CHINESE SCIENTIFIC SOCIETIES AND CHINESE SCIENTIFIC DEVELOPMENT

RICHARD P. SUTTMEIER

THE IMPORTANCE OF scientific societies in the development of science and technology in the West is well known.[1] Little attention has been given to the role of scientific societies in the contemporary non-Western world however, in spite of the serious efforts non-Western governments are making to foster indigenous research. In China, scientific societies have served as administrative resources, and as such, appear to be fundamentally different from professional societies in the West. Nevertheless Chinese societies have played a significant role in Chinese scientific development, particularly in helping to integrate a complex and variegated "science system."[2] A brief review on the evolution of this system will bring the role of scientific societies into clearer focus.

Two rather constant themes have influenced policy toward science and technology throughout the history of the People's Republic of China. First, science and technology should contribute to the strengthening of the country through service to production and national defense. Second, science and technology should be popularized and the "technical level" of the great masses of people should be raised.[3] The implementation of the first theme during the 1950s led to policies that brought Chinese research quite close to the Soviet Union in terms of operations and organization. Of crucial importance in the Soviet model was an academy of sciences, a scientific "center," for both research and planning. Whereas the centrality of the Soviet All-Union Academy (hereafter Soviet Academy) was a function of tradition and experience, the centrality of the Chinese Academy of Sciences (CAS) was a function of national policy decisions in the "post-liberation" period. Although the former Academia Sinica and the Peking Academy were merged in 1950, the major shift toward the Soviet system did not begin until 1954 when an Academy Secretariat was created with extensive administrative authority (see [25] [12]).

[1] The research for this article was supported by a Hamilton College faculty summer fellowship through funds supplied by the Ford Foundation. Mr. Michael Klosson assisted me in the research. The final preparation of the manuscript was done with the help of the Technology and Development Institute of the East-West Center. I am grateful to all.

[2] The term "science system" will be used to describe the interrelated organizations whose activities include basic and applied research and development, education and training, policy making, administration and political control, and popularization and "mass science."

[3] These two themes go back at least as far as the adoption of the Common Program in September 1949 which stated, "Efforts should be made to develop the natural sciences in order to serve construction of industry, agriculture and national defense. . . . Dissemination of scientific knowledge should be greatly strengthened" (quoted in [9, p. 10]).

The changes continued through 1955 when the organization of CAS into Soviet-style "departments" was inaugurated, through 1956 when long-range planning was initiated, and up until 1957 when a fifth department was established.[4] During this time in the Soviet Union, the Soviet Academy was not only the center of the country's research, but was also the center of planning and research administration. Presumably CAS was to occupy a similarly important place in China. This can be inferred from the composition and functions of the departments. Most accomplished scientists in China were members of the department committees, even though their main place of employment might not be in the Academy. Thus the department committees and the sub-department, discipline-oriented "academic committees" set up also during the 1954–56 period, had intersectoral representation. The bulk of the actual research done as revealed by the science budget, was done in CAS, and the bulk of the department committeemen had "concurrent positions," most typically as CAS researchers and university professors. The main responsibility of the departments in regard to the national research scene was in planning, and shortly after they were created, the departments were faced with the large task of preparing the twelve-year plan for science. At about the same time, a great number of research establishments were set up under government ministries. Overall expenditures for science increased dramatically in 1956, reflecting the construction of new research facilities, then going on. By 1957, CAS was receiving only 31 per cent of the expenditures for science, whereas previously it had received the lion's share [9, p. 83].

The drawing up of the plan, the expansion of research activities outside of CAS, and the growth of expenditures for science created a situation that called for policy and administrative capability beyond that of CAS. As of 1956, the success of the Chinese system presumed three conditions: first, that science plans would be meshed with economic plans, and that the structure of the Academy would be capable of contributing to the meshing; second, that scientists would put aside their disciplinary loyalties and work for the goals of the plan which, eleven times out of twelve, required interdisciplinary effort;[5] and third, that scientists and scientist-administrators would also put aside their sectoral (institutional) loyalties in the carving up of the pie (planning necessarily entailed resource allocations). As the Chinese found out, and parenthetically as the Soviets were finding out at about the same time, making "science serve production" was no easy task, and assigning the reconciliation of economic and scientific plans to a body that was organizationally ill-equipped for such a task was not the way to begin (see, for instance [20, p. 1985]). Similarly, as the great debates over research in the spring of 1957 show, the scientific community was not at all happy about the organiza-

4 The original four departments were for: (1) physics, mathematics, and chemistry; (2) biology and geology; (3) technical sciences; (4) social sciences. In 1957, separate departments were established for biological and earth sciences.

5 Although the plan was never made public its twelve priority areas were. Only one of these, "problems of basic theory in natural science" could be interpreted as having a disciplinary orientation (see the relevant article [NCNA, December 30, 1956] translated in *SCMP*, No. 1442).

tional intrusions brought about by planning, and about the privileges won by one research sector at the expense of another (see [36] [18]).

The Chinese responded rather quickly to these difficulties with an action that began a break with the Soviet model, the model which ironically had only just been constructed. In March 1956, they created a high-level Science Planning Committee (SPC) which like committees of cabinet officials anywhere, given the press of other responsibilities, was initially rather inactive. This committee, however, was undergoing restaffing and reorganizing by December 1956, and was becoming a powerful and seemingly effective instrument of policy-making, administrative control, and cordination over the Chinese science system.[6] It was further strengthened in 1958 when it merged with the State Technological Committee to form the State Scientific and Technological Commission (SSTC), which governed Chinese research up until the Cultural Revolution. The creation of SPC effectively lessened the administrative centrality of the Academy, and under the SPC, research activity in the industrial and university sectors continued to expand, relative to the Academy.[7] With the creation of the SPC, the center of decision-making was raised above intersectoral rivalries and a different perspective on research policy questions was institutionalized.

