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Dissemination of Scientific Information in the People's Republic of China

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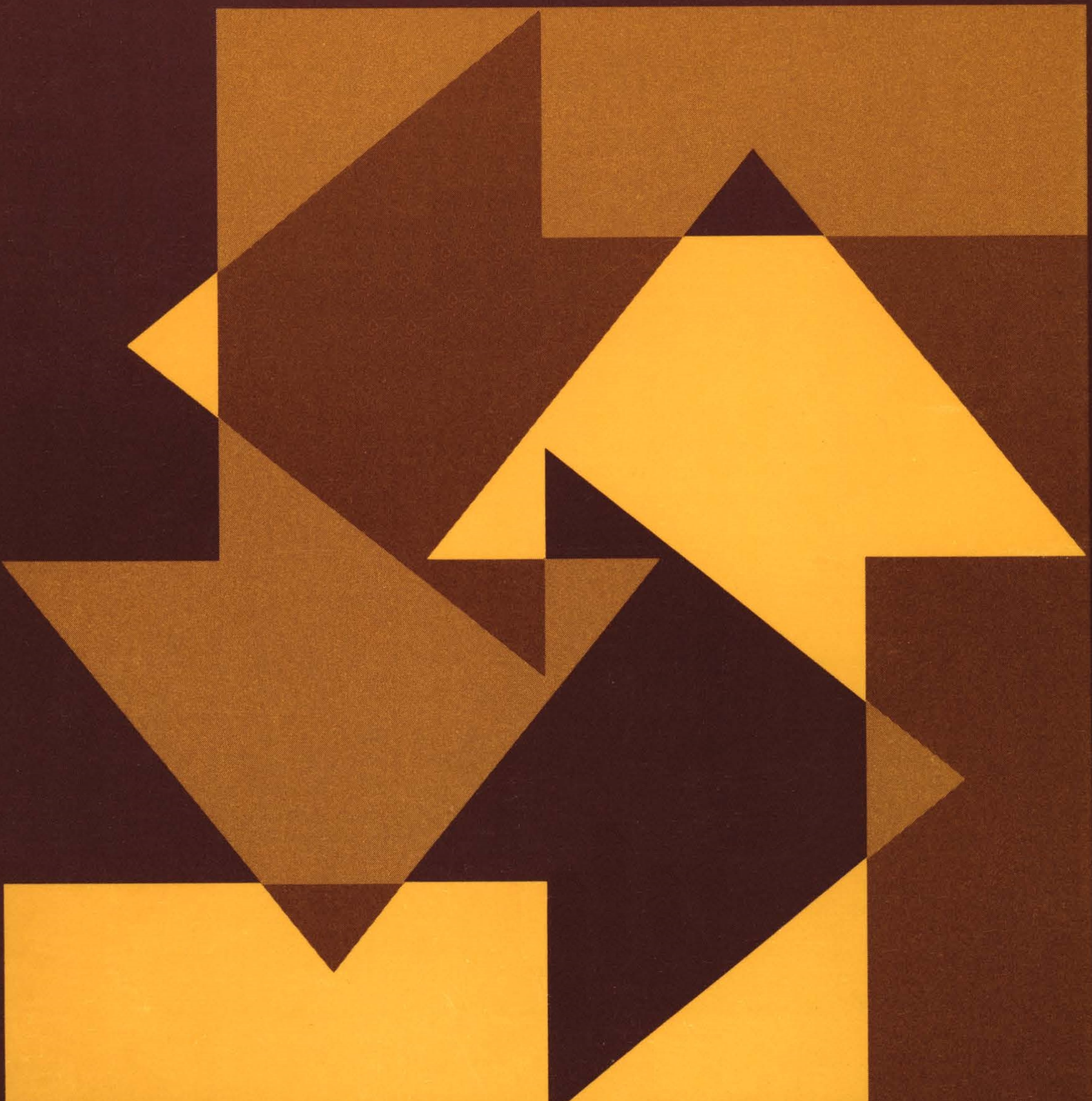
Kieran P. Broadbent



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The views expressed in this publication are those of the author and do not necessarily represent the views of either IDRC or CETA. Pinyin was officially adopted by the Chinese in 1975 as their standard form of latinization of the Chinese script and has therefore been used in this publication.

Contents

Foreword 3
List of Acronyms 4

PART I
Introduction 8
Libraries 12
Library Training 19
Information Services 22
Training in Information and Documentation 29
Awareness of Literature 30
Extension Literature 32

PART II
Computers 36
Computer Applications to Translation and Information Processing 42
Some Conclusions on Current Trends and Developments in Science and Technology Information 50
Appendix I 55
Appendix II 58

Foreword

This monograph is a personal account resulting from a visit to China made with the Chinese English Translation Advisory Group (CETA) between 5 and 26 April 1979. The CETA delegation visited a number of institutions and had discussions with many Chinese scientists, research workers, and teachers in the following areas: linguistics and philology, lexicography, language teaching, computer applications to translation, publishing, and libraries.

This report presents findings concerning library and information services and their related mechanization problems. It has been published by the International Development Research Centre in an effort to make the Chinese experience in scientific information dissemination available to a wide readership. This monograph presents a first-hand account of the present applications of computer technology in China and examines the ways in which the Chinese tackle the unique problems they face in the conversion of Chinese script to a machine-readable format.

I am forever mindful of the warm and friendly way we were received in China. My thanks go out to all those we met and talked with at all levels of society and especially those, in particular Luxingshe, who helped make arrangements during our tour. The support of the CETA and IDRC is also gratefully acknowledged.

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Program Officer
Information Sciences Division
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List of Acronyms

AGRIS	International Information System for Agricultural Sciences and Technology (coordinated by FAO)
AGRINDEX	A printed bibliography with indexes of all records added to the AGRIS file in the period between system updates
ALGOL 60	Algorithm Oriented Language
BASIC	Beginners All-purpose Symbolic Instruction Code
CAB	Commonwealth Agricultural Bureaux (U.K.) — a cooperative venture by the British Commonwealth governments to provide information on agriculture, mainly in the form of abstract journals
CA Condensates	Chemical Abstracts tape services (a brief review from the text of the hard copy: *Chemical Abstracts*)
CO/MARC	Cooperative system for cataloguing North American books
COBOL	Common Business Oriented Language
CPU	Central Processing Unit
CRT	Cathode Ray Tube
DBMS	Data Base Management System
DIALOG	Registered trademark of Lockheed information systems on-line information retrieval system
DOBIS	Dortmund Library Information System
ECL	Emitter-coupled logic
ERIC	Education Resources Information Centre
FAO	Food and Agriculture Organization of the United Nations
FORTRAN	Formula Translator
ISBD	International Standard Bibliographic Description
MARC	Machine Readable Catalogue (Library of Congress)
MINISIS	Mini Integrated Set of Information Systems
NATIS	National Information Systems (Unesco)
OCR	Optical Character Recognition
OS	Operating System
SCORPIO	Subject Content Oriented Retrieval for Processing Information On-line

SDI	Selective Dissemination of Information
SPL	System Programing Language
SSI	Small Scale Integrated
SYSTRAN	System for Translation
TTL	Transistor-Transistor Logic
UNDP	United Nations Development Programme
WAERSA	World Agricultural Economics and Rural Sociology Abstracts (CAB)

PART I

Introduction

Information is a basic need for all countries wishing to manage their resources in an efficient way. Information retrieval has a long history in China. The earliest methods consisted of the regular sampling procedures, enumerating units, and census takers in Imperial China. For instance, the Chinese recognized the close connection between food and population as early as 1368 AD when the first Ming Emperor, Tai Zu, decreed that a "Yellow Register" be compiled every 10 years giving the number of "mouths" (kou) to be fed in each household. A card was then posted on each gate and the number of "mouths" was recorded on it. Census takers were then able to relate the number of persons (ren) in each district to the amount of grain required.

Cataloguing of books and the first annotated bibliography were undertaken as early as the first century AD when Liu Shang (77 BC - 6 AD) started compiling the dynastic bibliographies in a systematic manner, which set the standard for later librarians in China. One of the largest library projects ever undertaken was the compilation of "The Four Treasures Library" (1773-82). It contained 3461 works in 78 016 volumes. Seven sets were produced of which four are said to still be in existence. With the completion of this project, China would have had an excellent foundation on which to build up a national library, but the emperor at the time assumed that all the worthy literature had been collected and the project ended. Literary persecution and a rigid censorship of publishing were equally common throughout China's history. From 1774 to 1782 AD alone the burning of proscribed books took place no less than 24 times, and 13 000 volumes were destroyed. Librarians were not exempt from persecution either, and some of them were even buried alive with their books. A hazardous profession! The destruction of documents, however, was not limited to the premodern period. In 1937 the war with Japan exacted a tremendous toll on library resources and half the national collection is reported to have been lost because of fire and pilage.

In 1949, the People's Republic of China inherited a wealth of library resources and tradition that had previously only been accessible to scholars and literati. Public libraries were first established in 1912, but generally they had inadequate facilities and were poorly endowed. The literacy level at this time also meant that users consisted only of a minority of the educated population, leaving the masses in rural and urban areas outside their influence.

The political events that led to the establishment of the People's Republic of China in 1949 hindered the development of library and information services at a time when the demand for more accurate information resources was growing. Now the growing reality of the need for greater communication to advance the pace of modernization is creating a new emphasis on the development of library and information services. In China, in the area of science and technology, information dissemination relates both to bibliographic data as well as to raw data, and the collection of general purpose scientific and technical information is considered to be an important function. Another interesting characteristic of the information function is the role of supplying equipment. Finally, the overall responsibility for supplying mass knowledge about innovations is an integral part of the information function.

The general esoteric position, in which information services have traditionally been held in China (a position that was intensified during the past two decades), must also be considered within this framework. Librarians and information scientists have occupied an ambiguous position in the face of social and political forces that either have been reluctant to give them the necessary means to improve their work or have wanted merely to manipulate them. However, the growing reality of instant worldwide communication opens up new frontiers in all fields of human endeavour. Through technological advances and reductions in computer costs, communication is rapidly becoming independent of distance. Moreover, widespread public applications of communications networks strongly support the concept that information technology is becoming extensively internationalized and will eventually blur the effectiveness of territorial boundaries.

There is also a growing awareness of the need to interact and collaborate with other countries and to communicate with foreign scientists, as well as a new realization of the benefits to China in cooperating with well-proven international cooperative systems that have developed in the past decade or so. China is now a member of the Food and Agriculture Organization of the United Nations (FAO) and has a permanent mission based in Rome, and Chinese scientists attended the third UNISIST meeting on the Planning and Implementation of National Information Activities in Science and Technology held in Warsaw, Poland, in January 1979. Yet, only a few years before, during the Cultural Revolution,[1] libraries were closed, in some cases books were burned, and scientists and teachers were dispersed to the countryside.

Reports of the Cultural Revolution often conflict. Certain visitors to China at that time had a positive view of the state of science and technology, for instance, Kurt Mendelssohn of the Clarendon Laboratory, Oxford, visited China in 1960, 1963, and 1966 and according to him in 1966 the Cultural Revolution was not affecting research.[2] Others, in a better

[1]Though launched by Mao Zedong in September 1965 at a meeting of the CCP Central Committee, as a result of an attack on a play by Wu Han and other literary figures, reference to it as a political movement of national dimensions first appeared in 1966 (*Red Flag*, No. 8, 1966) as an all-out campaign on all those in positions of authority who were "traveling the road of capitalism." Although it may be said to have officially drawn to an end in 1969 with the launching of the "new economic order," it lasted effectively until 1976 and the arrest of the Gang of Four. (*CCP Documents on the Great Proletarian Cultural Revolution 1966-1967*. Hong Kong, Union Research Services, 1968; and *Decision of the Central Committee of the CCP Concerning the Great Proletarian Cultural Revolution. The So-called 16 Points Adopted by the 11th Plenum of the Central Committee on 8th August 1966*. Peking, People's Publishing House, 1966.)

[2]*Nature*, CCXV 1967, 10-12.

position to judge, have been less optimistic including Vice-Premier Deng Xiaoping who criticized the excesses of the Cultural Revolution describing it as an episode best forgotten.[3] Fundamental to the issue has been the so-called struggle between two lines that developed between factions in the Chinese Communist Party (CCP) and polarized around Mao Zedong and Liu Shaoqi.

Any discussion of this "struggle" and of the details of the Cultural Revolution would be out of place in this report. The situation is highly complex. Let it suffice to say that politics had far-reaching effects on the whole area of science and technology and the dissemination of information in China. What has been evident is that China's development strategy has been distorted by politics to the extent that it has resulted in uneven growth in parts of the national economy.

Since 1976, the People's Republic of China has committed itself to a vigorous and ambitious program called the "four modernizations" (industry, agriculture, defence, and science and technology). The year 2000 is stressed as the time when China will have "caught up" with the West, but by 1985 China hopes to have made significant advances along the road, particularly in the area of science and technology. Currently, visitors to China report a new, open, and friendly spirit toward foreigners. Frank discussions (as the Chinese like to term scholarly and scientific exchanges) can now be held in a more open manner. Our particular group definitely found this to be the case, and we were given access to scientists and data on information systems and computer technology that would have been unheard of only a few years ago.

The post-Mao period has developed quite differently from many observers' expectations. Many view it as a return to the policies of 1957-58 when the Chinese were encouraged to "let a hundred flowers bloom." One member of our group, Professor Thomas Kennedy, a scholar of Chinese history, was struck by the similarity between the China of 1979 and that of 1879. Crossing the border back into Hong Kong he felt as if he "had just experienced a repetition of the 19th century and ... wondered if it could work a second time around. The 'four modernizations' could be viewed, in a sense, as a reorchestration of the theme that inspired the 'Yangwu Yundong' (foreign matters) movement of the late 19th century. This movement advocated a pragmatic adoption of Western science and technology to enable China to catch up with those countries whose superior technologies threatened its moral stamina and territorial integrity. The Yangwu Yundong and the 'four modernizations' both appear guided by utopian ideologies designed to bring the economic benefits of modernization without unpleasant foreign influences to China. The Yangwu Yundong was not successful in any sense. Undermined by political considerations and popular inertia, and distracted by the foreign presence and the pressure of imperialism, the movement delivered too little too late....The parallel is too tantalizing to ignore. The blame laid on the Gang of Four,...the Cultural Revolution, and the Russian threat of hegemony... [is a device]...similar to those employed by the leaders of the Yangwu Yundong." It is doubtful whether China is capable of interpreting its own history outside the very narrow confines of Marxist dialectism, and it may be a mistake to try and place the present political mood into any historical

[3]*Peking Review,* 9 July 1976, 9-12.

context. The present leadership in Beijing (Peking) see themselves plainly as modernizers who can adopt a pragmatic approach to China's development of science and technology. In other words, the lessons from the vicissitudes of recent Chinese development are to serve to ensure more rapid, steady, and viable modernization.

During our discussions we focused many times on how far the present situation would proceed. Often in our talks we were told that "there would be no going back" to the pre-1976 period of "politics in command." Nowhere were we more aware of this slogan than in the area of information retrieval and libraries. Authorship, scientific excellence, and dissemination of data were severely curtailed during the Cultural Revolution. Scientists and intellectuals who were rusticated or heavily politicized have been, to some extent, embittered by the process. The sharing of research results was actively discouraged, and the policy of self-reliance precluded coordination of research and development at all levels. The heirs to the guerrilla-style, mass peasant/worker movement approach to economic development assumed that by liberating the workers and employing them as "large armies of labour" they could solve any task. The result belied the boast. Now everyone freely admits that China lost almost a decade of development in all areas.

