, this issue is liable to become more visible and contentious.

There is no easy answer to this problem. Most U.S. agencies have made it a point to include Chinese-American scientists in exchange activities, but there is no consensus on the desirability of doing so. Some agencies are satisfied with this arrangement and see it as an economy measure in which they get "double duty" from Chinese American colleagues--as scientists and as interpreters. Other agencies, however, are dissatisfied with this arrangement. In some cases, agency program staffs include individuals with Chinese language capabilities, and the presence of these individuals has undoubtedly facilitated communications. The time has probably come when the issue of interpreters should receive more centralized attention in order to work out a mutually acceptable policy.

3. China expertise - For all agencies, relations with China have been a novel experience. China was a largely unknown country for most agency personnel. Yet S & T cooperation with China had become an important aspect of U.S. China policy which agencies were expected to help implement. Ideally, each of the agencies should have had in house China expertise to help carry out its mission. Approximately one-third of the agencies have made the effort to add a staff member with Chinese language and area studies capabilities. In some of the others, Chinese-American scientists already employed by the agencies have been recruited into roles as "China experts."

While the language and area skills of the China expert are clearly desirable to the agencies, most would find it difficult to justify hiring an individual whose sole responsibility would be China--the individual would have to have the additional qualities needed to make him/her a suitable program officer for discharging other responsibilities as well. It is clearly possible to find such people. Agencies who find that the pace of their activities with China is quickening should be encouraged to do so.

It would probably be a mistake, however, to think that the addition of an individual with language and area studies capabilities, or the designation of Chinese Americans as Chinese experts will meet all of the needs of the agencies for knowledge and analysis of China relevant to their missions. This issue will be discussed further below.

5. inter-agency coordination - Inter-agency coordination is in one sense a matter of policy management and will be discussed further in that connection below. There are also a few coordination issues that pertain to the operational level, however. First, some on the U.S. side believe that a lack of inter-agency coordination on the Chinese side has been a problem for the implementation of some of the agreements, and is likely to be a factor limiting the expansion of the program. As the U.S. side has come to learn more about the PRC S & T community, it is discovering that the expertise most compatible with its interests is not always in the bureaucratic system with which it has an agreement.

On the U.S. side, other than the problems at USGS with the earth sciences agreement which are really "intra-agency," the only other serious problem of inter-agency coordination has been in the area of export controls (to be discussed below). The most notable activities where coordination is essential are in the hydropower agreement and in the earthquake prediction agreement. In both, coordination seems to be working reasonably well. In addition, there are a number of areas where there are overlaps of interests that will require cooperation. These include environmental causes of cancer (EPA and HHS), pest management (EPA-USDA), aquaculture (USDA-NOAA), and Yangtze estuary studies (NOAA-COE).

5. modes of cooperation - The DOS's RFP included a question about the suitability of present modes of cooperation. The central implementation problem relating to modes of cooperation pertains to the uneven levels of scientific development in the two countries, and U.S. policy regarding the funding of cooperative activities. Some U.S. agencies have expressed the view that true reciprocity in exchanges is difficult to achieve since Chinese counterparts are often not at the same scientific level. Therefore, there is often a <u>de facto</u> training component (whether called that or not) in the agreements, which if not paid for by the Chinese side, in effect violates U.S. policy guidelines.

A second issue relating to modes of cooperation is that there have been more exchanges of delegations and less cooperative research than many on the American and some on the Chinese side would prefer. This problem is characteristic of a new

relationship, however, and presumably will solve itself as the two sides get to know each other better. The question of mutually satisfactory modes of cooperation has important implications for the reciprocity of the overall U.S.-PRC S & T relationship, and therefore warrants continuing monitoring.

6. access - For a number of agencies, the greatest appeal for cooperative activities in China is in the opportunities it offers for access to phenomena and data that are unique to China. While problems of access thus far have not been numerous, some problems have arisen. One as noted above, pertained to the choice of the most scientifically interesting areas of the East China Sea for the marine sedimentation project. While this case generated some misunderstandings initially (responsibility for which does not rest entirely with the Chinese), the access question no longer seems to be an issue.

Another case has been in germplasm exchange, where the American side has been denied what is regarded as essential, access to field sites. The Chinese have agreed to try to solve this problem. In other areas where problems of access could lead to misunderstandings (e.g., in public health) the Chinese have been cooperative. The major exception, and one that is likely to produce hard feelings, as noted above, is the social sciences field work problem.

In a few cases the U.S. has limited the access of Chinese to U.S. facilities. The most notable case is in the metrology area where NBS facilities at Boulder, Colo., were ruled off limits to Chinese on the insistence of the DOD.

7. social hosting - A final notable operational problem pertains to providing social occasions for Chinese delegations by American hosts. Typically American delegations to China are treated to elaborate banquets by Chinese hosts. Americans feel obliged to reciprocate, but cannot use government funds for this purpose. As a result, the costs of social hosting are often borne by Americans out of personal funds, and in a few cases, through the use of contract funds. This problem is likely to diminish as the program moves from the delegation exchange phase to longer term mutual visits and as both sides come to know each other's social mores better.

B. Problems of Policy Management

Problems of policy management are understood to include the problems of insuring that operational or program activities are consistent with the letter and spirit of U.S. policy toward China, and with the intent of the U.S.-PRC Joint Commission. Whereas some problems of policy management can be identified at the level of the individual agencies, it is at the OSTP and DOS/OES levels that policy management problems are most likely to be found.