The above suggests that by the late 1950s, the Chinese science system was a terribly interesting organizational phenomenon. The relationship of the science system with the larger political system adds a dimension of organizational complexity. Important policy changes associated with the Great Leap Forward highlighted these linkages. At that time, it was declared that science too was to "walk on two legs,"[8] and at the last session of the Eighth Party Congress in May 1958, policies for a "technological revolution" and the decentralization of research were issued, responsibility for which rested in part with the SSTC (see [35] [10]). The essence of this policy was to encourage "mass science," that is to stimulate workers and peasants to engage in innovation and bring authentic scientists physically into environments of economic production. This policy resulted in the celebration of worker and peasant innovations and the admittance of worker and peasant "scientists" into academic organizations.

Such a policy exacerbated the normative cleavages that were already a serious problem in the research system. The scientists, most of whom had been trained abroad, had internalized a professional ethos with its role-defining norms, which stressed the importance of autonomy in work and the primacy of expertise in scientific matters. Not unlike situations in industrial laboratories in the West, the bureaucratization of CAS and the creation of SSTC led to conflicts between

6 The interdisciplinary, task orientation noted above in regard to planning was reinforced at the December 1956, third enlarged meeting of the SPC, when the SPC for its purposes divided Chinese R&D into twenty-six task areas (see [26], cf. [9]).

7 See report of the announcement made by Nieh Jung-chen, Chairman of the SPC in [34].

8 "Walking on two legs" was a term used in reference to China's development strategy at the time and meant that large and small industry, modern and traditional methods, foreign and indigenous techniques, etc., should be developed simultaneously.

what might be called professional "codes" and bureaucratic "codes."[9] As shown in the West, these conflicts can be overcome through mutually beneficial accommodations, and such in fact were to be realized in China in the early 1960s. This is particularly true when motivations resulting from perceptions of mutual benefit, exist on both sides. With the "mass science" movement, however, additional strains were built into the situation. To the scientific community, regardless of sectoral affiliations, mass science was an additional offense to their professional ethos. For the SSTC, there was a requirement from above for the allocation of additional energies, not only to foster what it had understood as research, but also to popularize science and to foster "research" among the unschooled masses.

A second national policy change associated with the Great Leap was a decentralization of activities throughout the country (see [46, pp. 195–210]). In the area of science and technology, this meant the establishment of provincial and sub-provincial science and technology committees, under local party authority, and a proliferation of branches of the Academy of Sciences, also under the authority of local party committees.[10] This move was certainly related to the mass science program and indeed decentralization appeared to be a sound strategy for energizing the masses with innovative impulses.

In the aftermath of the Great Leap a number of adjustments were made. The instrumentalities for locally initiated "research" continued to exist and were used, particularly in agriculturally related areas. But the coerced movement of scientists into production was discontinued as were the intense political meetings of the more radical period. The second "blooming and contending" period of the early 1960s, although far more restrained than that of 1957, did seem to signal that accommodations were being reached between the research administration apparatus and the scientific community.

The Chinese science system of the late 1950s and early 1960s can be thought of as a multidimensional phenomenon organized around a number of axes. Cleavages occur along each axis, and when allowed to persist, they threaten the integrity of the system. Cleavages along one axis reveal problems of organization by academic discipline vs interdisciplinary organization. This cleavage is no less a problem in China than elsewhere. Another world-wide problem which also obtains in China is the applied research–basic research cleavage along the second axis. A third axis that causes special problems for the Chinese relates to the organization of research by sector—academy, industry, higher education. A fourth point of cleavage is along the "administrative level" axis, where the locus

9 "Codes" are understood as instruments for making sense out of statements of means-ends relationships, the "problem-solving devices," or "trusted recipes" which all social systems have "for meeting the untoward." Socialization can then be understood as the learning of "problem-solving programs—sets of formulae, maps, mazeways, or 'codes.'" See [28, p. 408].

10 For insights into the organization, programs, and activities of these decentralized units, see as a sampler, [23] [7] [43] [19] [4].

of control has varied over time due to change in degrees of centralization and decentralization. Finally there is a very significant normative dimension to the organization of research which is manifest in the question of whether professional or "mass" values should predominate in day to day activities. The control of these various dimensions and overcoming the cleavages within the system have been continuing problems for China's science administrators. It is within this context that the role of scientific societies must be seen.

I. THE ORIGINS AND GROWTH OF SCIENTIFIC SOCIETIES

In the pre-liberation period, not surprisingly, the voluntary association of scientists into scientific societies was substantial. According to Wu and Sheeks, there were fifty-seven such associations at one time or another during the period of the Republic [55, pp. 532–36]. The number of scientists in the population however was small and the voluntary association was a natural means for promoting science through mutual encouragement, popularization, and scholarly exchange. The embryonic Chinese scientific community, just as the embryonic scientific community of seventeenth century Europe, had certain functional needs, and scientific societies helped meet them. According to Wu and Sheeks, scientific societies helped to diversify research activity, promote professionalism in science and modernize Chinese thought, although their activity, as the activity of scientific societies in India, was mainly in urban centers [55, p. 27] (cf. [41]).

The pattern of development of scientific societies under the People's Republic is one of spurts and stops. Approximately, one-third of the societies in existence in the mid-1960s were founded before 1949, although they may have undergone reorganization since that date (see Appendix Table I). Of the remaining forty-three, most were founded during one of three periods of founding activity: 1949–54 (8), 1955–57 (14), and 1961–64 (19). These periods do not have much in common other than the fact that they were periods when political control and involvement in science was either relatively weak or relaxed. The first period is usually thought of as one of reorganizing and consolidating pre-1949 science activities, with only moderate efforts towards serious research. The second period was one of some serious research, intense organizational activity and expansion. The third period was one of orderly development, occurring after the main institutional framework for Chinese R&D had been established.