Present thinking in China tends to emphasize *how* China's abundant human resources may best be tapped. Without technical guidance, merit, and knowledge of innovations elsewhere, popular energy will be squandered aimlessly. There is still an unmistakable stress on mass mobilization, especially in agriculture and rural development, but it is now tending to be based more and more on scientifically researched data and proven techniques rather than obscure and naive concepts such as "peasant red and expertness." Education is being modernized, and at tertiary institutions that we visited we found a new emphasis on rebuilding curricula and replacing the worker/peasant intake short-term courses with competitive entrance examinations leading to formal 3- and 4-year degree programs. Subjects excluded for serious study during the Cultural Revolution, such as anthropology, social studies, economics, and even religious studies, are now being reintroduced, but priority is placed on the physical and natural sciences.

The March 1978 National Conference on Science and Technology was a key meeting and the theme of that Conference was free and open debate based on scientific principles of inquiry. Although such debate must take place under the guidance of the CCP, there seems little doubt that the present quality, extent, and amount of debate are unique. A second theme of the Conference was adherence to the new principle of seeking out foreign contacts and trying to learn the best of foreign scholarship. Foreign exchanges are now especially encouraged.

The "Outline National Plan for the Development of Science 1978-85" (draft) sets four broad goals:

(1) approach or attain the advanced world levels of the 1970s in important branches of science and technology;
(2) increase the number of professional researchers to 800 000;
(3) build up new centres of scientific excellence; and
(4) build up a nationwide scientific and technological program (includes buildup of library resources; provision of data banks; increase of documentation and computer applications to information retrieval).

Libraries

China has an extremely long library history. In this respect, the country must rank as one of the oldest developed nations in the world. China, for a great part of its history, managed to maintain a high degree of technological development. This record has been and continues to be well documented by Joseph Needham in his prodigious compilation of *Science and Civilization in China*. The historical writing and scientific literature of China were also recorded at an early date. The library tradition was well established long before any kind of organization of records took place in Europe. Descriptive and subject cataloguing began as early as 70 BC and the first library collections are said to date back to the Yellow Emperor (2697 BC). Some writers have also suggested that the oracle bones excavated from the site of the Shang dynasty capital of Anyang (1766-112 BC) were the first evidence of archives.[4]

In the past the Chinese viewed all libraries as a great national resource. As libraries increased in number, they became recognized as indispensable to scholarship: without them the accumulated knowledge of the past would be lost to future generations. When the Emperor of the Ch'in dynasty in 249 BC burned all the books, he was condemned for destroying the nation's greatest cultural asset. The people were said to have "mourned" this loss. The fact that these books were not meant for the people did not make any difference. The very possession of a library was seen as a sign of national wealth. Academic libraries in China can be traced back as far as the Tang dynasty when the Emperor Tai Tsung first instituted the Qiyuan Shuyuan (Academic Collections). First conceived as a kind of imperial archive, these collections soon developed into institutions in support of higher learning, achieving their greatest influence during the Sung dynasty when there were four major Shuyuans in existence. Dispersed in the Ming dynasty, they were restored in the Ching dynasty thanks to the efforts of the Emperor Shunzhi who in 1657 rebuilt the most important. In 1733 several more were strengthened and built under successive emperors of the Ching. Lacking a unified system, adequate financing, and government backing, they fell into decay in the 19th century until 1898 when they were turned into modern schools.

Among the other library and information activities that began early in China's history was the emphasis on the compilation of bibliographies (Yiwen or Jingji). Famous bibliographers, in addition to Liu Shang mentioned earlier, were Si Maqian (145-86 BC) who prepared the Shiji (Historical Records) and Ban Gu (32-92 AD) who wrote the Han Shu (History of the Han dynasty). These bibliographies, which began as

[4] Eichhorn, W. 1969. *Chinese civilization. An introduction.* London, Faber and Faber, 38p.

catalogues of the Imperial Collections, achieved a remarkable degree of standardization and set the pattern for future generations who were able to use them to scan the available literature and check and expand their own inventories.

Libraries in the modern sense have had a relatively recent history, and the concept of user-oriented libraries in the Western sense still has no real meaning. In 1905, following abolition of the traditional examination system, the first provincial library was opened in Changsha, Hunan province. This was closely followed in 1909 with the establishment of the Public Library Act, which created the National Library in Beijing (Peking) and in each provincial centre (Nanjing, Shanghai, Wuhan, etc.). Up to 1949, these libraries were restricted in use, inadequately housed, and poorly maintained. Closed stacks and limited circulation were the rule. In the early 1920s there were about 1000 public libraries in China. In 1936 the figure given was 1502.[5] War and revolution took their toll.

In 1949, the People's Republic inherited only about half of this figure. Currently, the number has increased to approximately 1000 libraries, but of these only about a dozen are of a size suitable for supplying practical, modern services, and 400 other libraries are being added. Book purchases have been severely constrained, and the practice, for a time, of making librarians financially responsible for all books held meant that few people wanted to become librarians. Some progress in amenities and resources was made in the 1930s, mainly with British and American assistance, but the literacy problem alone meant that the few public libraries that were available served only a small clientele. Up to the present, this has probably been the largest single factor that has prevented the development of large user-oriented library and information services in China.

The Beijing Library was built in 1910 and was known at that time as the Jingshi (Metropolitan) Library. Its main collection, however, predates this period and can be traced back to the Ming dynasty; it therefore has a history of some 500 years. It was designated as the National Library in 1958 as part of a network of other significant public libraries in Shanghai, Nanjing, Guangzhou, Wuhan, Sian, Tianjin, Chengdu, and Mukden. Its modern collection at this time reached some 1.4 million volumes. The present library occupies a splendid building of traditional style in the centre of Beijing and is currently being renovated and refurbished. Planning and thoughtful work have produced an aesthetic as well as a functional building, which can accommodate about 1000 readers in approximately 4650 square metres of space. At the time of our visit, the new scientific and technical periodicals reading room had just been painted and the main reading room was still under repair. The present holdings are estimated to be at about 10 million volumes, and 40% of these are in foreign languages. The main foreign collection is in English, Russian, and Japanese. There is no open access except to periodicals.

The library employs about 700 personnel, and some of the staff have received training at foreign library schools. The library was closed during the Cultural Revolution, and many of the staff were dispersed to the countryside, but no destruction of the collection took place. The work of the library, however, went into a state of limbo. Certain gifts and

[5] *China Yearbook of Education*, 2nd edition, 1937.

exchanges continued but, because the library had little to offer in exchange other than political tracts, some major libraries abroad discontinued their correspondence with the library. Consequently, there are serious gaps in some subject areas, so the holdings have an uneven bias. Long runs of periodicals have been interrupted, and the librarian said that obtaining back issues to some serials is a major problem.

The library is technically open to the general public, but there is some restriction[6] as to who actually gets a reader's ticket, which means that the actual number of users for a city the size of Beijing (4 million) is quite small. This is not the only public library in Beijing, but it is the only public library in the true sense, offering user services and providing a general and scientific collection as well as current periodicals. Neighbourhood libraries cannot be considered libraries in the accepted sense because holdings are restricted to a few items of popular literature and current newspapers.[7]

There was not much activity at the library at the time of our visit, although all available rooms had some readers who appeared to be serious scholars, government or army officers. Apparently, only the higher grades of government workers or the higher echelons of the military may actually borrow books, though others may be permitted to use the reference section.

There was insufficient time to inspect the main and Western catalogues closely; however, we were told that some 2000 volumes were received each month. The English-language section contained approximately 3000 new acquisitions that had been recently catalogued and, probably because of the large number of staff that was available to record the bibliographic data, there was only a minor backlog. Up to the present, various methods have been employed to catalogue documents. The Chinese Academy of Sciences (CAS) devised a system for scientific libraries in 1958, and the Ministry of Culture devised a scheme for neighbourhood libraries. Some libraries simply adopted UDC. Older books and documents are still classified according to the 3rd century Si bu system. Recently, efforts have been made to standardize classification schemes. The classification scheme for foreign collections, introduced in 1970, is similar to the Library of Congress and is simply called the Chinese Classification System (Quanguo Tushuguan Fenleifa). A roman numeral prefixed to the classification is used to indicate from which country the book originates. The classification scheme for Chinese materials is a decimal system linked with pinyin romanization. (Pinyin romanization of the Chinese script was officially adopted in the PRC in 1975.) The system

[6]In Shanghai three members of our group found a small but well-stocked library with what appeared to be a public reading room at the Shanghai Municipal Museum. The current periodicals on display contained many specialized journals in several scientific fields, as well as scholarly journals of major universities. However, the librarian in charge quickly asked us to leave saying that the "library was not open to the public."

[7]Small "independent" street libraries were evident and seemed to be quite popular. It is uncertain if these are operated by private individuals or not, but it appears that people can exchange or borrow popular novels for a small payment or "deposit." Popular taste in literature generally means traditional novels such as *Dream of the Red Chamber* There seemed to be little interest in or knowledge of contemporary literature. Several people questioned by a member of the group had not heard of such modern writers as Ai Wu or Hao Lan.

utilizes 22 letters from the roman alphabet for subdivisions for various disciplines, e.g., "J" is arts, "G" is science, and "Z" is designated as miscellaneous. Oddly, the letters L, M, W, and Y are not used and no reason was given. Older cards had no pinyin and were handwritten Chinese characters. New cards were printed and had pinyin for the main entry with tonal diacriticals (Fig. 1). Separate romanization was given for each character with no word combinations (e.g., nung ye not nungye for agriculture). This seems to indicate the transitionary nature of the main catalogue as well as official uncertainty about the correct use of pinyin for subject entries. No work was being done on the recataloguing of the older entries. A similar situation was found at other libraries that were visited. Librarians are probably just as confused and inadequately briefed on all aspects of pinyin as other individuals we spoke to. There still does not seem to be an overall policy, for instance, on linking words together to reflect the polysyllabic nature of modern Chinese. Sometimes words are linked together, sometimes not. This inconsistency is reflected in the cataloguing of books, in official documents, on shop signs, and as well with personal names. From a user's point of view, the present situation is confusing, particularly because, as we found, most Chinese at all levels have inadequate knowledge of pinyin to the point where they often misspell their own names or simply render them in Wade-Giles romanization. Librarians, therefore, are probably right in adopting a cautious approach to cataloguing at present.

Library mechanization has not been implemented in China except in the Nanjing (Nanking) University Library where, in April 1979, a small experimental machine cataloguing exercise began using a set of MARC tapes supplied by the Library of Congress. The object of the trial was to adapt MARC format to local hardware. Input is on paper tape to a Siemens 773 computer at another institute. All output is by line printer of the

dà qìng rén zhī gē
大庆人之歌 （小提琴独奏曲·钢琴伴奏） [正谱本]

蒋颂建编曲 张 申、焦 鹓配伴奏 人民音乐出版社 1978年9月

13页 16开 0.33元

J647.21 48.9441 L885 (38)
1978年10月11日编印 8026·3490 78—4663

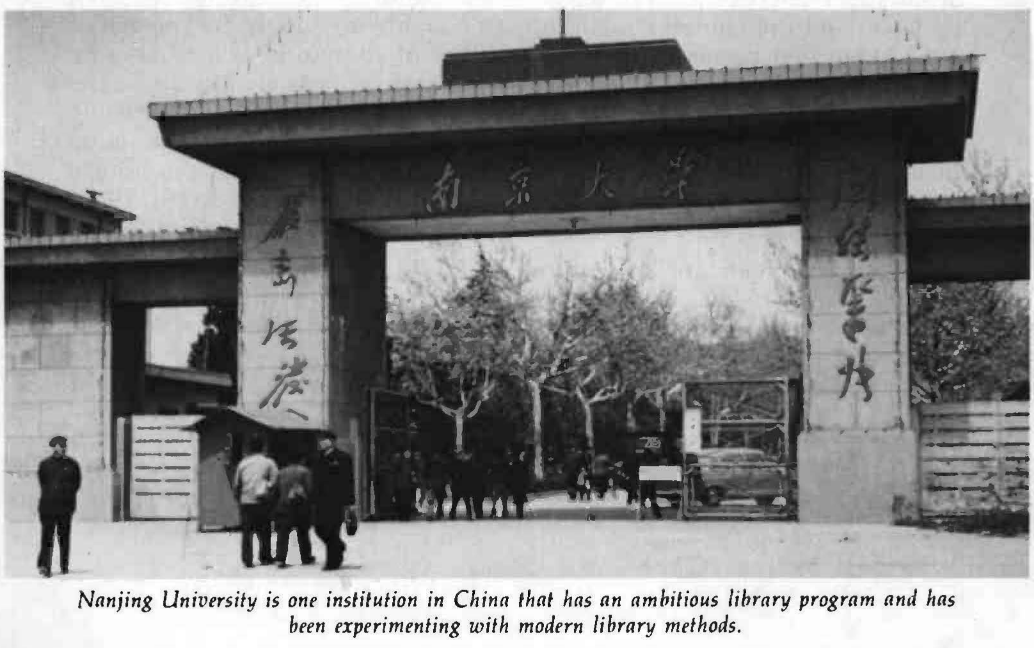
Fig. 1. Library Classification Card.

Main Catalogue Beijing (National) Library.

bibliographic record. No card output is possible. The work on hand is restricted to about 400 English-language documents. Cataloguing of Chinese books is not being contemplated because of encoding difficulties. We were told that elsewhere library mechanization was in the planning stage only. The National Library had no hardware nor any definite plans to acquire any in the near future. The person in charge of library automation, Miss Shao Changyu, said that library mechanization was only being discussed at present and would probably be carried out with an appropriate institute close at hand, such as the Institute of Scientific and Technical Information of China (ISTIC). She had only a few members of staff who were studying various systems such as MARC and SCORPIO. There was also an interest expressed in ISBD. The Beijing Library's main activities were described as providing user services, publishing the union list of periodicals and monthly current national bibliography (Quanguo Xinshumu), handling inquiries on a national basis, and compiling bibliographies on special topics. A National Union Catalogue of Classical Texts (Quanguo guji shanben shuzongmu) is being compiled. The library in Beijing is coordinating this work with other libraries in the network. The catalogue is planned for publication in 1982-83. Basically, each library will produce its own catalogue. When completed, the cards will be sent to Beijing. This is expected to be completed by early 1980.

Nanjing Public Library, which for a time was China's main library when Nanjing was the nation's capital, had no major resources for cataloguing and no mechanization plans. The main collection was taken to Taiwan when Nanjing was evacuated by Chiang Kaishek's nationalist government in 1949. This collection, together with certain other library resources, now forms the nucleus of the National Library in Taibei, Taiwan. The present Nanjing Library is being rebuilt as a provincial library but currently lacks the collection to act as library resource for the region. Great reliance, therefore, for Central China is placed on the Shanghai Library, which, together with the Beijing Library, forms the nucleus of the present national library structure in the People's Republic. The Shanghai Library, with a total collection of 6.5 million books, is, however, apart from Beijing, the only library one can consider as having national or provincial applications. It was formed as a consortium of four other libraries in 1952 and serves some 3000 readers daily. In addition, it is said to serve the nearly 1600 neighbourhood libraries and 2700 production brigades.

The national library network fell into decay between 1966 and 1976 and does not operate effectively at present. In 1955, a directive issued by the Ministry of Culture required all publishers in China to deposit a copy of their publications with one of the national libraries within 3 days of publication, but it is not clear whether this has ever been satisfactorily complied with. The system of interlibrary loans is basically operated by the Beijing and Shanghai libraries, and the system is restricted to a few government institutions. In any case, the national library network was really set up to rationalize the acquisition and distribution of foreign-language publications in conjunction with the China National Publication Import Corporation (Guozi Shudian). A Union Catalogue was also attempted but has not materialized and must presumably await library mechanization plans. The overall coordination and planning of the national library network comes under the Council of Scientific Libraries, which has drawn up a list of specialized libraries. Basically, this has drawn lines of



Nanjing University is one institution in China that has an ambitious library program and has been experimenting with modern library methods.

demarcation between the so-called public libraries and libraries attached to institutes of the CAS, the Chinese Academy of Agricultural and Forestry Sciences (CAAFS), and the Chinese Academy of Medical Sciences (CAMS). The academies have concentrated their efforts on science and technology while other libraries have concentrated on general topics and the social sciences.