U.S.-PRC S & T relations had an unusually high degree of policy salience from mid-1978 to the end of 1980. S & T relations conducted by the CSCPRC and other agents prior to normalization made significant contributions to the process of moving toward normalization, and the symbolism of S & T cooperation pervaded events just prior to and immediately after normalization.

This was particularly true during the visit of Deng Xiaoping to the U.S. in January, 1979. The possibilities for beneficial S & T cooperation were also very much in the minds of those responsible for China policy during the Carter administration. As a result, the S & T agreement with China seemingly had much greater political significance than S & T agreements sometimes have with other nations. The particular form of the agreement (i.e., having a central government-government umbrella agreement followed by agency-agency protocols) and the formal structure of policy management (centralized in the OSTP with the President's Science Adviser actively involved in the program) attests to the importance attached to S & T relations by the Carter administration.

The implementation of all such agreements, however, ultimately rests with operational agencies. In all such agreements, there are also the dangers that as the substantive activities devolve to the agencies, policy purpose is diluted, and coordinated action in support of that purpose becomes more difficult. In the U.S.-PRC agreement, efforts were made to avoid or minimize such dangers by requiring fairly strict central clearance procedures for all agency actions, by having a full-time member of the Department of State with responsibility to oversee the agreement, and by organizing the Executive Secretary's Committee of China project coordinators from all of the participating agencies. Nevertheless, certain problems of policy management are evident.

These problems are interrelated and involve monitoring and analysis, and briefing and debriefing activities. While it has been possible for the policy management staff at OSTP and OES to monitor the development of the program up to a point, it appears that the monitoring function has not been performed as well as it might have been.

The amount of information generated by activities under the bilaterals would in principle strain the ability of a single policy manager to keep up with. Fortunately, in one sense, the actual amount of information that has been generated and retained in the program is not beyond the abilities of a hard working and conscientious official. Unfortunately, however, the information reaching the policy manager is not always of the quality needed for the task. This investigator has been struck by the considerable information loss in the program. Requests to agency officians for trip reports, for instance, were often met with replies that none had been written. Documents from agencies that would offer perspective on the program by relating clear statements of agency objectives to assessments of Chinese capabilities and needs, and to U.S. policy goals are rare. The quality of agency reports to the Executive Secretary's Committee (which have been incorporated in the DOS "Title 5" reports to Congress) attests to this deficiency.

In short, there is not a great deal of high quality written material reaching the DOS from the agencies. Most of what is written is in the form of communications with China that require clearance. There is, of course, unwritten information in the

form of telephone calls and oral debriefing sessions, but these do not become part of the written record unless someone writes them down. As individuals rotate through positions, these oral communications are likely to be lost also.

The usefulness of monitoring activities is related to how the information gained from monitoring fits into ongoing policy review, evaluation and analysis activities. The latter gives significance to information and provides cues as to its importance. The fact that DOS felt it necessary to issue an RFP for this study is prima facie evidence that in house analytic capabilities are limited. It is also evident that DOS/OES is understaffed for this function. While some informal analysis does occur as a result of OES interactions with other parts of the Department, particularly the China desk, the prime concern of the latter is not necessarily S & T relations or Chinese S & T activities. Indeed, the only place where monitoring and analysis are combined within the government is at the CIA, but there may be institutional reasons why reliance solely on the CIA for analysis may be less than fully desirable.

Weaknesses in combined monitoring-analysis functions also influence the efficacy of the policy manager in briefing and debriefing situations. While some of the agencies may be relatively indifferent about China briefings, a number of them felt that having a more wholistic view of contemporary China would provide a needed sense of context for their activities. The ability to provide regular briefings, however, is a function of analytic capabilities. Similarly, making the most out of debriefing

sessions for returned delegations also goes back to the discussion above about the relationship between information and analysis. The inclusion of a representative of the CIA into the briefing/debriefing aspects of the policy management process has been a useful addition, but again the different institutional purposes of the CIA, the DOS and the agencies should be kept in mind in evaluating policy management problems.

A policy management problem of a different sort is the cultivation of constituencies in support of the S & T cooperation program. Three in particular are notable: Congress, the university community and the business community. Relations with Congress were outside the purview of this study. In one sense, relations with universities do not seem to be a problem since most of the bilaterals involve some university participation, and opportunities for university relations outside the S & T agreement are numerous. On the other hand, the study did uncover some uneasiness about the relationship of the program to university activities. This uneasiness ranged from concerns that university scientists were not as involved in the program as they might be and as a result the Chinese may not be in contact with the best science the U.S. has to offer, to concerns that the bilaterals were absorbing funds that could be used for other more productive forms of cooperation with China. While these concerns may be somewhat unfounded, the fact that there are some perceptions that the relations are not quite right is significant. At the least, the existence of these perceptions implies the need for providing more information about the program to the university community, and perhaps more active effort to create a liaison mechanism. One

segment of the university community--those concerned with studies of contemporary China--represents a special case and will be discussed separately below.