With very few exceptions, the societies founded after 1949 are in fields that would normally be making contributions in applied research and development, although many of these would require basic research as prerequisites for applied research breakthroughs. Similarly, the post-1949 societies on the whole are task-oriented, and interdisciplinary and are often related to an economic activity, rather than being oriented around traditional academic disciplines. Thus in a real sense there are two kinds of professional societies in China—those that are formed around traditional disciplines (most of those founded before 1949) and those oriented towards economic tasks, or at least applied research (most of which were formed after 1949).

It appears that prior to 1957 the activities of the societies, with a few exceptions, were somewhat limited. The societies published specialized journals, worked on the all important technical task of standardizing Chinese scientific terms, and did attempt to coordinate research, particularly CAS research, with the needs of national construction [3]. The mechanisms for achieving this coordination were flimsy at best, and the societies in the early years were underutilized administrative resources. By 1955–56 however, with the expansion of research and the opening up of new fields following the initiation of major planning, the potential usefulness of the societies became evident. As an example, one field emphasized in the plan, but previously weak in China, was semiconductor technology. Accordingly, in February 1956, the Chinese Physics Society sponsored a national conference on semi-conductors. Out of this conference grew a strategy for the development of a field. Initially it called for "short course" training for appropriate interested personnel, which was sponsored jointly by CAS and the Ministry of Higher Education, and it culminated in the establishment of an Institute of Semi-conductors in CAS [17]. It should be noted that in implementing the strategy authority passed beyond the hands of the Physics Society. However, the society did provide a natural and effective forum for bringing together personnel from the various sectors, without which a strategy would not have been possible. This "sector-bridging" effect of society sponsored conferences became an important theme in the news reports of scientific meetings from 1957 onward.

In spite of occasional initiatives like that of the Physics Society, until 1957–58, the role of individual scientific societies was overshadowed by the All-China Federation of National Science Societies. This organization, along with the All-China Association for the Dissemination of Scientific and Technical Knowledge grew out of a conference of scientists and party official in August 1950. Both reflect the influence of the Soviet Union with its all-union organizations for scientific societies and for popularization of science.

The Federation resembles a "peak association" in form, but in function was probably far more comparable to the other "mass organizations" established in China in that period. As such it was an instrument for party control and the party-initiated resocialization that, with varying intensities, has been an important aspect of life for Chinese scientists. Party resocialization in the form of ideological remolding was directed against the "bourgeois" professional ethos acquired by Chinese scientists during their training abroad and was directed towards what the party thought Chinese scientists should be and do. The Federation actively promoted Soviet science during the 1950s and worked to instill the doctrine that science should serve national construction and hence the people [29].

The Federation was also one vehicle for international contacts. It usually was the organization to sponsor Chinese representatives to the World Federation of

Scientific Workers and involved Chinese scientists in signing petitions such as those denouncing alleged U.S. use of germ warfare in Korea and supporting the World Peace Council's move to ban atomic weapons.[11]

As an instrument of control, the Federation acted as a funnel for policy coming down from above, and also extended the organization of scientists below the level of the national scientific societies. This latter activity, which formed a necessary prerequisite for later decentralization policies, was accomplished by setting up "branch federations" in big cities and by organizing local chapters of the national societies under the branch federation (see [3]). By the 1960s, except for highly specialized fields, most societies had at least ten local branches.

The value of the Federation as a channel for information was most pronounced at two important meetings during 1957, a momentous year for Chinese science. The first, a meeting of the Peking branch of the Federation was held in May under liberal, "Hundred Flowers" conditions. At this meeting, however, the flow of information was upward, from the Federation to the party. This meeting, along with the two important sessions at CAS during that spring, were major forums for airing the grievances of the scientific community. Under those liberalized conditions the Peking federation acted very much as the defender of professional interests against incompatible and apparently irrational organizational demands (see [48] [50]).

The second conference was the second enlarged session of the National Committee of the Federation which was held in July. By that time the "blooming and contending" period was over, rightism in science was under attack, and a new direction for the organization and management of research was under way as a result of decisions reached at a meeting of the Scientific Planning Committee in June. Sginificantly at the Federation meeting Nieh Jung-chen, by then head of the SPC, promised State Council support for the work of the scientific societies [27]. Criticisms of lack of support had been a major complaint at the May meeting of the Peking branch.

In 1958, the Federation was merged with the Association for the Dissemination of Scientific and Technical Knowledge to form a new organization, the Scientific and Technical Association (STA). This move requires special discussion below, but an interpretive summary of the events through 1957 and prior to the Great Leap Forward is in order. With the rise of Nieh Jung-chen to the head of SPC, a break with the Soviet model began, a break necessitated by the state of confusion in the Chinese research system. The centrality of the Academy and its system of departments was to go (although the departments themselves were not disbanded). The function of coordinating different research sectors clearly was to be SPC's [51] but with the reduced emphasis on the departments (it was three years before the next department committee plenum), one of the key mechanisms for providing SPC the kind of information it needed to do its job was removed. A group of scientists were included as members of SPC from

[11] See [3] [14]. It was however, the Physics Society, not the federation which extended congratulations to C. N. Yang and T. D. Lee on the occasion of their winning the Nobel prize.

the time of its reorganization in late 1956 until it became the SSTC, and may have served as the chief channels of informations. In 1958, however, the scientists were dropped from the roles and the SSTC was seemingly cut off from coordinated information from the various sectors. Under such conditions, the societies, with their inter-sectoral—and with the newer societies—their interdisciplinary memberships, would be ideal organizational instruments for the work of the SSTC. There began therefore the proliferation of society activity which so characterizes the early 1960s. This activity was directly related to the five administrative cleavages discussed above.