The situation is now blurred with the establishment of the new Chinese Academy of Social Sciences (CASS), and at the time of our visit it was not possible to obtain a clear understanding of the present library acquisitions policy. For instance, the Beijing and Shanghai libraries have several scientific and technical reference materials (*Chemical Abstracts, Agrindex, Science Citation Index, Food Sciences and Technology Abstracts*, etc.), which are also held at the CAS, and the Beijing Library receives all FAO publications. However, the Beijing Library did not appear to have any of the major social science reference tools such as ERIC, WAERSA, *Sociological Abstracts, Economic Abstracts*, etc. The major collection here focused on Soviet and East European abstracting journals such as *Abstracts of Bulgarian Literature*, etc. At the time of our visit to the Beijing Library there was a display on how to use the *Science Citation Index*, and scientific journals tended to be most prominent. But several current awareness and abstracting journals were obviously not being used; for instance, *Agrindex* lay on a shelf apparently untouched.

The position probably reflects the current state of exchange. In 1949 the new Chinese government launched a vigorous program of foreign acquisitions through Guozi Shudian. Between 1950 and 1953 this clearinghouse processed some 47 million foreign books and journals. Guozi Shudian also acts as the internal distributor of foreign-language materials and maintains more than 300 branches throughout China. Up to 1962, and prior to the Sino-Soviet split, the largest number of foreign book imports originated from the Soviet Union, which made up 70% of the total, followed by Japan and the United Kingdom with roughly 10% each. By the end of 1963 Japan had become the major supplier of foreign books, making up more than 63% of the total as a direct result of the Russian withdrawal. The present position is somewhat changed with a larger share now being accounted for by British and American books, which it is said make up close to 65-75% of the total, followed by Japan. Russian materials in library collections are, by contrast, quite dated, most titles relating to the 1950s and early 1960s.

Another important institution that is involved in acquisition and distribution is ISTIC. This institute, which is under the CAS, will be discussed in more detail later but, together with the National Library, represents the main element in library and information services.

Library Training

Modern library schools in China were largely a Western innovation, and the first schools, established in the early part of this century, came about largely as a result of British and American influence. Previously, librarianship evolved in the realm of the intelligentsia and the Imperial court. Librarianship, as a profession, is hardly established even today. The first School of Librarianship was the Boone Library School at Wuchang, founded by May Elizabeth Wood in 1921 and affiliated with the Central China University in Nanjing. It established a 2-year undergraduate program in the American tradition. It taught basic cataloguing of Western books, library administration, and reference services. In 1929, this library school was absorbed into the Central China Technical College and began admitting middle-school graduates into a 3-year degree program. The University of Nanjing Library School, founded by Harry Clemons in 1928, had a short history, surviving only until the mid-1930s. St. John's College, Shanghai, offered a 2-year undergraduate program until it closed in 1950.

The major library schools at present are at Beijing and Wuhan universities[8], and the only one offering a formal 3-year course is Beijing University. It began a special library course in 1947, offering 70 credits, including Chinese bibliography, as electives to all departments. The most famous staff member of the Beijing University library was, of course, Mao Zedong. He worked there as a messenger for a short time in 1919 under the university librarian, Li Dazhou, who was a founding member of the CCP and one of Mao's early mentors. Graduates or undergraduates of this special library course could obtain certificates of librarianship on completion of 70 credits, and it helped provide a steady flow of librarians to posts in various institutes in the Beijing area as well as elsewhere. This course was discontinued in 1949 but resumed again in 1952 under new university leadership and began to provide the only avenue of library training in China. During the Cultural Revolution the course at Wuhan University was discontinued, and the one at Beijing was "de-emphasized" and shortened.

We were told that Beijing University Library School was running the only modern course available at present and that courses in information science and computer technology were being introduced. This school processes about 200 new librarians a year. Neither Nanjing, Fudan, nor Shanghai Normal universities, among the institutions visited, offered library training as part of their curricula. The poor quality of instruction and technical bias of the Beijing School toward cataloguing were cited as among the main causes for so few applicants for library training. For

[8]Several other institutions, such as Southwest Normal College, Chongqing, may have courses but no one was very sure. However, some technical colleges and middle schools were said to be offering library studies as options to their curricula.

instance, China has generally tended to favour subject cataloguing rather than descriptive cataloguing. Readers are expected to find books by browsing instead of consulting catalogue cards. The previous lack of government emphasis has also been blamed for the present slow stream of trained librarians in China. We should also take account of the weakness of professional librarianship signified by the absence of a Library Association, which has created institutional as well as information dissemination difficulties. However, in July of 1979, a China Library Society was established and China's first forum on library science was held. The conference was attended by representatives from local library societies and library research centres in Beijing. At this conference Liu Jiping, curator of the Beijing Library, was elected as president of the Society's council. The China Library Society had already published the first issue of its publication *Library Science Reports* prior to the meeting.

Most educators had given a low priority to librarianship as a profession, feeling that it was easier to train middle-school graduates to catalogue and compile crude bibliographies than to attempt to train graduates or subject specialists to take over design, application, and growth of libraries. On-the-job training was preferred. Library administration took on a political meaning, and cadres were simply assigned to run the library as a function of a specific institute or neighbourhood management task, and during the Cultural Revolution major libraries were run by a revolutionary committee who simply recruited factory or farm workers and gave them part-time training. Libraries were also staffed by volunteers. The main idea was to prevent the development of specialization. The result has been that there are too few trained professionals to run libraries efficiently.

Library training received a further blow during the Cultural Revolution with the disruption of educational institutions, particularly at

A lot of basic information in China is still obtained by rudimentary means. This person is reading a wall poster, which in this case is calling for the support of Vice-Premier Deng Xiaoping's policies, on the Xidan (democracy) wall. The display of such posters has since been regulated.

Beijing where a great deal of student unrest and Red Guard activity suspended classes for several years. Those who actually went to library school had to have at least 2 years of farm or factory work behind them. However, the present political climate has revived an interest in librarianship and documentation, and training in information science is considered an integral part of the "four modernizations." Most librarians we spoke to are now extremely conscious of their professional status and their lack of contact with current developments outside China. Their main area of interest is in library automation and information retrieval programs, such as MARC, CO/MARC, SCORPIO, DOBIS, etc. It appears that each major library wants to modernize as rapidly as possible. The major drawbacks are: the lack of trained personnel to design and operate modern systems; the lack of library resources to operate user-oriented systems effectively; and the division between Chinese- and foreign-language publications.

China is, however, determined to catch up, is stepping up its training program, and hopes to train an entirely new group of graduates in librarianship by 1985. We frequently found that personnel or students were co-opted from the mathematics or physics departments at universities to implement library automation. Others are being selected for training at universities abroad, and we constantly received inquiries about suitable courses in North America or special libraries that offered in-service training. Visits by foreign experts are now common and can be expected to increase. For instance, in September 1979, as a follow-up to the visit to China in July 1978 by the Director-General of Unesco, ISTIC hosted a training course on information systems, sponsored jointly by the Bureau de l'information Scientifique et Technique (BNIST), Paris and Unesco. The program, attended by approximately 40 Chinese librarians and documentalists, consisted of lectures and practical exercises designed to demonstrate to the Chinese the impact of new techniques now available to documentalists and librarians in the field of information storage and retrieval — especially the use of on-line systems for the creation and maintenance of bibliographic files. Accordingly, different types of equipment, software packages, and indexing tools were discussed. It is intended, sometime in 1980, to disseminate the lectures given on this course to relevant institutions in China.

There is some evidence that reader services are being extended. But officials still appear reluctant to discuss in exact detail how such services will reach a wider public. However, with a broader latitude to collect new books on different subjects, Chinese librarians will now have more scope for developing user services in certain areas, and we saw some evidence of this for science and technology. There is a great deal of work to be done, however, on restoring collections in areas affected by the policies that existed during the Cultural Revolution. Catalogues reflect this need due to the large gaps in some subject areas where books have been culled out. Wherever we visited we got the impression of a cautious staff, but most were optimistic about the difficult tasks they will face in meeting increased demands on library services under the modernization program.

It became obvious from our talks that librarians and documentalists in China will need a great deal of assistance to catch up with modern methods. The message we emphatically received was that the main requirement was not for cash grants but rather technical advice and "hands on" training.

Information Services

Although libraries have had a long history in China, information and documentation is a relatively new area of development. The All China Association for Dissemination of Scientific and Technical Knowledge was established in 1950 to help disseminate current information and increase communication between scientists. Also, the Institute of Scientific and Technical Information was founded in 1956 to act as a clearinghouse for scientific information and serve user needs nationwide. It also had, as a novel side role, the responsibility for supplying items of technical equipment. Both organizations came under the CAS, and it, in turn, answered directly to the State Council. The CAS was formed from a merger of the Academica Sinica and the Beijing Academy of Sciences. The main original tasks of the CAS were specified as: (1) to define the direction of scientific research; (2) to administer programs; (3) to recruit and train workers; (4) to reorganize and consolidate programs; and (5) to engage in dissemination research.

Scientists and technologists in China, as elsewhere, are organized into professional associations to exchange knowledge. Prior to the Cultural Revolution there were some 40 scientific societies, which had a combined membership of more than 100 000. We were told that currently these figures were about the same, with membership of professional bodies now growing each year.

Scientists were grouped professionally into a body under the banner of the All China Federation of National Science Societies. This body also had an information function because it was conceived as a mass organization heavily politicized and charged with the task of "popularizing" science and technology. Because it developed branches and chapters in all parts of China, down to the lowest levels of schools, factories, and farms, it was seen as an appropriate vehicle for rapidly transferring the results of research. In 1958 the Science Society was merged with the Association to form a single science body called the Scientific and Technical Association of China. We may infer, therefore, that by the early 1960s dissemination of information was a centralized process, unified within the state structure, and under the control of the CCP.

The major source of dissemination of foreign literature has been the Institute of Scientific and Technical Information (ISTIC). (See Fig. 2.) Initially, its role seemed to be to act chiefly in collaboration with Guozi Shudian to acquire and distribute foreign literature within China, but individual societies and associations have maintained an independent information function, for example, the Agricultural Association of China disseminates agricultural information. Prior to 1960 and the Sino-Soviet split, this function was largely aimed at exchanges with Soviet scientific institutions and bulk purchases through bookstores in Hong Kong and

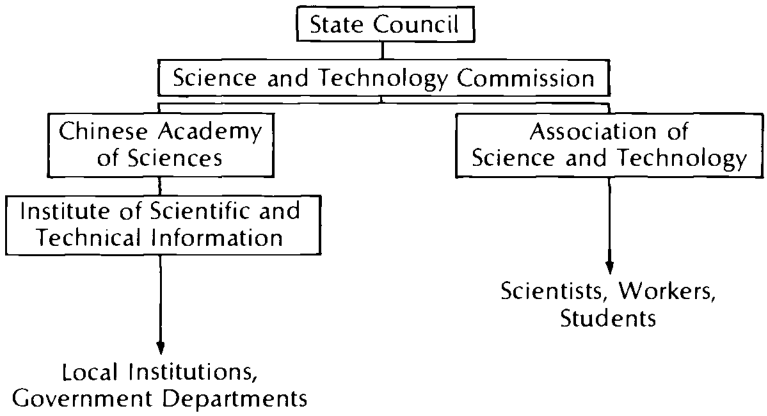


Fig. 2. Structure of the State Scientific Information System.

Tokyo. It started out with a small staff of about 200, some of whom were engaged in the documentation of foreign literature, and in 1960 it opened a branch office in Chongqing. In 1955 it founded a current awareness journal, *Kexue Xinwen* (Science News), and, in 1961, an index to Chinese scientific periodicals was issued in 28 monthly parts covering 7000 scientific serial publications in several languages, rather like *Referativny Zhurnal* in the USSR. In 1962, the *Annotated List of Scientific and Technical Periodicals* was issued, which contained 15 abstracting journals covering different branches of science. A large proportion of the abstracts were translations from *Referativny Zhurnal* or extracts from *Chemical Abstracts*, CAB journals, etc. In fact, English-language sources were most numerous. Translations were handled in the Translation Bureau and involved a great deal of work. During the early period of ISTIC (1956-66), more than 50 000 foreign texts were said to have been translated. The large amount of Russian translations has declined steadily since 1960. Up to that date approximately 50% of all texts translated were Russian. By 1970, the amount was said to be negligible, a mere 2%. ISTIC also acts as a publisher of scientific texts, which account for the largest share of published material in China at present. Scientific bookshops are popular and are always full of customers. Scientific and technical texts presently account for 63% of all publications.

In 1966, the Cultural Revolution severely impaired information and documentation services. Publication of scientific and scholarly journals was brought to a halt, and only political texts of a crude informative nature were permitted. At this time, Chinese scholarly journals sent abroad on exchange ceased altogether and in some cases were substituted with texts extolling certain features of the Cultural Revolution in terms of advances in agriculture or industry, etc. Many foreign libraries faced with such a situation simply gave up sending materials in exchange. Because China relied to a large extent on exchanges, library resources began to stagnate. Nevertheless, China did make purchases of certain books and reference tools, and CAB and other abstract journals continued to be taken regularly by Guozi Shudian for the whole period from 1966 to the present. There was some disruption at ISTIC and within the CAS structure, however, that impaired the work of documentation, and it is evident that abstracting and

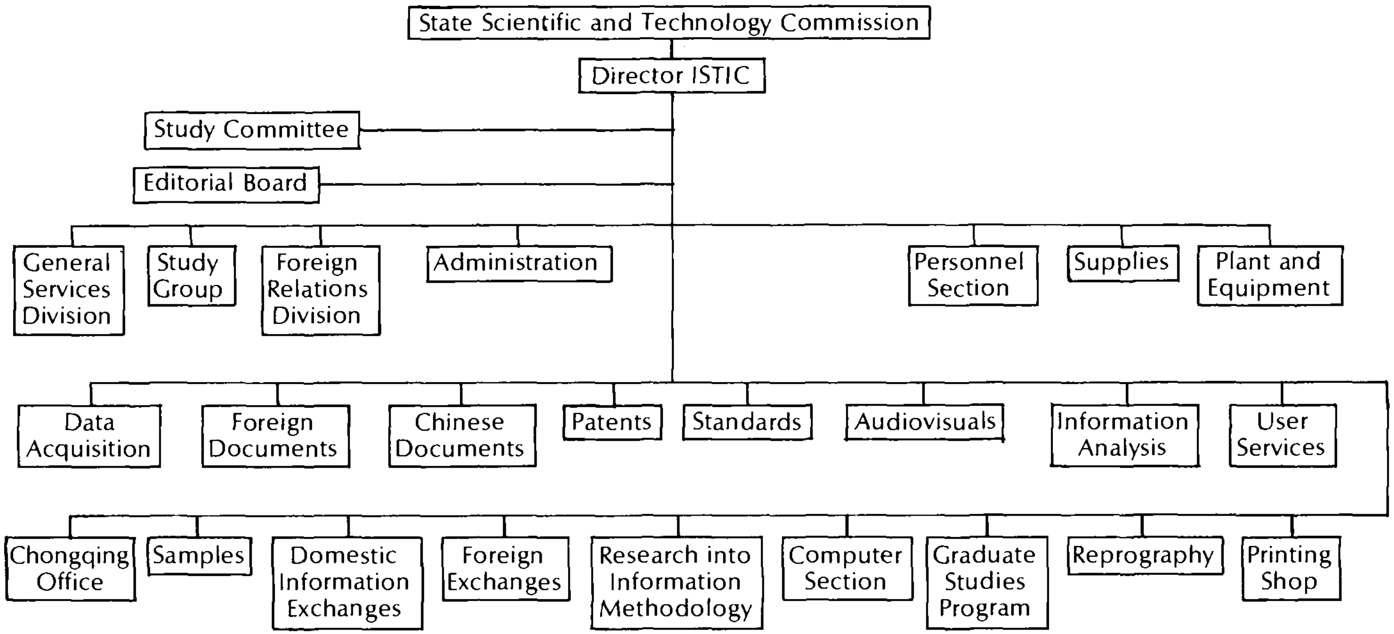


Fig. 3. The organization of the Institute of Scientific and Technical Information of China (ISTIC).

indexing slowed down as a result of the May 7th Movement[9] and dispersal of staff to the countryside. Foreign literature was viewed with suspicion and information dissemination received a new emphasis on indigenous knowledge. Production of the indexes became erratic, and distribution was ceased for a time.