Of particular interest here is the business community. It was an explicit objective of policy that the bilaterals contribute to commercial opportunities. While expectations of these have been deflated largely by changes in Chinese economic policy, there are perceptions in the business community that not only have the bilaterals not contributed to commerce, in some cases (e.g., the hydropower agreement) they have frustrated it. Without attempting to judge the merits of that opinion here, it is necessary to point out that in general, active efforts to cultivate the support of the private sector are not as numerous as they could be. While the business community is represented on the Joint Commission, and while some of the bilaterals have involved government-industry cooperation, ongoing, systematic efforts to involve the private sector are not in evidence. This question will be discussed further in the context of recommendations.

C. Problems of Design

In many ways the U.S.-PRC S & T agreement represented an interesting and ambitious new departure in the use of S & T as instruments of foreign policy. As we have noted earlier in this report, S & T figured prominently in the movement toward normalization. S & T development was given high priority in PRC modernization policies and the U.S. was preeminent in many of the

fields China chose for priority attention. Accordingly the S & T agreement enjoyed considerable political significance on the U.S. side, more in fact than had been the case with prior S & T agreements with most other countries.

In spite of--or perhaps because of--this political prominence, certain internal contradictions in the program have become evident. There was general agreement that the level of U.S. S & T was considerably above that of the PRC in most areas. The immediate scientific benefits to the U.S. side therefore were expected to be few (which has not necessarily turned out to be the case). Yet, the program was not intended to be a technical assistance effort (even though one of its objectives was to aid Chinese S & T development). The White House insisted that funding of projects be done on the basis of mutuality, or if that were not possible, on the basis of "benefiting side pays." This approach to funding is one of the major design problems of the program.

For most of the agencies, participation in relations with China (and indeed all foreign activities) have to be funded out of the normal operational budget. Not surprisingly, therefore, most agencies complained about funding arrangements for the program. As indicated above, this approach to funding means that discretionary decisions by agency officials are critically important in determining the level or extent of activities with China. During the Carter administration, these officials interpreted White House objectives to mean that in the exercise of discretion, programs with China should be favored. This high

level interest in China relations predisposed agency officials to find the necessary funds in their budgets. In addition, many of these officials traveled to China, were favorably impressed, and began to develop sympathy for cooperative activities with the Chinese. With the change of administrations, it is neither clear what White House/Department of State intentions will be, nor is it clear that the new incumbents in agency decision making positions will have the same sympathies for China programs as their predecessors, particularly in the face of severe budget cuts.

Funding arrangements in many of the protocols and annexes are vaguely stated. This has led to some confusion and misunderstanding with the Chinese. The Chinese have not accepted the concept of "benefiting side pays" as a funding formula, although they have clearly been willing to pay on a cost reimbursible basis for projects where the benefits accrue only to them. The concept of benefiting side is viewed by the Chinese as too ambiguous to be of use. The Chinese assume that the U.S. must perceive some benefit; otherwise it wouldn't want to enter into agreements. Furthermore, it is not clear whether the balance of benefits should be calculated on an intra-agency or cross-agency basis.

Ambiguity over funding formulae has been most notable in the hydropower agreement. To move the implementation of this protocol forward it was necessary to go outside normal agency budgets and draw on funds from the Trade and Development Program. But even with these funds, an impasse developed between the two

sides over Article 4 of the agreement which has resulted in the indefinite delay of a delegation from China to the Bonneville Power Authority to investigate long distance high voltage transmission technology. In this case the amount at issue was a mere $6,500-$7,000, but the question of who should pay it became a matter of principle for the two sides.

Although the hydro case has been the most notable example of a problem arising from funding ambiguity, less dramatic instances have arisen in situations where Chinese come to work in U.S. facilities. Since the Chinese scientists are often not up to the standards of their American counterparts, it is difficult to justify covering their costs on a receiving side pays bases (which the Chinese prefer), when U.S. policy is for the benefiting side to pay in cases where there is not mutual benefit. While this is a problem of funding, it is also due in part to the fact that the American side doesn't know as much as it would like about the individuals in question. In relations with other countries, informal scientific networks generate the necessary information about the qualifications and backgrounds of candidates for placement in American facilities. Presumably as Chinese scientific development progresses, and the two scientific communities learn more about each other, the U.S. can be more discriminating in deciding whom to accept, and whether the visits should be understood as training exercises or mutually beneficial research activities.

A second area where design problems in the agreement are notable is export controls policy, especially as it relates to

the space and high energy physics agreements. Although Chinese economic retrenchment is making these problems less pressing at the moment, it is instructive to note them nevertheless.

In both the space and HEP agreements, full implementation would have required the transfer of very advanced technology to China. In the case of the space agreement, there are indications that some high U.S. officials did not know how advanced the technology of LANDSAT D ground station was when the offer to facilitate the sale of one was made. Resistance to the offer from within the government suggests that there had been a failure of effective inter-agency coordination prior to approaching the Chinese.

Failures of inter-agency coordination are also evident in the HEP case. In spite of high level policy changes on exports to China made in 1980, resistance to the policy was encountered at lower levels in the bureaucracy. The HEP agreement required that a variety of advanced instruments and devices for the BPS be procured in the U.S. for export to China. Export licenses on most of what has been procured thus far have not been granted.

As indicated, budgetary cutbacks in China have made the export control issue in these two agreements less pressing. However, export control issues are bound to arise in the future. The U.S. seems to lack a clear policy for dealing with them. The changes in policy in 1980 were intended to liberalize the export license procedure to China considerably. However, not only were these new initiatives resisted, there still seems to be too much ambiguity in the decisional criteria for the policy to be implemented, even if the resistance were overcome.