As early as 1957, at the inaugural meetings of the Chemical and Chemical Engineering Society and the Society for Silicate Research, we find the discussions of the directions and research tasks of the fields sounding very much like the kind of planning that was to have been done by the CAS departments [8] [15]. The continuation of this trend can be seen at the 1960 second national meeting of the Chinese Mathematical Society, where both the direction of mathematical research and mathematical curricula were discussed. The meeting also outlined the key areas to be developed in mathematics.[12]

A report on the tenth anniversary meeting of the Society of Mechanical Engineering in December 1961, indicated how the new system was beginning to work. To prepare for the national meeting a preparatory conference was held in June, and in addition nearly half of the society's branches in the provinces held meetings. It was at these meetings that "heated debates on several important nation-wide issues concerning the machine building industry" took place, ". . . through which various schools adjusted their organization and solidified their theories" [16]. In preparing for the branch meetings ". . . many units which did not have such contact with each other in the past became more intimate and started exchanging technical data" [16]. Thus communication was improved between such diverse organizations as the industrial research units in the fields of machine building, metallurgy, coal mining, chemistry, petroleum, transportation, and weaving, institutes under CAS, and institutions of higher education. According to this report,

> Through these academic activities the relations among leading cadres, engineers, technicians and workers, the relations among production departments, research institutes and schools, and the relations among designing, manufacturing and consuming departments were greatly strengthened. [16]

At the national meeting itself the society heard a report by Han Kuang, vice-chairman of the SSTC and made plans to further mobilize its members for greater contributions.

By 1962, it appears that the new formula for using scientific societies as administrative mechanisms for coordination was being viewed with satisfaction. "Leading departments" on the basis of the needs of production, were to raise

12 [24]. The institutionalization of a forum for the exchange of views between mathematics researchers and teachers of math is particularly important given earlier complaints from researchers that the younger generation was being poorly trained.

problems for the societies to study and decide upon [42]. At the same time, there was the implied recognition that a certain autonomy for the societies would enhance their usefulness since, "it is necessary for the control of academic activities to reflect the demands of the scientific and technical workers themselves" [42]. By 1963, the new formula was being celebrated as having produced a "bumper year" of fifty-five academic conferences of the national societies, and the conclusion was explicitly stated that, "Societies of natural science are the best forms of organization for the different departments and units to get in touch with the specialists of the same trade" [57].

It is important to note that the variety of societies produced a variety of activities. As the mechanical engineering case show, the applied research and development areas were considered particularly important for coordinating research and production. A similar case, involving another society bringing together technical and economic interests, is the Plant Protection Society. At its inaugural meeting in 1962 it produced a number of concrete suggestions for the organization of plant production work, improving supervision of the production of, and inspecting the quality of insecticides, and rationalizing the prices of seeds and pesticides. It was reported that these suggestions were adopted by the department concerned [57].

Other patterns of activity were also discernible. For instance, two or more societies might work together to study and promote a new technology, as was the case of fluidization of metals. This problem was worked on jointly by the Chemical and Chemical Engineering Society, the Society of Metals and the Department of Technical Sciences of CAS [31]. Similarly, the Mathematics Society held conferences on the promotion of operations research and the societies of Zoology and Botany cooperated in sponsoring a seminar on cytology [54] [2]. Often conferences on special subjects would be called, and at times resulted in the formation of special study committees, not unlike patterns of society activity in the West. For instance, the Society of Mechanics sponsored a meeting on fluid mechanics, and a special committee on geomorphology was set up under the Geography Society [21] [13].

As an example of the importance of scientific societies in planning for the less applied, more academic basic research field, there is the case of the Astronomy Society. In late 1961 it sponsored three meetings in cooperation with the academic committee of the Tzuchinshan Observatory of CAS. Each was topically oriented: one on fixed stars and evolution, one on celestial mechanics, and one on solar physics and radio astronomy. The meetings were considered quite productive in summing up recent developments in the field, not only for putting "forward many constructive suggestions concerning the long range planning of various branches of science," but also for working out "arrangements for the current work of existing astronomical institutions, the directions of cooperation between the astronomical and other circles, and the tasks of astronomers" [1].

The astronomy meetings, like those of other societies in the early 1960s, were supposed to be centers of "blooming and contending" with diverse views presented. One such dispute occurred at the solar physics meeting at which two papers, using the same data, written by two men from Tzuchinshan, reached opposite conclusions about the peak value in the cycle of solar activity with special reference to the 1967–68 period.

This case is interesting in light of news of Chinese research activity during the solar eclipse of 1968. According to these reports, the only reason that China did any research on the eclipse at all was because the Cultural Revolution had encouraged and liberated younger "revolutionary" scientists to break their bonds with the older, more conservative "authorities." These authorities had argued that given China's limited technical capabilities, the kind of data that could be obtained from mounting a major solar eclipse program could be in no way compensate with the costs. Accordingly no plans had been made for such activities.

This basic decision went back to the 1962 Conference for Overall Planning of Scientific Research Work (see particularly [40], also [11] [6]). A plausible, but admittedly speculative, account of the role scientific societies played in planning can be hypothesized from the fragmentary data available. The 1962 overall planning conference, as a selective gathering, was presumably convened by SSTC for setting national research priorities. The reports from recently held, society sponsored academic meetings, which represented the most thorough "summing up" of the state of a discipline, would represent major inputs of technical information into the SSTC decision effecting solar physics—the eclipse decision—that the results of the most recent technical meeting on the subject would be ignored.