At present the services of ISTIC have received a new emphasis under the modernization program. It now has a total staff of 1500 including 400 in Chongqing (Fig. 3). Its current functions are: (1) collection of scientific and technical information both in China and outside; (2) indexing, abstracting, and editing of Chinese- and foreign-language materials; (3) translation; and (4) selective dissemination of information.

The international interests of ISTIC are now considerable. Acquisitions for 1978 included 35 000 research reports, 1400 conference proceedings, 7200 science and technology journals, 760 000 items on patents, 28 000 references to standards, 120 000 samples and brochures of manufacturers and equipment, and 203 filmstrips. The total domestic and international collection can be summarized as: 9700 journals on science and technology; 600 000 monographs, doctoral dissertations, and research reports; 6 million abstracts of patents; and 300 000 materials on standards. ISTIC presently maintains exchanges with 63 countries, 53 international organizations, and 2000 individual institutions. The following catalogues are provided: a general catalogue, a Western subject catalogue, a Japanese subject catalogue, a Russian subject catalogue, a catalogue of Western institutes and organizations with brief descriptions, and a catalogue of conference proceedings. In 1978 ISTIC compiled and published some 10 million titles, mainly in its indexing and abstracting journals, and conducted literature searches in some 90 special subject areas. In addition, more than 1 880 000 items were translated, covering some 50 subject categories. Research reports covering nine major subject areas were also published, totaling 6 730 000 items.

Currently, ISTIC is stressing document availability and operating a current awareness list backed up with journal circulation and photocopy services, a microfiche service, and patent searches.

In 1978, ISTIC responded to some 11 000 mail inquiries with the circulation of 3.5 million copies of journal articles and 4.4 million microfiche page copies. An additional activity is the Institute's role as conference organizer; for instance, between 1977 and 1979 it organized several national conferences on microbiology, laser applications, information processing, and control of wild oats. ISTIC receives hard copies of foreign data bases, for example, *Chemical Abstracts* and *Agrindex* but is not contemplating on-line services for foreign data bases at present because of technical difficulties. However, it is studying the possibility of introducing such services in the future. Meanwhile, *Chemical Abstracts* has received its first order for computer-readable information files from China. The

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[9]This refers to the directive on educational reform issued by Mao on 7 May 1966. In addition to wide political objectives designed to combat "revisionism," it specifically required every male professional under the age of 60 and female under 55 to indulge in physical tasks for varying intervals. In addition, a minimum of 2.5 out of 6 working days at institutions were to be spent on political study (*People's Daily*, 18 June 1967).

Chinese Society for Chemical Industry in Beijing requested, and has been granted, licences to use five *Chemical Abstracts* computer files. The licences were arranged through the China National Publication Import Corporation.[10]

Several problems are hindering ISTIC's development, basically these are:

(1) the location, size, and facilities available at the present site, which are shared with the College of Chemical Engineering on the Beihuan (North Circular) Road in Beijing (a UNDP grant had just been obtained to modernize information services, and to make purchases that include the installation of new computer facilities);

(2) the lack of technical know-how to introduce a fully computerized information retrieval system; and

(3) related to (2) above, the problem of translation.

A worldwide difficulty for communication of science and technology is language diversity. It is particularly acute in China, and a major problem confronting information processing by computer is the nature of the Chinese language itself. The 5000 basic characters needed for normal translation purposes, plus a further 3000-4000 needed to cover all scientific terms and concepts, are too many to be easily utilized by computer at present. Representatives from ISTIC said that a meeting had been held in 1978 to examine the whole problem of storage and retrieval of information by Chinese characters. The main questions addressed at the meeting were those concerning inputting the whole character, decomposition and recomposition, the use of latinization (pinyin), and the combination of pinyin with other character sets.

Research in this area must be considered ongoing. They had, for instance, looked at research on this problem being carried out abroad and had heard that the Wang Laboratories in the USA had developed a triangular method of encoding Chinese characters, but they did not see how this could be seriously adapted to the numerous complex characters in the language. A great deal of effort is presently being directed at reform of the written language, linguistic research, and translation problems. Plans are in hand to help scientists who can read foreign languages by making primary documents published in other languages more widely available.

Until translation problems have been solved, it has been decided to opt for one conventional language, English, for transfer of scientific information. Therefore, English-language teaching is being encouraged at every level of society. There is the impression that in opting for a dual policy in this area, the Chinese are unsure of the best long-term solution. They are probably mindful of the Japanese experience, where early in the 20th century the government encouraged massive translation of technical literature and textbooks. However, the quality of these translations was very poor and has remained so even after years of experience. Furthermore, Japanese neglect of the spoken word has been a definite stumbling block to personal contact with foreign scientists. Exchanges between Japanese and foreigners are still severely constrained as a result. However, this is not encountered so much in China where the government has invested in teaching foreign languages. The present intensity of

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[10] *National Federation of Abstracting and Indexing Services (NFAIS) Newsletter,* 1979, 21(2), 6p.

English-language learning is without precedent, and it is common to find labourers, peasants, and artisans assiduously learning English for at least half an hour a day. (Our group was continually being stopped to give pronunciation lessons to students in parks, shop assistants, and people in the street.)

At present, information storage and retrieval is performed by manual methods. Chinese- and English-language materials are handled separately because of the translation problem. A dual service is operated to aid the many scientists who read English. Therefore, ISTIC is interested in developing a separate computer system for its English-language materials. As its computer capability is extended over the next few years the staff hope to be able to operate SDI services in selected subject areas and to go abroad to foreign information analysis centres to study modern documentation techniques.

At ISTIC we learned that China is currently in receipt of a UNDP grant totaling U.S.$6 068 000(RMB 11 760 000) to provide a modern information service. The grant provides for both equipment ($580 000) and training ($380 000). The Chinese government will also give $7 587 100 to provide manpower training and a new building. The purpose of the grant is to establish in Beijing a training program in modern information retrieval and data base management methods, a new building and ancillary sites for ISTIC, a computer system with all peripherals, data bases and corresponding software packages, and user services.

Burroughs, the U.S. computer firm, was awarded the hardware contract, and Phoenix, another U.S. company, the software contract. Training of software personnel will be carried out in conjunction with the Beijing Institute of Computer Technology. A National User Committee has been set up to develop profiles for agriculture, food, industry, and energy users. Subsequent to our visit it was decided that between them both ISTIC and BICT would also purchase five Hewlett Packard HP3000 mini-computers to deal with information processing problems.

The discussion at ISTIC demonstrated that there is an urgent need to evaluate the mass of socioeconomic and technical data that is now available through mechanized data bases. Such information includes statistics and bibliographic data of key literature in such areas as industry, agriculture, energy, education, and medicine. The ability to tap such information resources rapidly would not only expediate the transfer of technology in China, but also facilitate dissemination of information unique to China that would be of potential value and use to other countries. The concept of international cooperation is now very strong. Unfortunately, China does not possess the necessary computer hardware nor software to process and analyze information of such a magnitude. National infrastructure is still weak in this field. The theory and practice of mathematical modeling needs to be encouraged nationally for a modern computer system to function well. The most pressing objectives are to organize suitable manpower training programs, create a centre of operations, install modern equipment, and acquire data bases.

Research into methodology is currently very important. We were told that Vice-Premier and Minister-in-Charge of the State Scientific and Technology Commission, Fang Yi, had stated at the recent National Science Conference in Beijing that by 1985 China will set up data banks and information analysis centres for various disciplines. China would join, through Unesco and FAO, international systems like NATIS and AGRIS that would benefit the development of scientific knowledge in China and help the modernization drive. For instance, an agreement was signed in May 1975 between the U.S. Department of Commerce and the Scientific and Technology Commission, Beijing, that will provide China with access to the mass of technical and scientific reports recorded by the National Technical Information Service (NTIS). Formal links have been established between ISTIC and NTIS that will include the exchange not only of scientific literature but also of personnel. It is also possible that China will implement some foreign systems, e.g., MARC. Software compatibility is a major drawback. However, China recently imported a few IBM machines and others compatible with IBM software. ISTIC, for instance, recently bought a Japanese minicomputer TDK 70 with a 64K core (16 bits) and is using this to train operators in the rudiments of mechanized storage and retrieval. It also has a PDP 11/45 and a smaller PDP 8, and is planning to replace these with the newer PDP 11/70. Storage and retrieval of both Chinese- and English-language documents are being experimented with on these machines. An automatic typesetting program and software are being developed in a batch mode process to handle profiles of specific scientific data bases. A thesaurus, for an agricultural data base, has been 75% completed. Machine translation is carried out as ongoing research with other institutes. ISTIC considers the large commercial data bases expensive to lease, own, and operate, for example, the CAB data base would cost in excess of U.S.$4200 at 1979 prices. DIALOG is not seen as an alternative either, because, even with the possibility of a satellite link-up, costs will be a major consideration and China has to consider the cost-benefit of utilizing such a system. International cooperative systems seem to offer the most satisfactory method of obtaining information in the long-term.

Among other institutions conducting studies into information storage and retrieval is the Beijing Institute of Computer Technology (BICT), which is developing a library information system for the CAS library. The CAS is a major library resource in China as well as for the greater Beijing area. In 1959, it had approximately 2 million volumes, which had grown from a nucleus of 250 000 under the pre-1949 Academica Sinica. Presently it holds close to 5 million volumes and nearly 25 000 periodicals. This does not include individual branch, province, and institute libraries. BICT is also experimenting with bibliographic retrieval systems both for Chinese- and English-language documents. It has tried using pinyin latinization for the Chinese data but this is very experimental. Retrieval of English-language documents has been tried using keywords and has simply been built around a thesaurus developed from various international vocabularies. The team lacks knowledge of workable systems and was very interested in the possibilities of MINISIS. All their computer programs are written in their own language, BCY (Bianyi Chengxu Yuyan), which is a pinyin acronym for algorithm translation language and appears to be an adaptation of ALGOL 60. Because ALGOL is similar to SPL in use by Hewlett Packard, BICT believes MINISIS would not be difficult to adapt for their purposes. Interest was shown in the HP series as an alternative to Japanese or indigenous machines because it has greater potential storage capacity for its size and greater flexibility of operations especially in the area of storage of bibliographic information.

Training in Information and Documentation

ISTIC already maintains a small training program for graduates in Beijing (Fig. 3). Students are mainly computer, mathematics, or physics graduates. Currently about 20 students are receiving instruction at any one time. Students receive training in indexing, abstracting, information systems, methodology, cataloguing, reprographic systems, computer programing, data communications networks, and media technology.

Training and education of the next generation of scientists and technologists is receiving a new emphasis. Language training is a key area and these youngsters were very anxious to test their English on members of the group.

Students and information scientists from the Institute are also being sent abroad for training at suitable universities. However, there appears to be no coordination of training in this area and at Fudan University, Shanghai, for instance, little was known about the training program available at ISTIC in Beijing. ISTIC admits that it lacks depth of knowledge about training programs in modern systems now being offered abroad, and for this reason it appears likely that Chinese students will now opt for programs at the major universities abroad and thus gradually build up their own capabilities in this area of instruction.

Awareness of Literature

The problem of dealing with a growing body of both indigenous and foreign literature now appears daunting to the Chinese. The literature explosion has meant more and more that manual methods are inadequate for efficient dissemination of information in science and technology. Until the last 2 years, and implementation of the principles of the "four modernizations," China has been effectively insulated from the massive problem associated with storage and retrieval elsewhere. The Cultural Revolution de-emphasized the influence of foreign innovations and, consequently, the need for a lot of foreign literature. Libraries, as we now know, were severely disrupted. Authorship was also discouraged during this period, and publication of research results was not a priority. Research was supposed to come up from the peasants rather than down from remote urban-based research institutes. It was, from all accounts, a decade of academic confusion when scholarly publication was suspended for all but a few multiauthor, politically biased tracts. The few papers that did manage to appear were often written by revolutionary committees and personal authorship was actively discouraged. Under such circumstances the flow of documents fell to a mere trickle, and dissemination of information for all practical purposes, in the accepted sense, ceased.

Today, books are a scarce resource in China. There is a severe shortage of paper. The present policy is to publish a large number of titles but in small quantities.[11] Consequently, many popular items are sold out immediately. Libraries rarely get more than one copy, even of basic textbooks. The situation for university students is a little better because the faculty submits textbook requests for Chinese texts several months before the beginning of the course, and the publishers tend to issue the exact number requested. Foreign texts are very scarce and are usually unobtainable, even in libraries. The present policy is to place priority on the publishing of scientific and technical books. The bookstores selling these books were always crowded in every city that we visited and were doing a brisk trade. There are many technical dictionaries and glossaries being published at reasonable prices. Our group acquired more than two-dozen such reference tools (mostly English to Chinese) in a wide variety of fields ranging from computer terminology to zoology. Most had been published in 1978 and 1979.

Another limiting factor governing the efforts to create a greater awareness of literature and dissemination of information is that

[11]According to a 5 January 1975 NCNA report far more books were published in 1974 than in previous years with 2100 million copies of 8400 titles in the first 9 months alone. The last year for which official statistics on book production are available is 1958, the year of the Great Leap Forward, when 2380 million copies of 45 000 titles were printed. *Peking Review*, 1959, 46, 22p.

Small-scale industries such as this carpet manufacturing firm benefit from modern methods of information dissemination.

traditionally most of the costs of these efforts have had to be borne by local governments. Some are richer than others, but the overall policy of self-reliance, fostered during the Cultural Revolution, meant that poorer regions actually could not afford to pay for information services. The minimum amount of cash outlay to maintain a provincial science dissemination of information program was claimed in 1956 to be RMB 285 000 (U.S.$178 000)[12] in Anwhei province. Costs of dissemination vary in relation to population size, density, accessibility, and communication method used, but it is easy to extrapolate, on the basis of the Anwhei 1956 figure, a rough national estimate somewhere in the region of RMB 6 million (U.S. $ 3.75 million), or approximately 2% of the total state budget for science and technology in that year. (CAS receives 20% of the total state budget for science and technology.) In 1979 we could, on the same basis, calculate a cost of somewhere in the region of RMB 15 million (U.S.$9.4 million) if we accept the rate of growth of literature to be the same in China as outside. Nevertheless, the Chinese scientists we met in the major institutions appeared to be remarkably well informed about foreign literature, though not so informed about current Chinese research. The position in minor institutions is not known.

[12]*Proceedings of the Third Session of the First National People's Congress, 1956*. Peking, Renminchubanshe, 351p.