The two problems of funding and export controls are treated here as the result of flaws in the underlying design of the agreement. Given the high political visibility of the agreement and the fact that the U.S. had as an objective the strengthening of Chinese S & T capabilities, the approaches taken on the funding and export control questions seem somewhat inappropriate. In the latter, while there was an effort to liberalize exports, the effort appears to have been somewhat uncoordinated and inattentive to problems of implementation.

With regard to funding, a case could be made that the approach taken followed well established principles of international S & T collaboration. According to this view, true mutuality of benefits should be the objective, and guidelines on funding should be drawn so as to enforce this principle. Agencies should not have access to slack resources or special funding, since this could lead to less discriminating judgments about what is truly beneficial to them.

There are two difficulties with this view when applied to China. First, the uneven levels of S & T development make the search for mutuality more difficult, though not impossible. More importantly, however, the funding guidelines limit the abilits of the agencies to be as forthcoming as they might be in working toward the stated objective of assisting in PRC S & T development.

V. Summary Assessment

It is no easy task to reach definitive judgments about a program which has become as broad and diverse as this one.

Criteria such as "mutual benefit" are difficult to operationalize, particularly since "benefit" must include political as well as scientific and technological aspects. In addition, the life of the program is still rather short, and by its very nature, realistic indications of benefits and costs will only become more evident with the passage of time.

Both the U.S. and China understood at the outset that the program had more than scientific significance. Both sides understood that it was one component of a process of building political relations between the two countries, and of overcoming the effects of 30 years of mutual isolation and of markedly different social systems. Realistically, S & T relations are not a substitute for political relations, and the former can only be conducted when the latter are viable. But it seems that both sides felt that the former could strengthen the latter.

In the short run, it is difficult to judge whether S & T ties have strengthened the political relationship, but a tentative judgment is that it has. This judgment is based upon three considerations. First there is no doubt that the program has contributed to better mutual understanding, the development of personal friendships, and to a certain amount of "people to people" contact. As one American official pointed out concerning the latter, the impressions created by Chinese delegations on taxi drivers, hotel employees and others who service their visits is not insignificant. More importantly, perhaps, the program has led to the active interaction of officials of the two governments, and has forced those officials to consider the interests of the other government in their own policy processes. Finally, and

following from the above, there is evidence that both sides have made the kinds of conscientious efforts to accommodate those interests, which would indicate progress toward a political partnership.

The American side will have no difficulty in recognizing what it considers to be the accommodations it has made, but it is important to recognize that the Chinese side feels it has made them as well. These include such things as access to factory management practices, access to rare and valuable species of flora and fauna, the provision of special housing and facilities for American scientists, the acceptance of U.S. cruise objectives in the marine sedimentation study and promised access to Chinese populations in areas of health research. To Americans, these may seem like small concessions that would of course be expected of a cooperating partner. However, given Chinese conditions of extensive bureaucratism, fragmented administrative jurisdictions and the multiple disruptive legacies of the Cultural Revolution years, the generally favorable impression of cooperativeness which most American officials have reported came as a result of real efforts on the part of Chinese counterparts.

There have, of course, been problems and irritations on both sides as well. But it is perhaps a measure of the progress made, that these have not been allowed to permanently sour the relationship. They have, in general, been handled in a spirit of friendship and cooperation instead.

The progress on the level of political relations would not be possible without some sense of mutual benefit on the level

of S & T cooperation itself. It would be a mistake for the American side to see the benefits accruing only to China, and it is regrettable that there has developed among some Americans who are concerned with U.S.-PRC relations, but who are not intimately familiar with the details of the program, a cynical view that this is in fact the case. While the U.S. side has reason to be disappointed that the program has not yielded the commercial benefits that had been anticipated, a number of scientific benefits have emerged that perhaps were not anticipated in the original calculation of "balance of benefits." These include the areas of agriculture, seismology, meteorology, and oceanography, with expected benefits in earth sciences, health and environmental studies. While there are variations in the levels of U.S. interests within and among these fields, it is clear that U.S. interests are sufficiently high to make efforts to characterize the program as a technical assistance effort a serious distortion of what is going on.

A standard approach to evaluating the quality of scientific cooperation is, of course, to judge the quality of the scientific papers that result. Unfortunately, it is still too early to see this result, but the expectation of favorable reviews from the scientific community is certainly one of the factors contributing to the enthusiasm for the project shown by U.S. scientists who have actually been engaged in substantive research with the Chinese.

The question of benefits to the PRC side, and the appropriateness of the program to PRC needs is discussed above. What has not been addressed so far is the question of PRC expectations

and the danger of a "backlash" should those expectations not be realized.

At one level, the question of expectations can be readily answered. It is fairly safe to say that expectations of those Chinese who are close to and familiar with the program are not inflated or otherwise unrealistic. Indeed, it has become quite clear to Chinese officials close to the program that in cooperation with the U.S. (and in comparison with cooperation with other OECD countries) one doesn't get something for nothing, and therefore there is no reason to allow expectations to soar.