This case highlights as well the significance of the planning process itself. Technical results, to the extent they are used in planning take on political significance far more quickly than they do in a less-planned system. Planning also is a powerful channelling device, which as the solar eclipse illustrates, can set the course of, and therefore the funding for research for years in advance. As such it is a type of political resource within the research system which gives individual groups with access to its control, considerable leverage. But the planning as hypothesized here also opens up the possibility for a kind of advocacy process in which an individual scientist or group of scientists can use the floor of society sponsored meetings to argue for a position, and perhaps change the direction of a field by winning a place in the plan for some new topic. Sitting as observers and judges of this process would be the non-expert state science administrators. It is not clear whether such a process is harmful to research, but it would seem to be rather sagacious administrative device for bringing the opinions of experts to bear on the decisions that must necessarily be made generalist-politicians.[13]

[13] As students of science and public policy in various countries will recognize, the interfaces of the expert and the general-politician in the making of public decisions is seldom a neat and tidy one.

II. BRINGING SCIENCE TO THE MASSES

The stresses and strains of the Great Leap Forward and the "technological revolution" effected the dimensions of the research system that pertained to levels of administration and to the interaction of professional science and the worker-peasant masses.[14] One of the implication for scientific societies was that the membership of many societies was thrown open to workers and peasants (see, for instance, [39]). The objectives of this action are stated in a report on a resolution passed by the Meteorological Society which called for

> the revision of the unreasonable parts of the laws and by-laws of the Society. Henceforth, the Society will absorb on a vast scale the great number of meteorological workers, the new type of experts among the workers and farmers, and all the comrades in charge of the administration of all meteorological research and teaching institutes. The members of the Society will then form a composite meteorological team in which all elements, domestic, foreign, and political and scientific, will be combined. [56]

By 1964, workers were elected to the governing councils of some societies as well [38].

The Great Leap period marks the beginning of serious efforts to implement the other major theme of Chinese science policy—the popularization of science and the raising of the technical level of the masses. One of the most significant steps taken in the late 1950s, was the merger in November 1958 of the Federation of Natural Science Societies with the Association for the Dissemination of Scientific and Technical Knowledge. The successor organization, the Scientific and Technical Association, would help define a new role for scientific societies, and utilize in new ways their technical resources.

The STA's broad mandate was to ". . . develop the characteristics of combining scientific technology and mass organization to promote a technical revolution" [45]. Although the control of the association rested with the national organization—a National Committee, Presidium, and Secretariat—by its very nature, it was to have extensive field operations. Thus local associations were to be organized in every province, city, special autonomous area, and county. The local branches were to be directed by the local CCP organization and receive technical supervision from the next higher level of the association.[15] In addition, the STA was to set up branches in mines, industries, people's communes and schools, again with local direction by the party organization (see [45]). The local branches of the scientific societies, like the nationals, would now be under the direction of the STA and the local political authorities, but would receive

[14] For the ideological background for the professional science–mass science normative cleavage, see [53].

[15] [45]. By 1959, local STAs had been set up in 1,399 *hsien* or cities, with a combined membership of 6 million (see [22]).

technical supervision from the higher structure of the society.[16]

With the emergence of branch academies and local level Science and Technology Committees, the establishment of local's STAs was very much a part of the decentralizing of a "science network" to bring research closer to production. At the lowest level of the network was the "research group" which existed at a low level of production, such as a production brigade. The composition of these in the countryside normally would include basic-level cadres, veteran workers, and "educated youth." The groups were considered "new products, and . . . a good form of organization for developing more scientific experimental activities in rural areas" [32]. The general objectives of the groups was to achieve a close combination of modern science and technology with the Chinese peasant's traditional experience. The importance of party leadership through local CCP committees was suggested in that the development of these groups "would necessarily involve the ideological struggle between the new and the old, the progressive and the conservative, personal interests and collective interests, and the struggle between two roads" [32]. However, it was also recognized that the level of scientific and technical knowledge available in the groups would be limited. STAs particularly at the *hsien* ("county") level were to provide the kind of technical support need to enable the basic level groups to operate [32].

The role of scientific societies in STA's support of "mass science" was crucial. According to an important *Jênmin jihpao* editorial on the subject,

> Through special academic societies and groups, the science and technology associations may in accordance with different conditions . . . carry out such activities as technical inspection, summing up of experiences, discussion of problems and the teaching techniques.
>
> On the one hand this will disseminate modern scientific and technical knowledge and give technical guidance over mass scientific experiments held at the basic level; on the other hand, it may familiarize the members of science and technology organizations better with the experiences acquired by the masses and the problems met in production. . . . [52]

Thus one of the societies' main supports of STA was to "sum up" and evaluate the scientific significance of worker and peasant innovations, often through the use of "on the spot," summing up conferences.[17]

The societies under STA supported other association activities also. Among these were the establishment of spare-time colleges for workers and peasants. A 1960 account reported that eight such colleges were opened by scientific societies

[16] [45]. It is not clear whether financing of local society activity would also be the responsibility of the nationals. Wu and Sheeks believe that scientific societies are financed (apart from membership dues) from the national science budget and that local government is not usually called upon for financial support. However, local governments are expected to finance popularization and dissemination of information work. See [55, pp. 244–45].

[17] [5]. The use of trained technical personnel for evaluating worker and peasant experiments and innovations has been noted by C.H.G. Oldham. See for instance, his report [37].

in Shanghai, seven in Harbin and that societies in Wuhan were also planning this kind of work. In each case it was the societies working under the direction of the STAs that provided the specialized competence [47] [49]. In addition the societies continued to provide other kinds of technical support to the STAs through lectures, films, broadcasts, and the activities centered around the STA-sponsored "halls of science" in the major cities.