Extension Literature

A concept of information exchange arose, based on grass-roots principles. The theory was that, if scientists were dispersed to the countryside to work among the peasants, everyone would be able to exchange information freely and China would become one vast "invisible college." The basis of this was:

(1) self-reliance, wherein a scientific problem is presented by the peasant or worker and the solution is sought locally. Requests upward for information are made only when necessary and then at one level at a time. The principle is that of the peasant/scientist working in close collaboration. This is said to represent the ultimate in developmental Marxism, i.e., the eradication of the division between mental and manual labour;

(2) interlevel cooperation, where brigade and production teams or factories set up study points at their place of work. Research institutions collaborate at these points for a few days, weeks, or months until the problems are solved, requests for information being met by local resources built up from dispersed central collections.[13] The principle adopted is that the information is not to be collected locally until it is actually required. A file is built up to serve only the specific need. Meeting other requests for the same information, although not being actively discouraged, is not encouraged either. This fosters (a) self-reliance; (b) low-cost services; and (c) a reduction in the duplication of effort; it also prevents the systematic creation of large files of irrelevant information;

(3) the integration of research and production achieved by rustication of scientists, i.e., living and working in the countryside, and coordinated by extension programs devised by them in conjunction with workers and peasants with emphasis on local testing, demonstration, and popularization.

As these functions suggest, scientific effort in the commune and factory has been directed primarily toward the specific application of technological knowledge and dissemination of scientific information at the base operational level. For instance, a trend up to 1975 was to establish "agricultural" academies at the commune level.[14] These academies offered an additional means for making technical information available at the grass roots. The provision of information at the neighbourhood level, which grew during 1965-70, could be considered as one of China's strong points

[13]It has been estimated that in 1958 there probably were as many as 35 580 local libraries (run by the trade union, production brigades, and the local Party branch) with holdings of some 20 million publications comprising periodicals, basic textbooks, and extension manuals among others.

[14]*Kuangming Ribao*, 18 November 1971.

because it was composed mainly of workers and peasants engaged in solving production problems and was coordinated by scientific committees that helped arrange science forums and study classes. These "information innovations" frequently received acclaim both in China and in other countries. However, the system was not without problems.

This problem-solving approach assumed a dead end for most files on research results, i.e., that no further queries would likely result or need to be shared once the problem was dealt with. For example, if an effective method of insect control were developed, the results would be expected to be disseminated and adopted in a province or area within a given period of time. Positive results of research are, hopefully, translated into action-oriented programs. Popularization[15] as this form of extension is often referred to, effectively characterized the priority associated with the preparation, dissemination of information, and implementation of new practices for the benefit of the masses. Because all research was viewed as problem-solving at the base level, interaction, nationally, was not considered important. The setting up of costly data banks was thus considered unnecessary.[16] The key to this was the question of whether scientists or innovators could permanently work in isolation from each other or out of the mainstream of the flow of pertinent literature. The need for scientists to read broadly, sometimes outside the scope of their core area, seemed to have been disregarded at that time. Access to general literature outside one's field is still restricted.

The current reorganization of education, research, and information services reemphasizes the basic need for access to literature, especially foreign literature. Authorship is no longer being discouraged and publication of research results has brought about the reappearance of many of the academic journals and a few new ones. A CAS conference, held in 1978 in Beijing, set out to evaluate library resources and the needs of schools and university libraries. A review of textbooks for various courses was made. Currently, China is seeking to identify the main texts used at major Western universities and to make these available at institutions throughout the country.

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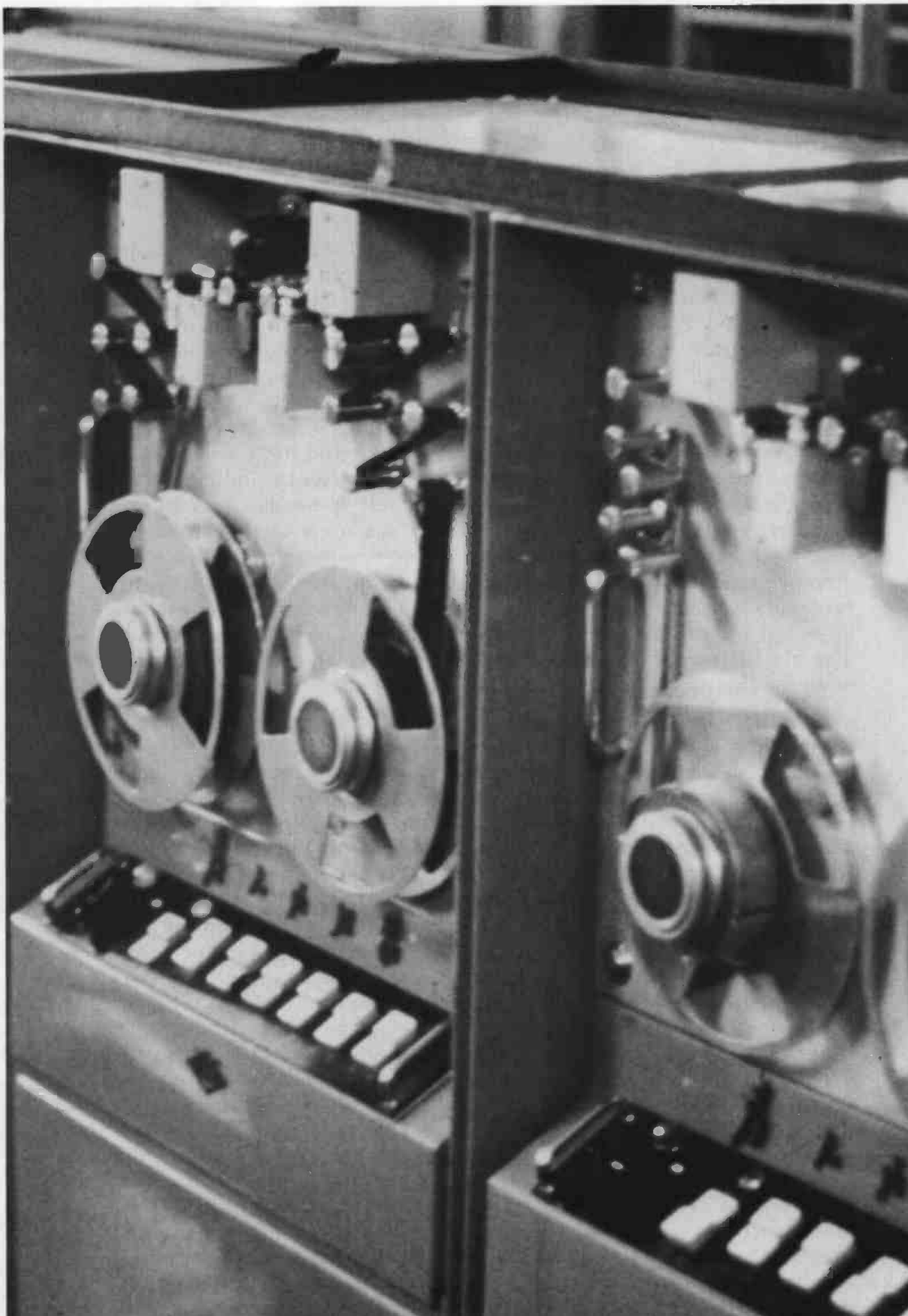
[15]Popularization (dazhonghua) comes from dazhong, "people" in the mass sense, hence its pejorative meaning "popular." It means a dialogue between the masses and the experts, the untrained and the informed, between those committed to an innovation and those who are not. Popularization of techniques cannot rely solely on demonstration or formal instruction but must involve public participation. To suggest that popularization is synonymous with "simplification" would be misleading. It is precise and difficult but because its object is to involve the masses in specific disciplines, as well as new techniques that may have taken scientists years to perfect, experts must do all they can to remove ambiguity and present the innovation in both a language and an application that local peasants/factory workers can best understand. In this sense popularization is not what is termed in French as "vulgarisation."

[16]In agriculture China tried to group all modern techniques into one-volume publications and distribute these locally for extension personnel to disseminate. Two basic extension books were issued between 1960 and 1970: the *Hundred Lectures on Knowledge of Agricultural Science* (edited and published jointly by Hubei Province Scientific and Technical Association and Hubei Agricultural Department, June 1963), and *Fundamental Knowledge of Agriculture* (edited and published by Shansi Province Scientific and Technical Association, 1963).

In summary, the development of information services, access to literature, and library development have taken place in a relatively short time, in a largely uncoordinated fashion, and have been the subject of intense political pressures. There is a good foundation for national institution building, but information resources need to be coordinated and rationalized with more effective functioning of activities at individual levels, which can be brought about by the introduction of mechanization and management by objectives. There are good services in some provinces for some disciplines (agriculture) and no services at all in others (industrial networks seem weakest in rural areas). The planning and development of new services and the rationalization of existing ones require, first of all, access to knowledge, equipment, and training outside China so that the loss of one decade, which the Chinese admit happened with the Cultural Revolution, can be made up. Some positive indication is now required of the extent and type of cooperation that China is prepared to engage in with international cooperative systems to provide the type of modern services that users of scientific information badly need. China also needs to specify the technical facilities and training requirements needed to make this level of cooperation possible. We were told that China now has ample sources of funds for key projects and overseas training and exchange because of the substantial currency reserves from exports.


PART II

Computers

The first Chinese computer was built in 1958 with Soviet assistance and was based on the Ural 2. The Sino-Soviet split in 1960 forced China to develop its own computer industry, and in 1962 the first Chinese model was produced. By 1965 the Chinese were able to produce their first solid-state computer. We were told that the Cultural Revolution and the period of the Gang of Four seriously hindered the development of science and technology. If we accept this, then the progress of the last 2 or 3 years must be regarded as remarkable. The largest computer we saw (the 013 at the BICT) was designed and built between 1973 and 1976 and it is a very impressive machine. The policy of self-sufficiency induced compartmentalization of ideas. If an institution felt it needed a computer, its employees either built it themselves or set up a factory to do so. At Shanghai Normal University, for example, we toured a factory that employed about 400 workers making computers, in addition to tape recorders and electric meters. This doctrine allows for some exchange of ideas but requires, for the most part, everything to be developed in-house. The inefficiency of doing business this way, which maximizes the number of times the wheel is invented, is clear, at least to the Western eye.

A delegation of computer specialists in China prior to our visit estimated the total number of computers to be about 1000, half of which, it is said, are being used for military applications. None appears to be applied to social and economic development planning, or for simulating models of the sectoral economy, e.g., cereal supply. Some are applied to seismic research and general problem-solving in technology and the hard sciences. The BICT is well endowed in that it could boast having eight computers. The main model is the 013 referred to above, though it is not in wide use. It looks like an IBM 7030 model but, in fact, was planned and built on the premises using a mini DJS (Dianzi Jisuanji — which means electronic computer) series 111, located upstairs in the same building, to design the layout of circuit boards. The 013 occupies three large rooms. The CPU, memory, and engineer's console were in one room; the operator's console, paper tape units, and line printers in a second; and eight magnetic tape units in a third. The 013 is an emitter-coupled logic (ECL) machine built entirely by hand using small-scale integrated circuits. It has a three-level memory, 128K, 140K, and 512K. A single address space covers all three kinds of memory but the strategy of using 512 words of fast memory is up to the individual programmer. The machine works at an average of two instructions per microsecond. There are two accumulators, 16 index registers, and a 13-stage instruction pipeline. The mean time between failures of this machine was said to be 20 hours, which is impressive in view of the situation and condition of the rooms in which this and other machines were manufactured and expected to operate. The 013 had one of the few disc storages available in China. The disc system was of the 20-surface variety with an access time of 50 metres per second, a storage capacity of 10 bits per millimetre (mb) drive, and two drives per enclosure.

There is no punched card equipment attached to machines in China. Output is by line printer. Four 600 lines per minute models, very similar to the IBM 1403, were attached to the 013 model. There were also eight tape punches (16 track, 20 mb versions), four paper tape units (8 track), and two CRTs.

As in most other respects, concern for standardization is again entirely lacking. There are no tele-hookups. This 013 is the most modern computer available. There is little or no interactive computing. Even small machines are used in a batch-mode process. The scientists prepare their own program and data input on tape and simply take turns feeding it into the machine. There are no machines that can compare with the most modern Western ones. When additional power is required, the policy is to purchase foreign equipment. For example, Nanjing University uses a French Seti Pallas (32K, 28 bit) machine tied to an IBM terminal.

Fudan University in Shanghai appears to place considerable emphasis on computer technology, particularly on the manufacture of integrated circuits. The main model they have built is the FUDAN 719, a 32K, 48 bit, 110 kops machine developed by the University as a prototype version of the Shanghai Institute of Computer Technology (SICT) model 709. The 709 is a third-generation 110 kops machine made in the now famous Shanghai factory, which had previously made door handles. Storage for the 719 is on two 28K drums (48 bits each), two paper tape (8 track) readers, and two line printers. Fudan uses this machine for applications and a minicomputer for design (Fig. 4).

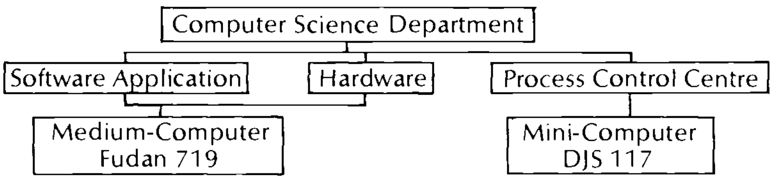
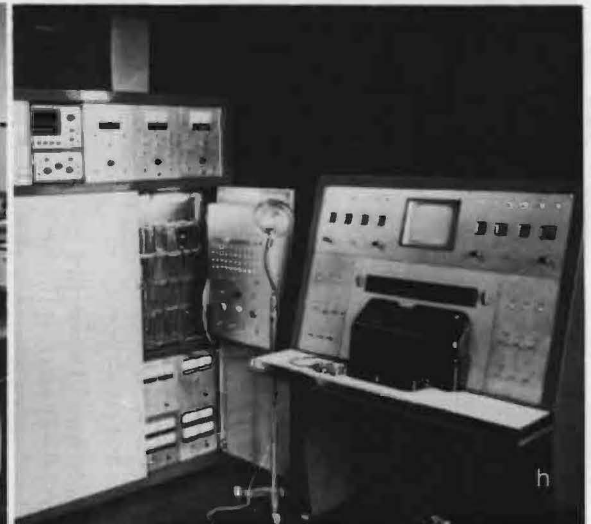


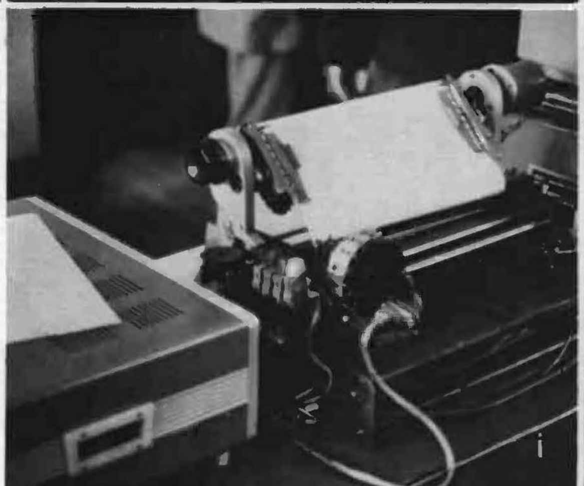
Fig. 4. The general organization of the Computer Department at Fudan University.