The more difficult question is whether politically powerful Chinese who are not close to the program have inflated expectations which could lead to disappointment and resentment if they are not realized. One could develop an argument that such people exist and that such a danger is real. Such an argument need not play a major role in assessing the S & T program, however, for two reasons. First, it is unlikely that the S & T program by itself would raise unrealistic expectations. The S & T program as part of the larger U.S.-PRC strategic relationship could, however. But in this case the overarching political, and particularly military, relations will be determining. Second, inflated expectations about U.S.-PRC S & T cooperation, if they exist, are China's problems, not ours. If such expectations exist, they are presumably part of a view which sees cooperation with the U.S. as an elixir which will rapidly cure the dysfunctions of PRC S & T development. This would be, in its ignorance of actual Chinese conditions, a regrettable view. In the final

analysis, however, the existence of such a view does not carry any specific implications for U.S. conduct of the relationship. It certainly would not imply that the relationship should be reduced or terminated, or even that the U.S. has a special responsibility to disabuse those who might hold it.

There is a more serious question of expectations, however, that requires the attention of the new administration. This is not a question of inflated expectations, but rather one of disappointing those with realistic expectations. As suggested at several places above, while the Chinese who are responsible for the program certainly seek to get as much benefit for China from it as possible, they also give evidence of seeing it from the perspective of the development of a political and scientific relationship that will be enduring. The program therefore has symbolic political importance to the Chinese side, a symbolic importance certainly cultivated by the U.S. side during the Carter Administration.

For this reason, unless the Reagan Administration intends to alter fundamentally U.S. China policy, the symbolic importance of the program should be recognized and substantive cooperation in keeping with the level of Chinese expectations should be supported. At the least, a strong endorsement of the program backed with a modest budgetary commitment to it, would be a useful signal that the new administration takes the political relationship with the PRC seriously. More active efforts to expand the program, perhaps with a creative, more concessionary approach to funding, could be a useful way to signal U.S. interests in moving

the political relationship forward, and would be an alternative to more controversial (and probably less desirable) "signals" such as arms sales.

I have already mentioned problems of information loss in the conduct of the program. In conducting the study, I could not escape the impression that the written record supporting the program was rather weak. Analytical capabilities are not well developed at either the operational or policy management levels. Of course, the most egregious case of squandered opportunities to generate information from the program is the total lack of interest on the part of the Commerce Department to involve specialists on the Chinese economy and Chinese management in the Dalian program. It would be rather inconceivable if a country like Japan undertook a Dalian-type project and ignored the intellectual resources and expertise that would help produce maximum benefit to the Japanese. In the U.S., such oversights are becoming a national trait.

Information loss, and loss of opportunities to generate information, are also evident in the approach the U.S. has taken to the position of the science attache in the embassy in Beijing. While an experienced scientist was chosen for the position, the definition of his duties and the failure to provide support staff has meant that the value of the attache's experience and expertise is not being realized. There is no point to select a senior scientist for this position if he is only expected to administer the program. If in addition, the science attache's time is spent on administrative details because of a lack of

secretarial support, one can't expect him to make the kinds of extensive contacts among Chinese S & T personnel that would permit expert assessments of Chinese scientific research and technological capabilities. It would be a mistake to assume that generalist commercial officers could make such assessments. Finally, there are important questions of how the science attache's reports are received and used in Washington, and whether he is able to serve as a science adviser to the U.S. ambassador. However, it may be too soon to reach judgments on these questions.

It is interesting to compare the Swedish approach to the science attache's role with that of the U.S. The former has a professional staff of five, and its activities articulate directly with Swedish commercial interests. In addition to reporting back to the Swedish government in Stockholm, the science attache also shares information on a systematic basis with the Research Policy Program of the University of Lund.

As a result of these arrangements, the science attache has the time to visit Chinese research institutes and factories, and the information gained from such visits is fed back to Lund where it is subject to systematic analysis by a professional staff. When the Swedish efforts are compared with those of the U.S., it is difficult to escape the conclusion that Sweden takes its S & T relations with China more seriously than does the U.S. (in spite of the much larger size of the U.S. program) and more generally, is more attentive to the role of S & T in foreign policy and international trade.

A strategy to overcome 30 years of mutual hostility and misunderstandings could be based on assumptions of caution, gradualness and the maintenance of a low profile. The Carter Administration, in general, did not follow this strategy. Its strategy instead was to mobilize a broad range of American interests including, of course, the technical agencies of the U.S. government, to seek contacts with the PRC and initiate a variety of programmatic activities. Interestingly, behavior on the Chinese side showed certain parallels.

As suggested at various points in this report, it was not possible to plan for all of the contingencies once the mobilization took place, and although efforts were made to modulate the relationship through administrative means, these efforts had mixed results. In addition, while there was a conscious effort to create a constituency for the new China relationship, doubts persisted about the conduct of Carter Administration China policy in the most important constituency of all, the U.S. Congress. As a result, once the initial mobilization was effected, the political grounds for follow-through support activities were not as firm as they might have been. This is particularly true with regard to funding and export controls.

One of the conclusions of this study is that in spite of the very great differences between the two countries, to a remarkable extent the mobilization strategy has been successful. A wide variety of mutually beneficial relationships in S & T have been established, and it is unlikely that they would have been had a more cautious, low profile approach been followed. For instance, in the oceanography area, had there not been the political

entrepreneurship that characterizes the mobilization strategy, it is quite conceivable that both sides would now be in a protracted negotiation over details for possible projects instead of sharing exciting new knowledge from a successfully completed first cruise, and planning for future activities on the basis of mutual understandings that did not exist three years ago. The Dalian project, which has not escaped criticism in this report, is another example of how political entrepreneurs were able to get a valuable and interesting project started in spite of the fact that numerous reasons could be mustered for a more cautious approach. Other examples could be cited.