III. CONCLUSION

The argument running through this paper is that Chinese scientific societies formed an invaluable administrative resource for overcoming organizational deficiencies in a relatively differentiated and variegated system of science-related institutions. As such they have been an integral part of the "Chinese model" for scientific and technological development. Scientific societies have been used instrumentally to overcome the cleavages that threatened the integrity and functioning of the science system and thus have aided science administrators in achieving certain of the goals set by national science policy.

The achievement of these goals is reflected nicely in a foreign visitor's report on the activities of the Shanghai branch of the Electronics Society. According to the director of the branch, the "most important duty of the . . . society is the interchange of technology" [44]. Society members who are workers discuss technical problems at manufacturing sites. "The problems which could not be solved by workers at the plant are brought to the society meeting and discussed by technicians, researchers and scholars in order to obtain the solutions to the problems" [44]. Thus the Chinese scientific society is not a place for "fast publication" and for enhancing professional status, but functions instead as a "service organization," exchanging knowledge by assembling the experts from plants, research organizations, and universities [44].

Although the domestic role of scientific societies in Chinese scientific development since the Cultural Revolution remains unclear, their importance as instruments in international scientific affairs has increased. In placing greater value on scientific exchange with non-Communists countries, the Chinese leadership has again found in scientific societies a useful administrative resource. This is particularly true in those cases, such as Sino-American relations, where the delicacy of diplomacy precluded government to government contacts. In dealings with American science, it was the China Medical Association that represented the Chinese side. More recently, the first delegation of Chinese scientists to visit the United States in more than twenty years had as head and deputy head of delegation officers of the STA.

Chinese scientific societies are in many ways quite different from those found in the West. Although the element of voluntary association that characterizes the Western professional society may exist in China, it is severely prescribed. The extent to which Chinese societies are politically controlled and administratively integrated into a larger system certainly sets them apart from those in the West. However, both in contemporary China and in the West at an earlier stage of scientific and economic development, scientific societies perform functions that are necessary ingredients to scientific and technological progress. In the Chinese case, given its particular institutional setting, and stage of development these functions include opening up communications blocked by bureaucratic shortsightedness, traditional scholarly detachment and the apparent abuse of professional status, and helping to bridge the gap between academic research and technological innovation.

The most intriguing aspect of Chinese societies in comparison to earlier Western societies is their anti-professionalism and support for the participation of amateurs.[18] Although the social milieu and basis for amateur participation in the two settings appear to differ markedly,[19] in both historical circumstances—that is, in social systems in the early stages of industrialization—scientific societies have provided a common forum for men of the academy and men from factories and farms.

REFERENCES

1. "Academic Activities in China" (*K'ohsüeh t'ungpao,* 1962, No. 3), *Survey of China Mainland Magazines,* No. 313.
2. "Academic Forum on Cytology Held in Peking" (*Jênmin jihpao,* September 9, 1962), *Survey of China Mainland Press* (hereafter *SCMP*), No. 2832.
3. "Achievements of All-China Federation of Scientific Societies in the Past Four Years" (*Kuangming jihpao,* June 9, 1954), *SCMP,* No. 859.
4. "Army of Scientists One Million Strong to be Built" (*Kuangming jihpao,* August 2, 1958), *SCMP,* No. 1842.
5. "Association of Science and Technology of Shanghai Sums up and Popularizes Achievements in Technical Innovations" (*Jênmin jihpao,* September 8, 1960), *SCMP,* No. 2340.
6. "Background Material: Solar Eclipses and Their Research" (NCNA, January 23, 1969), *SCMP,* No. 4348.
7. "Branches of the Chinese Academy of Sciences Set Up in 14 Provinces and Autonomous Regions" (NCNA, November 2, 1958), *SCMP,* No. 1900.
8. "Chemical and Chemical Engineering Society Founded in China" (NCNA, June 29, 1959), *SCMP,* No. 2048.
9. CHENG CHU-YUAN. *Scientific and Engineering Manpower in Communist China, 1949–1963* (Washington: National Science Foundation, 1965).
10. "China's Mass Campaign in Scientific Research" (NCNA, September 28, 1958), *SCMP,* No. 1865.

[18] Needham notes the case of John Graunt, the founder of vital statistics, and the first to apply mathematical methods to "bill of mortality." Since Graunt was only a "small tradesman" there was some doubt about whether he should be admitted to the Royal Society. The matter was eventually referred to the King who replied that ". . . they should certainly admit Mr. Graunt, and if they found any more such tradesman, they should be sure to admit them also without delay." See, [33, pp. 225–51].

[19] The apparent differences in the societies of the seventeenth and eighteenth century Europe and contemporary China should not be accepted uncritically, since it is beyond our knowledge at present to state unambiguously the crucial social variables that explain sustained scientific and technological development in any society. In this one regard China may be more comparable to seventeenth century Europe than we think. Although it is beyond the scope of this note to argue for comparability here, it is worth noting as one example that both settings had a pervasive ideology which legitimized the institutionalization of science. For seventeenth century England, see [30].