The main series of computers in use in China is the DJS miniseries. This series was first produced in 1962 (Fig. 5). The earliest machine had a 2K memory (1800 kops per second). The first transistorized, second-generation model (DJS 21) was produced in 1964. The DJS 111 model, used in the design of the 013 at BICT, had a 64K memory 48 bit word length and was a third-generation machine built in 1970. Shanghai Normal University had a DJS 112 whose speed was rated 117 kops, 16K memory (16 bits). The machine is a small-scale integrated (SSI) computer with a nine-circuit board and magnet-core storage, and is a very compact machine, microprogramed (192 microinstructions, including 32 for diagnostic purposes). Another room at the same university had a DJS 130 with a JY 80 line printer being used for software development and debugging. The speed was 500 kops per second, a little faster than the 112 series. It had a 32K memory. The laboratory had an air of informality with spare parts lying around on the floor, units open, and parts exposed to the dust outside. Tapes were simply

(a) The DJS 112, and (b) the DJS 130 with backview (c). The largest computer in China at present is the 013 (d). Scientists verifying data of the 013 at BICT (e).



This photograph shows an OCR machine in operation at Fudan University (f). The processed script appears on the inside of the open cabinet on the left of the photo (g). Output also appears on the small CRT on the console in this picture (h). Electrostatic printers such as the one in this illustration are most common (i). Scientists prepare their own program and take turns feeding it into the machine (j).



Model	Date	Word Size	Memory	Speed	Application
DJS 111	1970	48 bits	64K	180 kops	Design
DJS 112	1974	16 bits	16K	117 kops	
DJS 120	1975	16 bits	24K	200 kops	
DJS 130	1975	16 bits	24K	500 kops	Training
DJS 131	1077	16 bits	32K	500 kops	
DJS 154	1977	16 bits	32K	200 kops	
DJS 210		32 bits	32K	100 kops	
DJS 220		32 bits	32K–64K	200 kops	
DJS 240		64 bits	?	400 kops	
DJS 260		65 bits	?	1000 kops	

Fig. 5. DJS series minicomputer development.

hung on racks on the wall by an open window and were blowing in the wind. Nevertheless, the staff impressed us with their ability to cope and their innovative approach to less than ideal conditions.

The computer factory at Shanghai Normal University employs about 400 people, but only about half of them were at work at the time of our visit. On the work benches were various bits of components that were to be assembled manually. The people in the first floor workroom were engaged in producing oscilloscopes and meters. The employees on the second floor were working on integrated circuitry and computer assembly. The machine being assembled was the DJS 130. The 100 series is now obsolescent, but was still being assembled here at the rate of about 10 machines a year. There were no plans for assembling the 200 series. This DJS 130 model had a 24K memory but had direct memory access only in the most recent versions. There is no disc storage nor punched card input. The factory also assembles the CAT 601 line printer and JDK 10 CPU. The work rate did not appear to be very high and though the rooms were generally tidy, there seemed to be an interest in surface cleanliness only, especially where integrated circuit work was being carried out. Everyone seemed to be doing several tasks, and quality control was left until the end of the assembly process and was not carried out for each component part. The testing room had four DJS 130s, four 601 line printers, and four JDK 10 CPUs being checked for quality. There was a high rate of faulty parts, and a great deal of time was being spent on checking operations, which should have been done earlier. The equipment was being produced for sale on the local market.

In general, there appears to be little coordination in design, planning, or production in China. Although the Fourth Ministry of Machine Building has overall jurisdiction and attempts to coordinate a national policy over computer production, much of the research and development and production involves many diverse organizations and small factories (Fig. 6).

Programing is done in assembly language, Basic, FORTRAN, ALGOL 60, and a Chinese variant of ALGOL called BCY (translation of delimiters into putonghua, the national language, and writing them in pinyin). We did not hear of any other programing languages, but the DJS 200 series is said to use an instruction set similar to that used by the Data General Nova. COBOL and SPL are also said to be under development. OS lags behind hardware development and probably reflects the present application of

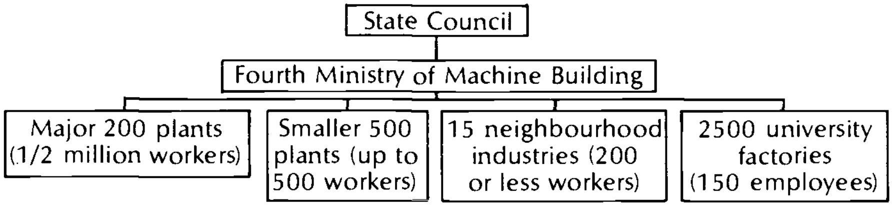


Fig. 6. Computer production organization.

computers in general in China. OS systems developed for machines include a real-time OS for the DJS series at Fudan University.[17] OS systems for the latest 200 series are being developed at BICT and at Nanjing University. The latter is also experimenting with Pascal-type programing languages (Fig. 7).

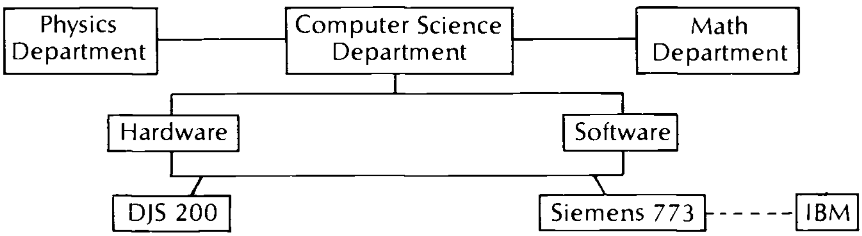


Fig. 7. Computer science activities — Nanjing University.

To sum up, there is a need for training in DBMS. To support the continually increasing information processing demands of modern society it is necessary to write and maintain an enormous number of computer programs. The main factor currently limiting the wider application of computer technology is a lag in the production of software and the shortage of experienced programmers. The art of computer programing is poorly developed and there is a strong impression that much of the computing that is being done is directed at developing I/O systems to handle Chinese characters and at training student programmers. For instance, the computer group at Shanghai Normal University exhibited a general vagueness about research priorities, and we were asked whether any foreign data bases provide tapes in edited format for use in information retrieval programs. Their main objective was stated to be to set up a minicomputer terminal with CPU to carry out program instruction first and a resource centre second. Greater coordination both in production and quality control needs to be exercised at the national level. More attention needs to be paid to standardization so that Chinese machines can be made to be compatible with foreign software. This is particularly important if China wishes to purchase or lease foreign data bases to operate a modern SDI system.

[17]Pan Jing-ping. 1975. *A real-time operating system of a mini computer.* Occasional Paper, Shanghai, Fudan University.

Computer Applications to Translation and Information Processing

Compared with the West, computers hardly influence public life at all, and it appears that little attempt has been made to employ computers to solve everyday problems. Considering the areas of translation and information processing where computers may be of assistance, one may conclude that the Chinese language itself presents a formidable obstacle. The 5000 or so Chinese characters needed for day-to-day translation, plus the additional 3000-4000 characters required to express scientific terminology, are too many to be utilized by computers by cost-effective means.

The investment of personnel in lexicographic projects in China is prodigious by Western standards and some reluctance was expressed when the advantages of applying computers to it were mentioned, but as far as we could judge no work had in fact been done in this field. Likewise, each institution that was visited exhibited a keen interest in library automation, and mechanized storage and retrieval of information, but there was little evidence of any application in this field beyond a few scattered experiments in one or two university departments. For instance, Nanjing University, using borrowed time on a Siemens 773 linked to an IBM machine, has developed programs based on MARC and has experimentally catalogued some 400 English-language volumes. But so far, they have found no satisfactory way of producing cards from the output.

At present China is adopting three basic approaches to the solution of its information processing problems and is: treating Chinese- and foreign-language documents separately; giving greater emphasis to English-language materials; and relying on language teaching to bridge the gap between translated and nontranslated texts.

It was generally felt, from the outcome of the discussions, that China was not seriously considering massive investment in machine translation. However, some interest was shown in SYSTRAN and the problems encountered in Canada with its English-French translation program.

The only work being carried out on machine translation is confined to French and German texts. A small French-Chinese translation project was being conducted at BICT. The machine prints in pinyin, and the Chinese characters are written in afterwards by hand (Fig. 8). However, no details on the actual working of this program were given.

The Chinese obviously feel that ultimately it should be possible for texts to be translated and indexed automatically and a coded language for conversion purposes to be provided fairly easily. Although some experiments have been carried out and interest has been shown in some

《法汉机器翻译的计算机打印结果》
上行是被译法文，下行是计算机翻译的汉语拼音的
译文，汉语拼音中的号码 1·2·3·4·表示汉语的四声

(A) French 86 CHAMP ELECTROMAGNETIQUE RAYONNE PAR UNE OUVERTURE CIRCULAIRE PLANE DANS SA ZONE PROCHE

(B) Pinyin Code TONG1GUO4 ZAI4 SA LIN2JIN4 LING3YU4 ZHONG1 DE2 YUAN2 PING2MIAN4 KONG3 DE2 FU2SHE4 DE2 DIAN4CI2 CHANG3

(C) Chinese equivalent 通过在邻近领域中的圆平面孔的辐射的电磁场

(A) 87 AJUSTEMENT MATHEMATIQUE DE PARAMETRES IONOSPHERIQUES

(B) DIAN4LI2CENG2 CAN1SHU4 DE2 SHU4XUE2 JIAO4ZHENG4

(C) 电离层参数的数学校正

(A) 88 MODES PROPRES DES SYSTEMES COUPLES APPLIQUES AU CALCUL DES LIGNES A MEANDRES MICROBANDES

(B) XI4TONG3 OU3 YU2HUI2 WEI1BO1DUAN4 DE2 XIAN4 DE2 JI4SUAN4 DE2 YING4YONG4 DE2 GU4YOU3 FANG1SHI4

(C) 系统偶运迴微波段的线的计算的应用的固有方式

(A) 88 CONVERSION PARAMETRIQUE DE FREQUENCE INFRAROUGE VISIBLE--

(B) HONG2WAI4XIAN4 KE3JIAN4DE PIN2LYU4 DE2 CAN1SHU4 BIAN4HUAN4

(C) 红外线可见的频率的参数变换

Fig. 8. An example of a French-Chinese machine translation printout from the Beijing Institute of Computer Technology (BICT). (A) represents the original French text to be translated, (B) is the computer generated translation in pinyin code, and (C) is the Chinese equivalent handwritten into the text.

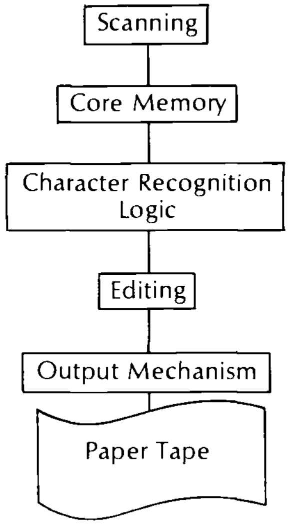


Fig. 9. Flow chart, OCR experiment, Fudan University, Shanghai.

foreign experiences, the results are not clear enough to warrant serious consideration. This conclusion is reinforced by the lack of concrete applications of mechanization coupled with the expressed desire for more information and additional research in this field.

We also saw an experiment being carried out at Fudan University with optical character recognition (OCR) to provide an automatic way of entering human readable information directly into the computer (Fig. 9). This method eliminates the need for a keyboard and operators to input the printed information into computer code. OCR technology has been used with much success in the computer industry generally, and a great deal of use has been made of it where it has not been possible to input directly by tape. OCR has proved to be an accurate and cost-effective alternative for small centres to operate. It has proved very useful, for instance, for several AGRIS input centres by eliminating the need for double keyboarding of entries into *Agrindex.* Data entry costs and labour time have been significantly reduced, sometimes by as much as 90%.

Fudan University has built an enormous item of equipment in-house that, by its appearance, seems to resemble an electronic microscope (see illustration page 39). Optical scanning by this mechanism is accomplished by the equipment sensing subtle degrees of reflected light from the text. When there is sufficient contrast between the amount of light reflected from the printed letter and the amount of light reflected from the surrounding background, the machine picks up the outline of the character. The principle behind the Fudan system is the shedding of a beam of light from a laser. The light picked up from the sheet of paper strikes a photoelectric cell, which generates a corresponding electrical signal. This process produces a modulated electrical signal corresponding to the black and white areas on the printed page. The signal is designed to break up the black and white areas into a series of dots. The dots represent digitized "picture" elements with white corresponding to binary "0" and black to

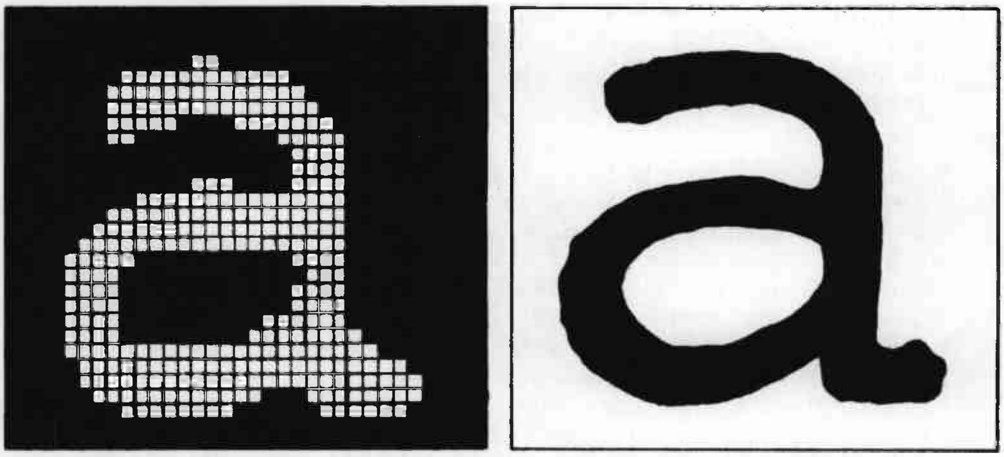


Fig. 10. The representation on the left shows a sample of a lower case "a" stored in the computer's core memory; the character on the right is how it would appear on the page for scanning.

binary "1." The digitized "picture" is stored in the computer on a 32 × 32 dot matrix (see Fig. 10 and illustration page 39). Picture scanning and storage are done on a Fudan 719 computer, also developed and built at the University. The system we saw operating was entirely experimental and was designed to deal only with alphabetical and numerical systems. No work was being done with Chinese characters, though the experience gained from this process will be useful in any future systems set up to handle Chinese characters.

Input of Chinese text into the computer has received a great deal of attention.

> The coding of Chinese characters is a key link in the handling of Chinese-character communications and information. With the swift advance of modern science and technology, the use of electronic computers is infiltrating all spheres of production and life. However, because of their complex structures, numerous forms and large numbers of identical pronunciations, the Chinese characters used by our country have brought tremendous difficulties for the input and output of electronic computers. If we do not solve the problems in handling Chinese-character communications and information, the use of electronic computers will be severely limited and the four modernizations will be affected. To enable square Chinese characters to quickly and accurately enter an electronic computer, the characters will have to be transformed into codes that can be handled by computers. Therefore, the coding of Chinese characters becomes necessary. In the past 10 years and more, many experts, scholars, professors, and amateurs from all trades and professions in the country have carried out a great deal of research and exploratory work painstakingly and self-sacrificingly and have put forward many kinds of coding plans. More than 40 plans were submitted to this meeting alone. From these plans, it can be seen that our country's research on the coding of Chinese characters displays a broad avenue of thought, an exertion of hard effort and a gratifying achievement.[18]

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[18]National Meeting on Coding Chinese Characters held in Qingdao, OW011442 Beijing (Peking) Radio Domestic Service 0800 GMT 31 January 1979. FBIS 2 February 1979.

During the visit to ISTIC, four different kinds of Chinese text input were discussed. They were: (1) the use of a large keyboard; (2) the structural components of the Chinese character; (3) pinyin; or (4) a combination of (2) and (3).