One difference between political and private entrepreneurship, however, is that the consequences of and responsibilities stemming from the entrepreneurial act for the former are often easier to evade. With a change of administrations, the problem of confronting consequences and dealing with responsibilities becomes further blurred. Yet a failure to follow through on initiatives that have already been taken by the U.S. government would create the impression that the U.S. is afflicted with the fickleness of the immature.

The Chinese have indicated their overall satisfaction with the program of S & T cooperation, and in most areas, find that it is consistent with their interests in S & T development. They have also expressed the view that they regard the program as an important part of the overall relationship. As a result, they believe they have made accommodations to U.S. interests in some projects that are not as close to their interests as they might

be, and in some situations where established Chinese practices would have prevented cooperation had they not been changed.

The program has also produced beneficial and scientifically interesting opportunities for the U.S. side, which are perhaps not as widely known as they might be. However, after taking many of the initiatives in the program, most of which have been remarkably successful, the U.S. side seems a bit unsure of what the overall U.S.-PRC relationship means to the U.S., where it would like to see the relationship going, and what the role of S & T cooperation in the overall relationship should be.

The purpose of this study was not to evaluate U.S. China policy, but was rather to assess the appropriateness of the S & T program for the interests of both countries, and to assess the degree to which it is consistent with U.S. China policy as defined by the Carter Administration. The conclusion is that within the constraints affecting both countries, and with due regard to differences between the two political and economic systems, the program has been appropriate, and has been a significant instrument of policy for the objectives defined. But as the discussion above indicates, the program is not without problems. The final section of the report offers suggestions for ameliorating some of them.

VI. Recommendations

Since one of the central conclusions of this study is that the program for S & T cooperation has served the interests of both sides, the main recommendation is that the program be

continued at least at roughly current levels. A significant expansion of the program at this time would not be appropriate in light of the financial strictures both sides now feel, unless creative new approaches to financing are adopted. This, however, would require renewed momentum in the political relationship. Should the U.S. clarify its China policy to a greater extent than it has done as of this writing, and decide that U.S.-PRC S & T cooperation is in the long term interests of the two countries (a view which this investigator endorses), one approach to providing greater flexibility in funding might be the creation of an endowment fund for S & T cooperation with contributions from both sides (including perhaps the U.S. private sector). While this approach has not been widely used in U.S. foreign relations in S & T, a version of it supports U.S.-Israel cooperative programs, and it might have considerable political significance (as well as operational usefulness) in relations with China, should both sides agree that the relationship warrants a special approach.

On the assumption that original approaches to funding are unlikely for the foreseeable future, it is nevertheless desirable and financially possible to carry to completion the current items in the various work programs. In addition, to maintain momentum, as current activities are completed, U.S. agencies should be encouraged to initiate some new activities in keeping with their interests and resources, and to be receptive to PRC initiatives. While it is neither possible nor desirable to limit U.S.-PRC S & T relations to the bilaterals, the latter

have served as an important bridge between the two scientific communities and the technical agencies of the two countries. It is important to keep the bridge in good repair for a few more years at least, while individuals and groups on both sides discover new and perhaps more viable modes of interaction.

Budget constraints on both sides will be significant obstacles to expanded cooperation for the foreseeable future. There are a number of implications that stem from this fact. First, the U.S. government cannot possibly anticipate all the resources in the U.S. that might be available to support U.S.-PRC S & T cooperation. It is therefore desirable to make greater efforts to involve non-governmental parties in the bilaterals in order to facilitate the matching of opportunities with resources. This point is discussed further below.

Second, tight budgets will and should force greater scrutiny of the program with an idea toward reassessing benefits. Under conditions of scarcity, the concept of "benefit" is likely to be subject to a more rigorous definition. It is appropriate under such circumstances for the U.S. to maintain its "benefiting side pays" position in spite of the fact that China's other partners in S & T cooperation are more generous. However, the U.S. should offer the PRC a detailed rationale for this position, emphasizing U.S. practices in its relations with other countries. In addition, the use of "benefiting side pays" in communications with the Chinese should be discontinued. The concept has not been acceptable to the PRC and is inherently ambiguous. There seems to be no reason not to substitute instead such concepts as "reimbursable" and "non-reimbursable"

forms of cooperation. This terminology is in fact used in some of the agreements and is used in agreements with other countries. The shift in terminology should, however, be accompanied by a change in the practice of writing agreements. Future agreements, including where feasible, the annual work programs under existing protocols, should provide more detailed statements of how the projects to be performed are to be financed.

In addition, the U.S. should make an extra effort to explore alternative means for funding projects of interest to the PRC but not of direct benefit to the U.S. This might include U.S. support for PRC initiatives toward international funding agencies. It might also include creative new approaches towards limited concessionary financing on a bilateral basis. Creative approaches are particularly warranged in the area of PRC hydropower development, where the long term benefits to both sides are substantial, but where short term funding problems threaten to stymie the relationship.