11. "China's Success in Making Large Scale Comprehensive Observation of a Total Eclipse" (NCNA, January 23, 1969), *SCMP*, No. 4348.
12. "Chinese Academy of Sciences Set Up Secretariat to Strengthen Leadership of Scientific Research Work" (NCNA, April 14, 1954), *SCMP*, No. 792.
13. "Chinese Geographical Society Meeting in Shanghai" (NCNA, December 16, 1961), *SCMP*, No. 2644.
14. "Chinese Scientists Sign Against Atomic Weapons" (NCNA, February 17, 1955), *SCMP*, No. 991.
15. "Chinese Society for Silicates Research Founded in Shanghai" (NCNA, December 2, 1959), *SCMP*, No. 2154.
16. "Chinese Society of Mechanical Engineers Commemorates Tenth Anniversary" (NCNA, December 4, 1961), *SCMP*, No. 2845.
17. CHOU PEI-YUAN. "China's Progress in Physics" (*K'ohsüeh hsinwen*, September 28, 1959), *Joint Publications Research Service* (hereafter *JPRS*), No. 3116.
18. "Criticisms and Suggestions Made by Scientists at Department Meetings of Department Committees of the Academy of Sciences" (*Jênmin jihpao*, May 27, 1957), *Current Background* (hereafter *CB*), No. 460.
19. "Development of Scientific Work in Kwangsi" (NCNA, August 11, 1958), *SCMP*, No. 1832.
20. DEWITT, N. "Reorganization of Science and Research in the U.S.S.R.," *Science*, June 23, 1961.
21. "First Chinese Seminar on Fluid Mechanics" (NCNA, November 17, 1963).
22. "First National Science and Technology Association Conferences Held" (NCNA, March 20, 1959).
23. "Fukien Science & Technology Committee Set Up" (NCNA, August 25, 1959), *SCMP*, No. 2087.
24. HUO LO-KENG. et al. "The Correct Path in the Development of Mathematics in China" (*Jênmin jihpao*, April 11, 1960), *JPRS*, No. 2928.
25. KUO MO-JO. "Report Concerning the Basic Conditions of the Chinese Academy of Sciences and Its Future Work," given to 204th meeting of the Government Administrative Council, January 28, 1954 (*Jênmin jihpao*, March 26, 1954), *CB*, No. 359.
26. ————. "On Coordination of Scientific Research," speech at third plenary session, National Committee of the Chinese People's Political Consultative Congress, March 19, 1957 (*Jênmin jihpao*, March 20, 1957), *SCMP*, No. 1515.
27. "Kuo Mo-jo Encourages Contention Among Scientists" (NCNA, July 17, 1957), *SCMP*, No. 1541.
28. LANDAU, M. "Linkage, Coding, and Intermediacy: A Strategy for Institution-Building," *Journal of Comparative Administration*, Vol. 2, No. 4 (February 1971).
29. LI SSU-KUANG. "Scientific Work" (*Jênmin jihpao*, September 29, 1952), *CB*, No. 257.
30. MERTON, R. K. *Science, Technology and Society in the 17th Century England* (New York: Howard Fertig, 1970).
31. "National Conference on Fluidization Held in Peking" (*Kuangming jihpao*, August 31, 1962), *SCMP*, No. 2825.
32. "National Science and Technology Association Holds Meeting in Peking on Mass Experimental Activities" (NCNA, May 20, 1964), *SCMP*, No. 3231.
33. NEEDHAM, J. "On Science and Social Change," *Science and Society*, Summer 1945.
34. NIEH JUNG-CHEN. "Chinese Research to be Decentralized" (NCNA, June 13, 1957), *SCMP*, No. 1554.
35. ————. "Let the Whole Party Lay a Firm Hold on Scientific and Technological Work to Carry Out the Technological Revolution" (*Jênmin jihpao*, August 2, 1958), *SCMP*, No. 1831.
36. "Numerous Contradictions Within the Ranks of the Scientific Circle" (NCNA, April 30, 1957), *SCMP*, No. 1541.
37. OLDHAM, C.H.G. "Science and Education," *Bulletin of the Atomic Scientists*, June 1966.
38. "Outstanding Peking Workers Now Council Members of Engineering Societies" (NCNA, May 22, 1964), *SCMP*, No. 3227.

39. "Outstanding Workers Joint Research Societies" (NCNA, October 18, 1958), *SCMP*, No. 1880.
40. "People Use Mao Tse-tung Thought to Study Solar Eclipse" (NCNA, January 24, 1969), *SCMP*, No. 4349.
41. RAHMAN, A. et al. *Scientific Societies in India* (New Delhi: Survey and Planning of Scientific Research Unit, Council of Scientific and Industrial Research, 1965).
42. "Raise the Level of the Academic Activities of Natural Science Societies" (*Kuangming jihpao*, September 9, 1962), *SCMP*, No. 2832.
43. "Rapid Growth of Scientific Institutions in Chekiang & Kiangsu" (NCNA, July 30, 1958), *SCMP*, No. 1826.
44. "Report on the Activities of the Shanghai Branch of the Electronics Society" (*Rajio gijutsu*, March 1966), *JPRS*, No. 29.
45. "Resolution on the Establishment of the Science and Technology Association," *JPRS*, No. 1502 DL.
46. SCHURMAN, F. *Ideology and Organization in Communist China* (Berkeley: University of California Press, 1968).
47. "Scientific Associations in China Set Up Spare Time, Workers' Schools" (NCNA, March 14, 1960), *SCMP*, No. 2220.
48. "Scientists Discuss Diverse Problems" (NCNA, May 12, 1957), *SCMP*, No. 1530.
49. "Shanghai Scientific Societies Run Spare Time Colleges" (NCNA, August 7, 1960), *SCMP*, No. 2316.
50. "Specialists Criticize Past Practices at Symposium" (NCNA, May 12, 1957), *SCMP*, No. 1541.
51. "State Council's Scientific Planning Commission Holds Third Enlarged Meeting" (NCNA, December 29, 1956), *SCMP*, No. 1453.
52. "Steadily Develop Mass Scientific Experiment Activities in the Countryside" (*Jênmin jihpao*, May 21, 1964), *SCMP*, No. 3231.
53. SUTTMEIER, R. P. "Party Views of Science: The Record from the First Decade," *China Quarterly*, No. 44 (October–December 1970).
54. WU SHU-HUA. "Chinese Mathematics Society Holds Academic Forum on Science of Operations & Programming" (*Jênmin jihpao*, August 16, 1962), *SCMP*, No. 2810.
55. WU, Y. L., and SHEEKS, R. *The Organization and Support of Scientific Research and Development in Mainland China* (New York: Praeger Publishers, 1970).
56. YANG WEN. "Second and Third Enlarged Council Meetings of the Meteorological Society of China" (*K'ohsüeh t'ungpao*, 1958, No. 16), *JPRS*, No. 772 NL.
57. "A Year of New Achievements and Many Successes in Research for Scientists in China" (NCNA, January 13, 1963), *SCMP*, No. 2906.