The most interesting method we saw was based on the IBM "signowriter" of the mid-1960s and was one of the few examples of interactive computing that we heard about and the only one we saw.[19] It uses a CRT vector display and a light pen. The terminal also has a keyboard, which has still to be integrated into the system. Although there was a demonstration of input by structural components, it was not possible to see a demonstration of the research on a specific design for input by a combination of pinyin and structural component. However, a description of the concept was given. The research is adopting a dual approach. Each is based on the use of a four-position, alphanumeric descriptor for each Chinese character. The first approach consists of a four-position code in which: (1) the first two positions of the code are the first two letters of the pinyin for the character; (2) the third position is the tone number; and (3) the fourth position is a semantic element code. The second approach utilizes a four-position code in which: (1) the first two positions are the same as in (1) above; and (2) the last two positions are two letters representing the semantic element of the character.

The system is based on the input of two components that will cause display of a group of Chinese characters and from these the desired character can be chosen for input. The CRT is divided horizontally into three sections (Fig. 11). The top portion (1) is reserved for characters of the text to be composed. Below this (2) is the portion reserved for display of up to 32 of the most frequently used characters. The bottom section (3) has 24 symbols that are used to define a character and to punctuate the text. The selection of characters is based on the description of the upper and lower half of the character to be input. A set of 20 components is used to describe the upper half and a set of 21 for the lower half. In addition, four types of punctuation marks are displayed along with the 20 upper half components, and three of the lower half components are duplicated so that the bottom section of the CRT always contains 24 symbols. If a character to be input cannot be located among the 32 most frequent characters displayed in the middle section (2), the operator simply points the light pen at the component that describes the upper half of the character to be input. The lower section (3) then displays lower half components that can match the character to be input and the operator selects from this display. The system then displays the group of characters that fit the operator's selection in section (2). Finally, the character selected is touched by the light pen, and this causes it to be displayed in section (1). At any stage of the operation, if the next character to be input is on the screen in any position, it can be input by simply pointing the light pen at it. This system is still in the experimental stage and so far has not been applied. The main problem is storage space on the computer for a large inventory of characters to apply to a scientific vocabulary.

[19]The method has been described in a paper given to us at the time of the visit by three of the scientists concerned, Zhu Naigang, Ni Guangnan, and Zhen Zhiying; *Chinese Characters Input and Interactive Computing*. Peking, Chinese Academy of Science, Institute of Computer Technology, n.d., 24p.

A CRT vector display with light pen (signowriter) is used for Chinese text input into the computer at BICT.

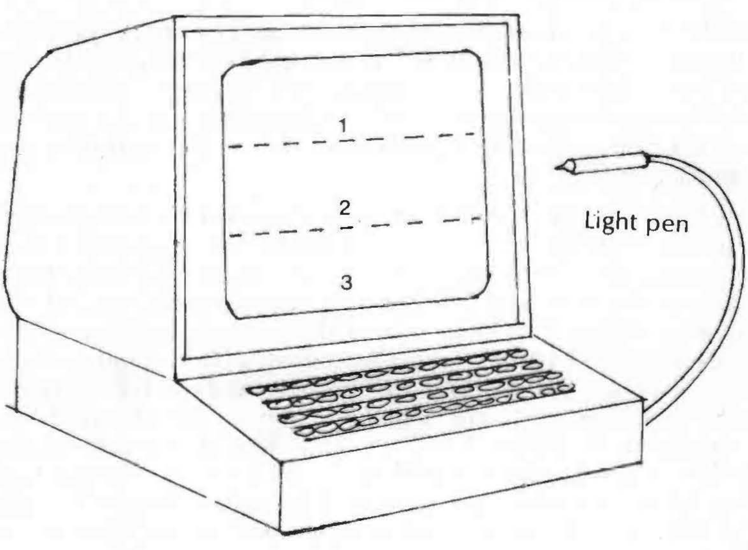

Fig. 11. Chinese character input method (BICT).

Another system is the one invented by Zhi Bingyi, chief engineer at the Shanghai Institute of Electrical Engineering.[20] His system uses a special item of terminal equipment, which we could not view because it was dismantled at the time of our visit. There is, however, reason to suppose that little actual experience has been accumulated with this system because, although it is interactive, it demonstrates very little appreciation of the principles of interactive computing. The operator must be trained to analyze the component structure of each character by a set of rules. He must then encode the character by these rules. This relates to the first letter of the pinyin pronunciation for each structural component of the character. Thus, taking the character zhang (張), it is broken down as follows: 弓 = gong = G, 長 = chang = C, ㇏ = na = N, and the whole character in pinyin is pronounced zhang = Z. The code, therefore, for 張 is written GCNZ. This system presents each structural component as a "character" in its own right or a "link" to a character. Operator skill is very important. The claim is that it takes just 2 hours to learn the system, 2 weeks to master it, and 2 months to reach an input speed of 32 characters per minute. It has proved feasible to build up a total file of 17 000 entries. So far, 8500 have been encoded with 2% error. Each letter encoded requires 5 bits, each character 20 bits. A 32 × 32 matrix stores the character design.

The design of this system clearly betrays an orientation to batch processing. But for this, there would be no strong reason to fix the length of string used to encode each character or to require operators to learn a complex set of encoding rules. An interactive system would be far less rigid in the requirements it makes of its users. The same thinking is adopted for pinyin input. Nanjing University, for example, is experimenting with a pinyin method of Chinese text input, which consists of a code for pinyin spelling of the character to be input, plus an additional code to signify the structural element. The notion that the pinyin might be used to retrieve a short list of characters from which the operator could then choose had not occurred to any groups other than at BICT.

At ISTIC a Japanese T4100 character input/output system is being used, linked to a TK70 computer. This sytem has been adapted for Chinese use and represents a different approach to Chinese text processing. The T4100 consists of four components: a keyboard for input; a magnetic tape storage; a Chinese character generator; and an electrostatic printer for Chinese characters.

The input keyboard is made up of 26+ main keys, each representing 12 characters arranged in a 3 × 4 pattern on the key. A group of 12 selector keys is arranged in the same 3 × 4 pattern and used for selecting specific characters on the main key. The 26+ keys are arranged in 9 blocks (six 4 × 7 and three 4 × 8) (Fig. 12). The machine allows 3168 possible positions used to represent 3072 characters plus the English alphabet and numerals, etc. Each character is stored in a 32 × 32 bit matrix, and 6144 character patterns can be stored. The characters on the keyboard are arranged by radical component, and the operator uses the right hand to operate the main key and the left to operate the selector key. Trained operators are said to be able to input 30-40 characters per minute. The system is used in support of ISTIC's information storage and retrieval project for Chinese-language

20 *Peking Review*, 1 January 1979.

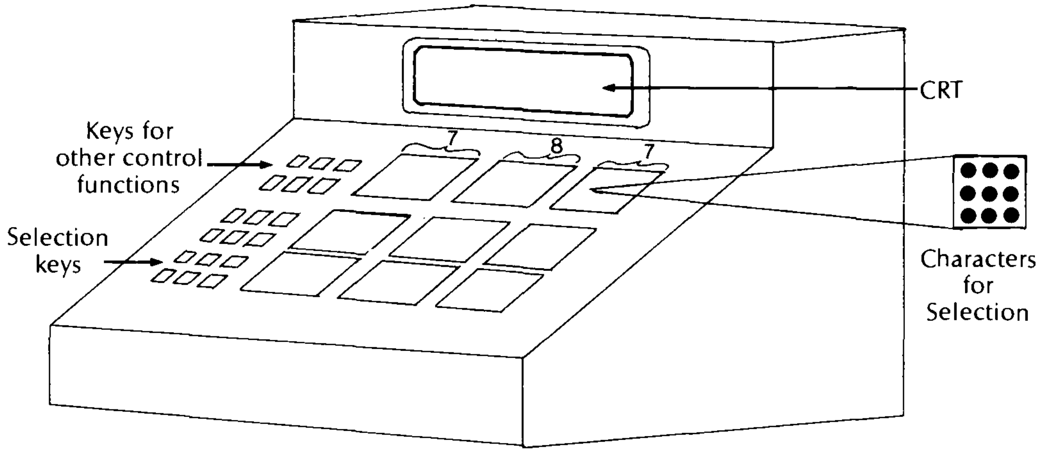

Fig. 12. ISTIC input/output system.

documents and text processing. It is also used as a teaching aid to these problems as well as for automatic typesetting of Chinese characters. Typesetting is in production mode, which supports ISTIC's large quantity of publishing tasks.

Some Conclusions on Current Trends and Developments in Science and Technology Information

A major drawback that we noted in China was the lack of effective communication. It is common to find an office or institution unaware of what another is doing. We were told many times: "It is difficult to get cooperation." This is surprising in China when one considers that the basis of their society is supposed to be cooperation. Projects are not well coordinated and as far as computer development is concerned, it appeared that there was no overall policy. The concept of research management is unknown. The main reason for this seems to be the policy of self-reliance vigorously pursued during the Cultural Revolution. This has generally been termed in China as the "products design revolution." "Copying of Western designs is rejected....Let us break the foreign designs....We must not crawl behind others, China must design for its own use."[21]

This policy discouraged standardization and information sharing. It also smothered any growth of national policy in these areas. Information sharing during, and to some extent prior to, the Cultural Revolution was regarded with suspicion. Even simple technical information was hard to locate. Access to foreign literature was restricted on the "need to know" principle and individual authorship of academic papers in China was discouraged. Collective authorship was the rule, and papers rarely contained any significant results but merely concentrated on heavily jargonized political propaganda relating how the policy of self-reliance and the Party line were helping to advance technology. Chinese scientists now freely admit that this was the case and regard the period as one of severe political interference in the area of science and technology that stifled progress and produced near total disaster. Scientists are now eager to discuss problems and are not afraid to admit China's deficiencies in these areas. They estimate that they are about a decade behind in such disciplines as computer technology, information retrieval, and in some areas of high-level technology.

Information on professional training of any kind is scarce in China. However, there have been fairly accurate estimates, both from Chinese sources and from foreign observers, of the number of students trained prior to the Cultural Revolution.[22] Up to about 1966 approximately 2 million students had completed some form of higher education.

[21] *People's Daily*, 13 November 1965.

[22] See, for instance, Wu Yuan-li, and Sheeks, R.B. 1970. *The organization and support of scientific research and development in Mainland China*. New York, Praeger Special Studies.

Approximately one-third (650 000) of them had received training in engineering disciplines, and 125 000 had scientific training. A significant proportion, about 50 000, had completed courses in computers and related subjects. In contrast, there were only 125 000 college-trained graduates in China in 1949. Most, if not all, of China's tertiary educational institutions were closed during the Cultural Revolution, as were many of the primary ones. It was only between 1970 and 1971 that any reopened. At that time, students were admitted largely on the basis of working class origins and political astuteness. This policy is now considered to have placed a serious impediment on the educational system; it was almost certainly responsible for a decrease in the production of scientists. The technical capability of many scientists educated in China in the past 2 decades is open to question. Although many must have received good training, those unfortunate enough to be enrolled in abbreviated or part-work/part-study courses in worker/peasant colleges must have suffered. We were continually told this throughout the trip, by both students and teachers. We were also told that there is now a shortage of teachers and senior scientists capable of providing leadership and research guidance for younger students, and China is now actively soliciting help from foreign scientists for long- and short-term lecture tours to help bridge this gap.

Universities whose curricula were curtailed or closed are now returning to normal and are even expanding their courses in several subjects, especially science and technology. The merit system has been reintroduced, and there are more applicants than places. Almost 6 million candidates took the national college entrance exam in 1978. New universities are being built, or are planned to be built, to cope with the demand. Evidence of the new upsurge in modernization of the economy is most dramatically shown through the study of the English language. China recognizes that English is the language of science and technology accounting for almost 75% of the world's literature in this field. English is being studied at every level of society. On one occasion we were amazed to be hailed by a passing labourer pulling a cart loaded with about 20 empty oil drums. He stopped and pulled out a tiny notebook in which was listed, in very neat handwriting, English words and short phrases, with phonetic equivalents, followed by the Chinese characters. We were asked to pronounce the list for him.

Shops open at 0930. Prior to opening is English lesson time. Every establishment is complete with blackboard, cassette tape, and an eager group of self-teachers who will immediately engage your help in instructing them. It is evidence of the ability the government has to point the country in a given direction and get the masses to follow enthusiastically. Until recently, the British Broadcasting Corporation had the monopoly on English-language instruction. Now it is Voice of America's *English 900* series of lessons that has become most popular among the Chinese. Voice of America (VOA) has not been able to meet the surge in demand for its textbook. In less than 2 months, after official broadcasts were permitted to be beamed to China, the entire stock of textbooks had run out due to the great demand. The VOA has had to charge for the new edition.

The general development of science and technology has been uneven largely because of three main influences: the Sino-Soviet split in 1960; the Cultural Revolution 1966-70; and the influence of the so-called Gang of Four 1973-76.

Nevertheless, although some scientists were dismissed from their posts altogether, dispersed to the countryside, or just generally harassed, a great deal of development did take place. For one thing, political influence was not uniform and some sectors were not as hard hit by rampaging Red Guards or political extremists as others, e.g., agricultural science, because food supply has been and continues to be of major importance to overall development. China has had to rely largely on the surplus of the agricultural sector for its exports to pay for imports of foreign technology.

Although the Chinese present an air of optimism that may be indicative of a new commitment (everywhere there are posters announcing that China will catch up with the West by the year 2000), total recovery and progress may prove to be slower than the leadership would like. A decade of training has been sacrificed. The benefits from pushing new graduates through advanced studies and promoting exchanges abroad, a policy presently being stepped up, will take some time to achieve results. China lacks experienced researchers and technicians in many areas. To combat this a new emphasis is being placed on inviting top scientists from institutions in the West to work in China, but language is a problem; hence the emphasis on English-language teaching. Efforts are being made to entice overseas Chinese to return from the United States, Canada, Singapore, and elsewhere. The CAS in Beijing is undertaking a building program of new laboratories and housing to accommodate them, if they can be successfully persuaded to return in great numbers. These "overseas Chinese" are very evident in China at present, and the authorities go to great lengths to accommodate them.

Immediate development is hindered by the lack of adequate resources, particularly with regard to libraries and the provision of user services. Certain libraries were actually sacked, and some books destroyed during the Cultural Revolution. Most were closed or at best their activities severely curtailed. University libraries were the hardest hit and their collections of modern literature and serial publications have subsequently fallen into decay. There is an urgent need for new textbooks, scientific periodicals, and trained staff to meet the new demand. The government has recently initiated a textbook development program involving all university libraries, and libraries are now encouraged to build up special collections and engage in interlibrary loan systems and documentation projects. Cataloguing is considered a basic task in the library program, and library mechanization is discussed as a quick solution to the situation. Each university is encouraged to develop an exchange program, but so far this is but a "straw in the wind" because, for the most part, China does not have too much to offer in the way of exchange. Not only are there few publications, but the majority of scientific papers are in Chinese and tend to contain what must seem dated research to foreign scientists working in similar disciplines. Essentially, China would like to be able to make outright purchases of certain foreign texts that are being used at major Western universities and is opting to import foreign computers to bridge the gap in the development of local hardware or to relieve a bottleneck in certain areas of information processing.

In this regard a great deal of self-reliance still exists, and it is unlikely that China will make massive purchases of equipment from the West except where it is necessary to make a significant area contribution. Instead, the Chinese would prefer to buy the expertise to produce domestic equivalents or to help in teaching student scientists basic skills in some key disciplines. China is not a signatory to international patent agreements, so many foreign firms may be unwilling to sell some products. On the other hand, the Chinese do not seem to copy foreign designs as much as they could. This is particularly true in the computer industry where compatibility with foreign machines could enable China to implement various software possibilities and thus go ahead alone with information storage and retrieval projects. The present evidence points to a great deal of reliance on Japanese technology. China, in some ways, seems overanxious to bypass some stages in the technological revolution that is taking place, especially where it believes it can catch up more rapidly, for example, going straight into production of microprocessors in computer technology. But methods, facilities, and especially quality control need to be thoroughly improved before the Chinese can produce even medium-scale integrated circuitry, and yet they consider jumping directly into production of chips and semiconductor memory techniques, lasers, etc. However, no preliminary work in these areas appears to have been done, and everyone is vague as to the actual research in progress. No register of current research projects was being undertaken at ISTIC, and only one institute at Nanjing plans to organize a current research information project, which would only then be at the provincial level. At present, a great many unconnected services are seen at various levels and, in most cases, are of limited scope. This is detrimental to efficiency. It is also an obstacle to cooperation with foreign partners and international systems because it is not always clear which is the appropriate Chinese agency one should be dealing with in the exchange of information.