Third, in spite of tight budgets and approaches to cooperation on the basis of the benefiting side formula, the continuation of the program at present levels will be difficult if modest sums are not available for investments in the program. The U.S. practice of funding activities out of existing agency budgets (with the few exceptions noted) has the advantage of enforcing discipline on the agencies in their assessments of the value of PRC activities to them. It is also a useful device for protecting funds for activities with the PRC from zealous budget cutters. It is, however, a poor way to account for

the total benefits and costs of the S & T program and tends to undervalue the importance of investments needed to realize full benefits. A particular form of investment that is absolutely necessary for the program is travel. While there may have been excess slack in travel budgets for the government as a whole, it is difficult to see how the continuation and growth of the China program (and international scientific activities generally) can occur without adequate travel funds. It is therefore desirable to set funds aside for essential PRC program travel, either within the various agencies, or in a special account controlled by the DOS.

Finally, the question of funding should be put on the agenda of the next Joint Commission meeting. The approach should be less to initiate negotiations than to explore possibilities. Since both sides are experiencing economic difficulties, the time is right for a frank exchange of views on how those difficulties are likely to constrain participation in the program, and on how improvements can be made in the financial basis of the program.

Another conclusion of the study is that the relationship between the U.S. government and the private sector is not as good as it should be. In a few areas, it is bad. In most others it is relatively non-existent. The commercial benefits of the program were probably overestimated at the outset, and hopes for commerce on some of the "big ticket" items have been dashed by PRC economic retrenchment.

The time is now right for a rethinking on the U.S. side of the relationship between bilateral S & T activities and trade

promotion. Three recommendations are offered in this regard. First, trade promotion interests should be represented at what I have called the policy management level. Concretely this would involve including a representative with trade promotion responsibilities from the DOC on the Executive Secretary's Committee, and a more active liaison between DOC and DOS/OES in this area. Without too much difficulty, one could imagine how the trade promotion resources of the DOC could be coordinated more with the bilaterals. For instance, Chinese participants in the bilaterals could be presented specially prepared literature in Chinese on private sector activities paralleling those in the government and on the type of instrumentation and support services for scientific research available from the private sector. Special meetings between Chinese scientists and representatives of the private sector could be hosted by DOC, and appropriately defined and organized tours of private sector facilities could be organized.

Second, individual agencies with responsibilities for protocol implementation should attempt to formalize their relationships with the private sector such that private sector views on activities with the PRC are routinely incorporated into agency planning. It may not be possible or appropriate for all agencies to emulate the USDA model, but USDA experience should be studied. Perhaps the most pressing area where more formalized consultations are needed is in hydropower.

Finally, some resolution must be brought to the export control problem. In the course of the study, there was some

indirect evidence that the export control process, and the uncertainties surrounding it, have had an anticipatory impact on Chinese behavior. That is, the mere existence of the controls deterred Chinese pursuit of commercial relations growing out of the bilaterals.

There is clearly no easy solution to export control problems, but in the context of the S & T bilaterals, there is a need for greater coordination between agencies who are initiating activities with the PRC, officials responsible for China policy, officials responsible for making export license decisions and the private sector. To the extent possible, export control questions pertaining to cooperative agreements should be resolved before the agreement is signed, and once signed, the agreements should serve to facilitate the licensing process.

The relationship between the conduct of most of the bilaterals and the university community in general does not in fact seem to be a major problem, although as noted above, there are perceptions that the relationship is not as good as it might be. In a few cases there may be underlying competitive tensions between university and government scientists that could under certain conditions become problematic. The problem of coordinating university calendars, grant cycles and agency activities may also inhibit a more effective coordination of university activities and the bilaterals. One way that the national resources held at universities might be exploited more fully would be to involve a body like the CSCPRC, with extensive university contacts, more actively in the planning and execution of activities under the bilaterals. Again, USDA

experience may also be of relevance to to other agencies and deserves attention.

Another conclusion of the study is that the information benefits to the U.S. from the program are not as great as they should be. There is clearly a need for more centralized collection and analysis of information and for a mechanism to insure that analysis reaches policy makers who need it. First, the participating agencies should enforce a requirement that all program related travel must be followed by a trip report. A standard reporting form should be available as an optional mode of reporting. Copies of all trip reports should be sent to the Executive Secretary in OES. Since it is unlikely that OES will have the capability for sustained analysis, information generated in the program should routinely be made available to interested parties outside the government. Some of the information may be classified, but classification need not be a major problem since usually the information needing protection can be readily excerpted.

It may be desirable to foster this analytic activity on a contract basis. Again, the use of CSCPRC comes to mind since they have some relevant experience and could develop the needed capability. However, low-cost non-contractual possibilities also exist. There are non-governmental parties with professional interests in China who would be happy to receive trip reports and reports from the SCIATT, and who would do the analysis as part of ongoing professional research activities.

The analysis function could more fully serve the U.S.-PRC relationship if there were more complete information on Chinese

policy thinking and processes. The Chinese side should recognize that it is in its interest to share information about its science and technology policies and institutional arrangements for R & D. Given the importance of S & T relations for the overall relationship, it would be useful to both sides if a small joint science policy studies group were established that would produce an annual report to be shared with all participating agencies.

A final area of findings involves the articulation of the S & T program with China policy more generally. Four interrelated points can be made. First, there appears to be on the U.S. side a lack of long term vision in both China policy generally and the S & T program particularly. While short term benefits to both sides can be readily demonstrated, by staying the course, the future holds even more substantial political and scientific benefits. Yet, the U.S. seems to resist taking the longer term view, and seems unclear about how the PRC connection fits into its long term interests. As a result, the inevitable short term irritations and frustrations, and perceptions of Chinese domestic problems has produced a cynicism that is not conducive to the progressive conduct of the S & T relationship. Public "trendiness" perhaps has had too much of an impact on officials whose duty it is to rise above "trendiness" in order to chart a course which will serve the public interest over the long run.