APPENDIX TABLE I

PROFESSIONAL SOCIETIES IN THE NATURAL SCIENCES AND ENGINEERING FIELDS AS OF 1966

Period of Founding	Field	Founding Date	One or More Publications	Local Branches	Membership
Pre-1949[a]	Anatomy	1947[b]	*	21	800
	Astronomy	1922	*	5	100
	Bacteriology (W&S)				
	Botany	1933	*	15	1,200
	Chemistry	1932[c]	*	30	5,000
	Physical Chemistry (W&S)				
	Geology	1922	*	20+[d]	
	Geophysics	1947[e]	*		140
	Mathematics	1936	*	24	4,000+
	Medicine	1914	*	54	19,000
	Meterology	1924	*	11	
	Michurin Society	1948			
	Microbiology	1928	*	24	1,400
	Palaeontology	1929	*		140
	Pedology	1945	*	14	1,400+
	Pharmaceutics	1912			
	Physics	1932	*	26	2,200
	Physiological Sciences	1926[f]		22+	
	Plant Pathology	1929[g]	*	20	
	Shipbuilding	1941[h]	*	10	
	Textile Engineering	1930[i]	*	26	4,000
	Zoology	1934	*	16	700
1949–54	Architecture	1953	*	16	4,000
	Civil Engineering	1951	*	26	6,000+
	Entomology	1950	*	24	900
	Forestry	1951	*	13	
	Geography	1950[j]	*	19	1,000+[k]
	Mechanical Engineering	1951		21	
	Oceanography & Liminology	1949			
	Aeronautical Engineering	1955			
1955–57	Agriculture Machinery	1956	*	11	
	Agronomy	1956	*	27	
	Animal Husbandry & Veterinary Science	1955	*	25	1,600+
	Chemical Engineering	1956[l]	*	16+	
	Electronics	1956	*		
	Electrical Engineering	1957	*	27	
	Food Technology (W&S)				
	Geodesy and Cartography	1956	*		
	Horticulture	1956	*	12	600
	Hydraulic Engineering	1957	*	17	
	Mechanics	1957	*		1,000+
	Metallurgy	1956[m]	*	12	1,000
	Psychology	1955	*	19	500+
	Silicates	1956		8	

APPENDIX TABLE I (continued)

Period of Founding	Field	Founding Date	One or More Publications	Local Branches	Membership
1958–60	Automation				
	Paper Making	1959			
1961	Aeronautics	1964			
	Crop Research	1961 (W&S)			
	Epidemiology	1961 (W&S)			
	Fisheries	1961 (W&S)			
	Fuels	1961 (W&S)			
	Internal Medicine	1961 (W&S)			
	Measurement Technology & Instruments (D)				
	Metal Corrosion & Protection (D)				
	Obstetrics & Gynecology	1961 (W&S)			
	Opthomology	1961 (W&S)			
	Otolaryngology	1961 (W&S)			
	Pediatrics	1961 (W&S)			
	Plant Physiology				
	Plant Protection	1962[n]			
	Radio Electronics	1962 (WOL)			
	Radiology	1961 (W&S)			
	Shipbuilding Technology	1962 (WOL)			
	Silk Cultivation	1963 (WOL)			
	Surgery	1961 (W&S)			

Sources: Wang Chi, comp., *Mainland China Organizations of Higher Learning in Science & Technology and Their Publications* (Washington: Science and Technology Division, Reference Department, Library of Congress, 1961); *The World of Learning, 1967–68*, 18th ed. (London: Europa Publications Ltd., 1968); *Directory of Chinese Communists Officials* (Washington, 1966); Yuan-li Wu and Robert B. Sheeks, *The Organization and Support of Scientific Research & Development in Mainland China* (New York: Praeger Publishers, 1970).

Note: Abbreviations used: W=Wang Chi; WOL=*World of Learning;* D=*Directory of Chinese Communist Officials;* W&S=Wu & Sheeks.

[a] Includes only those which continued after 1949.
[b] Reorganized 1952.
[c] Merged with Chemical Engineering in 1959.
[d] WOL. Wu and Sheeks report 8+, but since geology is a field with particularly active "mass science" work, it is likely that the WOL figure is more accurate.
[e] Reorganized 1953.
[f] Reorganized 1953.
[g] Reorganized 1950.
[h] Reorganized 1951.
[i] Reorganized 1954.
[j] Merger of Geographical Societies of Peking (founded 1907) and Nanking (founded 1953).
[k] WOL cites membership as more than 2,000.
[l] See footnote c.
[m] WOL cites founding date of 1954.
[n] "A year of New Achievements and Many Successes in Research for Scientist in China" (NCNA, January 13, 1963), *SCMP* No. 2906.