A worldwide problem in scientific communities is language diversity. In China a great deal of thought and investment has to go into solving linguistic and translation problems. Some common mechanism will have to be found to make major foreign texts widely available fairly soon. Account must also be taken of the status of librarians and information scientists in China. They do not seem to have been accepted as true professionals and have been in the invidious position of taking the brunt of social and political upheavals and either have not had the means given them to deliver an efficient service or have simply had to submit to political manipulation, being expected to provide the channels for government propaganda. Therefore, it is important that the government allow them to group into viable professional associations such as the Chinese Library Society.

A major conclusion from our visit was that Chinese information scientists are now eager to work with their foreign counterparts on a wide range of storage and retrieval problems in science and technology. The Chinese are now increasing both the amount and range of research materials and scientific literature from foreign countries. Retrieval activity is most advanced at ISTIC. Though we found that no computer equipment was comparable to the large time-shared systems in the West, we were impressed with the ingenuity of some Chinese designs considering their lack of contact with advances outside China. Equipment for the most part, though functional, seemed lacking in human factors design. Moreover, if China is to move toward remote data base access, they will need, as a prerequisite, to modernize their telecommunications system to offer a reliable service to users.

The Chinese very freely admit these and other weaknesses, and information systems are now receiving priority planning. China has attended recent Unesco conferences and seminars in this area and has currently negotiated a substantial grant from UNDP to establish a management information system and information retrieval system. However, unless library resources are built up and proper access to scientific documents is a reality, the effects of the grant will not be felt in scientific circles. However, we left China with the impression that the scientists we met were highly capable persons, resourceful, innovative, and extremely dedicated. Many of the computers we saw appeared crude but were, in fact, very good machines. Some, like the Chinese character encoder we saw in Beijing, were prototypes in a very complex field of research. Therefore, care must be taken to place developments in their true context. So much, of course, depends on the political situation. In private discussions we were often frankly told that there would be "no going back" to the situation that prevailed during the Cultural Revolution. But liberalization in China does not have the same meaning as it does in the West. Although expectations have risen among the general mass of the population, it does not follow that these expectations will have to be satisfied to the same degree one would expect living outside China. The need for a period of relaxation, consolidation, and expansion now seems very strong. There is a feeling of confidence among the people we spoke to from all walks of life that things have to get better in China. But it would be foolish to try and predict what will develop in view of China's recent history. What was apparent from our visit was that China possesses a very adaptable and innovative scientific community. That alone is a considerable asset.

Appendix I

Institutions Visited and Discussants

Chinese Academy of Sciences

Institute of Scientific and Technical Information of China (ISTIC)

Yao Weifan, Director of Methodology Division
Liu Yongquan, Institute of Linguistics and Philology, Academy of Social Sciences, China. (Fields: Machine translation, computational linguistics, linguistic terminology.) Coauthor with Zhao Shikai, *English-Chinese Glossary of Linguistics Terminology,* published by the Chinese Academy of Social Sciences
Jiang Yingpeng, Computer Division
Chen Tongbao, Computer Division
Chen Binggang, Methodology Division
Wang Shiaochu, Group for Foreign Affairs

Beijing Institute of Computer Technology (BICT)

Yang Gangyi, Director
Li Runwen, Deputy Director
Teng Chin-sian, Deputy Director
Chen Shu-chin, Deputy Director, 9th Research Department
Chen Hu, Research worker, 9th Research Department
Chu Chi-yan, Research worker, 9th Research Department
Wang Len-chien, Research worker, Library of the Institute of Computer Technology
Chen Sin-fan, Research worker, 9th Research Department
Nee Kuang-nang, Research worker, 6th Research Department
Chen Tong-yin, Deputy Director, 6th Research Department
Gen Nee-ta, Research worker, 3rd Research Department
Li Hsiao-pei, Postgraduate student, Institute of Computer Technology
Li Kuang-hua, Staff member, Science and Technology Department

Chinese Academy of Social Sciences

Institute of Linguistics and Philology

Lu Shuxiang, Director
Li Rong, Deputy Director
Wang Yongling, Researcher
Sun Dexuan, Dictionary compilation
Liu Qinglong, Dictionary compilation
Cao Yushen, Phonetics research
Liu Lianyuan, Phonetics research
Lin Lianho, Phonetics research
Xiang Zhenghui, Scientific research
Fang Houshu, Publication of dictionaries, State Publications Bureau
Guo Liangfu, Chinese languages, editor, commercial press
Zhu Puxuan, Foreign languages, editor
Zhou Yuguang, Language reform committee
Xu Shirong, Language reform committee
Fu Yongho, Language reform committee
Shen Jian, Researcher

State Publications Bureau and Commercial Press

Chen Hanbo, Acting Director, State Publications Bureau
Wang Heng, Specialist, State Publications Bureau
Chen Yuan, Editor-in-Chief, Commercial Press
Meng Chuanliang, Staff member, State Publications Bureau

Shanghai Electrical Instruments Research Institute

Zhi Bingyi, Deputy Director and Chief Engineer

Nanjing University

Language/Lexicography Group
Bian Juefei, Professor, Chinese Languages Department

Liu Chunpao, Foreign Languages Department
Yueh Mei-yuan, Foreign Languages Department
Xu Weixian, Chinese Languages Department
Chen Jianwen, Library automation
Chiu Zhipu, Professor, Chinese Languages Department

Computer Group
Guo Juifeng, Professor, Mathematics Department
Xu Jinhong, Professor, Mathematics Department
Wang Xupeng, Professor, Electronic Computers Department
Liang Side, Professor, Electronic Computers Department
Li Yongxiang, Professor, Electronic Computers Department
Zou Zhiren, Library automation
Yang Keyi, Library automation
Xue Tuchuan, Library automation
Zhou Songshan, Secretary, Office of the President, Nanjing University

Beijing Library

Bao Zhenxi, Deputy Librarian
Tan Xiangjin, Deputy Librarian
Qiao Ling, Western Languages Cataloguing Section
Ma Fabi, Documents Section
Shao Changyu, Electronic Computers Section
Li Xunda, International Exchange Section

Shanghai Foreign Languages Institute

Members of the department
Chang Dei-yun
Lin Hsiang-chow
Nieh Zhen Xiong
Chang Chao Zeng
Gu Boling
Mu Kuo-hao
Chen Teh-yung
J.C. Chan
Gu Baodju
Pan Hsu Nien
Yang Hui Chung
Shi Xing
Chen Shih-yuan
Lue Pei-ying
Yen Yeh-yun
Wu Ting-pai

Beijing Foreign Languages Institute

Wang Tso-liang, Professor of English
Lin Xuehong, Editor, Foreign Languages Teaching and Research
Zhuang Yichuan, Lecturer
Ying Manrong, Lecturer
Liu Shimu, Lecturer

Fudan University, Shanghai

Hu Yu Hsu, Deputy Director and Professor of Chinese Language Department
Cheng Yu Min, Deputy Director and Professor of Foreign Languages Department
Lu Guo Shen, Assistant Professor, Foreign Languages Department and Editor, English-Chinese Dictionary
Wu Ching Shon, Lecturer, Foreign Languages Department
Shue Shiyi, Lecturer, Foreign Languages Department, dictionary compilation
Hsu Li Chuan, Lecturer, Foreign Languages Department, Computational linguist
Pan Jin-ping, Computer Science Department
Tuan Xin, Computer Science Department

Shanghai Normal University

Liu Funian, President
Chen Yu, Deputy Librarian, University Library
Wan Jiaro, Associate Professor of Computer Science, Department of Physics
Chang Dong Wei, Associate Professor of Computer Science, Department of Physics
Chen Suining, Instructor, Chinese Languages Department
Shi Tsunzhi, Associate Professor, Chinese Languages Department
Lu Jingcai, Foreign Languages Department

Computer Group
Wan Jiaro, Department of Physics
Chang Dongwei, Department of Physics
Wang Weiqiang, Office of Scientific Research
Xu Guoding, Mathematics Department
Wang Xijing, Mathematics Department
Wang Xuehai, Mathematics Department
Chen Peifang, Electrical Engineering Department
Yang Wenyu, Electrical Engineering Department
Cai Guo-lian, Electrical Engineering Department
Xu Liming, Electrical Engineering Department
Yang Huizhong, Foreign Languages Department

Zhou Shouling, Instruments and Telecommunications Industries Bureau
Li Yongfu, Researcher
Li Gongyi, Machines Department
Qian Feng, Computer Software Development, Electrical Equipment Institute (Zhi Bingyi's assistant)

Shanghai Language Society

Qian Feng
Xu liming
Lin Rongli
Chen Da
Jin Wenming

Shanghai Foreign Languages Institute Dictionary Project

Panel discussion — approximately 40 participants

Appendix II

Notes on Universities Visited

Shanghai Normal University

Established in 1951 as the East China Normal University under the Ministry of Education, the university's aims are to train middle school teachers, college faculty at the assistant professor level, and some senior researchers. Students are drawn from all parts of China. The length of undergraduate work is now 4 years. During the Cultural Revolution the baccalaureate program was reduced from 5 to 3 years. As with other academic institutions, students were admitted on the basis of political and class quotas. Entrance examinations have now been reinstated, and there has been a significant change in the quality of the students now matriculating.

There are, in addition, a small number of students on a postgraduate basis, who stay for 2-3 years. The 3-year residence is more common. Postgraduates do not always work for specific degrees. The American model is found in the research institutes and institutions with predominantly hard sciences programs.

There are 10 academic departments that subsume 18 specialities. The departments are: (1) Chinese Language (and literature), (2) Foreign Languages, (3) Political Education, (4) Pedagogy, (5) History, (6) Mathematics, (7) Physics, (8) Chemistry, (9) Biology, and (10) Geography.

As an example of specialities within departments, Foreign Languages was cited as including English, French, German, Russian, and Japanese.

There are three research institutes and 12 laboratories. It was not entirely clear if these laboratories represent separate programs or whether they include the concept of space assigned.

There are about 4000 undergraduates and 200 postgraduates currently enrolled. Most students live on campus, but there are about 100 day students (commuters). Tuition, board, and stipends are free to all students. Graduates, in turn, are expected to discharge responsibilities of national character and serve governmental, social, and economic needs. Students attend from all over China but may be sent wherever there are special needs.

A second campus has been recently established for students in the electronics industry. This is jointly administered by the Shanghai Normal University and the Municipal Electronic Meters Bureau of Shanghai. There is also a school-run factory-workshop, which serves the institution's educational and scientific research purposes. Finished electronic products include oscilloscopes, computers, and tape recorders. The factory workers are specifically staffed for such manufacturers and are not students or university technicians though it is the appropriate departments that determine the kind of equipment produced. The school also sells equipment to factories, plants, and to government offices, for which it is fully reimbursed. Such funds can be used by the institution for whatever purpose it deems necessary. From time to time, faculty will accommodate research and service requests for agencies outside the university.

The library has more than 1 million books and related items. Western periodicals and newspapers seemed to be very much behind in terms of date. Shanghai Normal University is one of the institutions with which the Library of Congress has established an exchange program.

The total faculty is said to number 1100, but it is not clear whether this figure represents faculty only in the sense of teaching and research. There are some indications that administrative and support staff are included in the total full-time employed faculty account. Nevertheless, there is clearly an extraordinary and salutary faculty-student ratio. The present enrollment of 4200 students is expected to increase to 6000 in the fall of 1979.

To date no Shanghai Normal University students have been sent abroad. Some of the faculty have been sent to Europe but none to the U.S. There is, however, a specific institutional quota for Shanghai Normal University in the China University overseas program whereby four students and faculty will be sent to the U.S. The institution can make its own plans but must go through the Ministry of Education for approval. All involvements with foreign currency require government consultation. There are, so far, no foreign students enrolled, but they are planning to enroll some in the future.

Fudan University

Fudan University dates from 1905 and at the time of the delegation's visit was planning its anniversary celebrations. There are 13 academic departments and two basic divisions — Sciences and the Liberal Arts. The Sciences include six departments: (1) Mathematics, (2) Chemistry, (3) Biology, (4) Physics, (5) Nuclear Energy, and (6) Computer Sciences. The Liberal Arts division has seven departments: (1) Chinese (Language and Literature), (2) Foreign Languages, (3) History, (4) Philosophy, (5) Journalism, (6) Political Economy, and (7) International Politics. There are, in addition, five research institutes: (1) Mathematics, (2) Genetics, (3) Surface Physics, (4) Lasers, and (5) International Economics.

An Economics program is being formulated. The Liberal Arts have research programs on Chinese Literature, History, and Geography. There are departmental libraries for each program, and the total library holdings are more than 1.65 million.

There are more than 2000 faculty members at Fudan University including 250 at the professorial level and 900 lecturers. The balance was described as young teachers. The total student enrollment was 4100, of whom 3700 were undergraduates with 400 postgraduates. There are 26 foreign students, including one American, with whom the delegation had an opportunity to discuss student life in China. The foreign students take their meals separately and generally have better fare than the Chinese students. There is some socializing beyond the campus, often dependent, in China as elsewhere, on personal interrelationships.

In discussion with several members of other scientific delegations visiting China at the same time, it was felt that Fudan's science faculty was among the most up-to-date in China in terms of the main trends and research being done in Western countries. There is considerable ability shown in the design and building of research instrumentation and equipment and for conducting solid scientific research.

Nanjing University

Nanjing University was established in 1902 as the Central University. In 1949 it changed its name to Nanjing University. It divides social studies into: (1) Chinese, (2) Economics, (3) History, (4) Philosophy, and (5) Foreign languages. The sciences are represented by: (1) Astronomy, (2) Mathematics, (3) Computer Sciences, (4) Physics, (5) Chemistry, (6) Geology, (7) Meteorology, (8) Biology, and (9) Geography.

There is a total enrollment of about 4200, of these students 4000 are undergraduates and 156 are postgraduates. There are 40 foreign students. There are 1700 faculty, one-fourth of whom are engaged in scientific research. Again, it is simply not clear whether the remaining faculty are all teaching staff or whether administrative and supporting staff are included. In 1966 the total enrollment had reached 3000, of whom 200 were research students. By 1980 it is expected that the enrollment at Nanjing University will reach 6000.

The Nanjing University administrative planners envisage two major tasks: to restore teaching and to support the preparation for modernization. The following measures to be implemented are:

(1) a broad exchange between the universities in the country and between the research institutes;

(2) the establisment of close ties with foreign countries in connection with mutual faculty and student exchanges; and

(3) the import of advanced teaching tools.

There are now four special research institutes and eight research sections. Each faculty member is associated with some research group. The research institutes include: (1) Acoustical Sciences, (2) Chlorine Chemistry, (3) Vulcanology, and (4) Environmental Protection. The research sections are: (1) Seaweed Cultivation, (2) Astronomy, (3) Crystallography, (4) Mathematics, (5) European Culture, (6) American Culture, (7) Economics, and (8) Religion.

Not all research programs are fully operational. There are ongoing projects in fertilizer research. However, economics research is only in a planning stage. When economics projects are established they will be concerned with national economic planning.

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