A related problem is the uncertain definition of the PRC in U.S. policy thinking and policy procedures. The U.S. seems

unable or unwilling to clarify the status of the PRC for the purposes of implementing policy within the context of U.S. laws. This is a problem that has concrete consequences for such questions as how PRC scientists are to be treated in government supported laboratories, how export license applications are treated, and how the question of concessionary aid and Exim credits should be approached.

A third problem is that public awareness and understanding of the S & T programs is low. This is true even for such "attentive publics" as commercial firms wishing to trade with China (often in S & T related products) and the professional "China community." It is neither necessary nor desirable to engage in elaborate public relations or make exaggerated claims for the program, but more attention to educating the public as to the value of the program does seem warranted.

A final problem uncovered is the tendency on the U.S. side to undervalue the role of the S & T program in U.S.-PRC relations. This conclusion is somewhat ironic in light of the role of S & T in U.S.-PRC normalization, but is an understandable reflection of the unfortunately low status accorded S & T as an instrument of U.S. foreign policy generally. The initial weak support provided the SCIATT in Beijing and the failure to develop in house analytic capabilities on the conduct of the program are symptomatic of this orientation. The failure to prepare for the linking of S & T and export promotion is also indicative of failures to perceive how the comparative advantage of the U.S. can be used to advance U.S. interests.

In light of China's current situation, including the emphasis now being placed on contract research, an example of a creative new initiative to use S & T to support U.S.-PRC relations while also involving the private sector would be to work with the Chinese side in developing a model contract research institute. U.S. experience with the establishment of the highly successful Korean Institute for Science and Technology (KIST) might provide inspiration, but would not necessarily represent a model to be emulated. The work of such an institute might initially be oriented to the improvement of China's export performance (and thus serve the interests of U.S.-PRC trade in the long run), and its successful operation might serve as an effective catalyst for much needed reforms in China's research system. If properly approached, the U.S. private sector could be expected to actively participate (the Dalian project indicates such willingness, albeit on a more modest scale). Such a project,however, would require clarification of U.S. interests vis a vis China, considerable thought about financial responsibilities, and considerable effort to orchestrate all of the interested parties. However, instead of sustained and thoughtful explorations of this type into how the S & T relationship could be creatively developed to serve the political and economic interests of both countries, much of U.S. policy thinking has become distracted by the pursuit of a largely chimerical military relationship.

The determination of the role of U.S.-PRC relations in long term calculations of U.S. interests is beyond the scope of this

study. However, an evaluation of the S & T program is not unrelated to the problems of making such a determination. On balance, the conclusions of this study are that the program in S & T cooperation with China has been remarkably successful thus far in spite of inadequate public understanding of the program, and in spite of inadequate institutional preparation to capitalize on opportunities to advance the national interest through S & T cooperation. The Chinese side has found participation in the program to be in its interest, and in general, has shown good faith in carrying out its responsibilities. The summary recommendations of this report therefore are (1) that the U.S. continue its support for the program; (2) that it do so with long term mutual benefits in mind; (3) and that it prepare itself more adequately to realize those benefits by upgrading the status of S & T in foreign policy with the corollary that scientific, commercial and foreign policy interests be more effectively coordinated.

Appendix 1 - Chinese Officials Interviewed in Beijing

State Science and Technology Commission:
Jiang Ming, Vice-Minister
Wu Yikang, Deputy Director of Foreign Affairs Bureau
Wu Ping, Office of Science Policy Research

State Economic Commission:
Wang Hao, Deputy Division Chief, Education Bureau

State Agriculture Commission:
Huang Yongning, Deputy Division Chief, Foreign Affairs

National Bureau of Oceanography:
Luo Yuru, Deputy Director

General Bureau of Aquatic Products:
Tian Chengshan, Deputy Division Chief, Foreign Affairs

Ministry of Public Health:
Chen Haifeng, Director, Science and Technology Bureau
Cheng Keru, Deputy Director, Foreign Affairs

Ministry of Electric Power:
Jia Ke, Director, Foreign Affairs

Office of Environmental Protection, State Council:
An Yang, Division Chief, Foreign Affairs

State Bureau of Metrology:
Du Fangjiong, Division Chief, Foreign Affairs

State Bureau of Standardization:
Hu Qingzhao, Deputy Division Chief, Foreign Affairs

Central Meteorological Bureau:
Zou Jingmeng, Deputy Director

Chinese Academy of Sciences:
Feng Yingfu, Deputy Director, Foreign Affairs
Wang Xinmin, Deputy Director of Space Center Ground Station, Space Science and Technology Center

Chinese Academy of Social Sciences:
Lin Qing, Division Chief, Foreign Affairs

Ministry of Education:
Ji Xiaolin, Deputy Division Chief, Foreign Affairs
Xue Qikang, Division Chief
Li Qun

Institute of High Energy Physics:
Zhen Min, Associate Professor

Ministry of Geology:
Yang Zhiling, Deputy Director, Foreign Affairs

State Bureau of Seismology:
Wei Yiqing, Deputy Director
Zou Qijia, Foreign Affairs Office