CHINA EXCURSION 1981

FYSISCH MATHEMATISCHE FACULTEITSVERENIGING

state university groningen
the netherlands

Photographs by Seth Shostak

Cover by Eef Bos

© Copyright 1982. FMF, Westersingel 34
9718 CM Groningen
The Netherlands.

REPORT OF THE

"STUDIEGROEP WETENSCHAPSSAMENWERKING MET CHINA"

Acknowledgements

Once upon a time there was a tradition that every two years the F.M.F. (the society in physics, mathematics and astronomy of Groningen University) organized a study-excursion to a foreign country, and every four years the destination would be a "far-away-country". And thus students went to Belgium, Germany, England, Russia and the United States of America. It was 1979 and people had to decide where to go in 1980; it was then they decided to go to THE PEOPLE'S REPUBLIC OF CHINA.

The words above look a bit like an old-time fairytale and sometimes the 25 people, who went to China last year, indeed had the feeling it was a dream: walking around in unknown China. But it wasn't a dream.

We decided to go to China because of the Chinese struggle to revalue the capacity of Chinese science after the desperate years of the Cultural Revolution, and the hereby associated renewed contacts beween the Chinese and Dutch scientific worlds. In June the assembling of a capable committee, for organizing the excursion, began.People were kicked in and out and finally a basic structure was created. In September research was started how to organize and, the more difficult problem, how to finance the excursion. We obtained some inside-information from students of the University of Technology of Delft, who had been in China in 1978, and the professional staff of our own University; some of them had been in China too.

In the beginning of 1980 the committee succeeded in getting money from all kinds of local and national institutions, and so they got ready for what should have been the apotheosis of the financial war; obtaining subsidies from Dutch industries. However this wasn't a big success, probably because of declining industrial interest in China and the worsening Dutch economy. This was followed by another defeat: no subsidy from the board of our University. After a lot of groaning and begging some generous subsidizers solved the problem. Then the knot was chopped into pieces, there was no way back: 20 graduate students and 5 staff-members would make an excursion to China in April 1981. Notwithstanding the delay of one year, caused by the financial problems, everybody was in a winning mood. On November the 25th most of the members were known and the second phase of the organization started.

With enthusiasm everybody threw himself on the project, trying to find out what kind of research was done in China and preparing on a particular topic.During the battle of Taiwan everybody got nightmares and on the friday-afternoon-meetings there was a gloomy atmosphere. But at last people began to believe in life again and so the first members left Holland on the historical day March 26, 1981.

We want to express our thankfulness to all who helped us to make this excursion a success. It would take up to much space to mention all the professors, students and other notables of our and other universities in person, but they were all of great importance to us. An exception is made with respect to the members of our "Board of Recommendation" and our beloved subsidizers; a list containing their names is enclosed in this report. Further I want to mention the name of Prof. Dr. H. de Waard, who was the leader protocolair of our group.

Groningen, February 1982.

On behalf of the China-studygroup,
Tamme-Siert Wierenga.

PREFACE

The organization of international scientific excursions has become a traditional activity of the "Physical-Mathematical Faculty Society" (F.M.F.). The importance of this activity can hardly be overrated. It notably enables our students to learn about research activities in other countries but it also gives them a chance to get an intimate view of the societal condition under which such research is carried out. It therefore introduces them to the truly international aspects of modern research. Such an activity deserves strong University support, the more so because the preparations have always been very thorough, each student being alloted a specific task in observation and of reporting his findings. Though understandable in a time of budget cuts, the hesistance of some of our authorities to subsidize the excursion was ill founded. It is only due to the persistance and optimism of the student China Committee that a sufficient financial basis was finally obtained and it appears to me that the succes of the excursion, laid down in the following report was fully justified the subsidies given.

The excursion itself was a busy time for both students and accompanying staff. This was partly caused by our being tourists, which necessitated intensive discussions with our local guides immediately after arrival in each city, in order to establish a satisfactory scientific program. It must be gratefully acknowledged that in every case, our guides managed to fulfil our wishes to a large extent. It was also clear, however, that the number of visits envisaged in the original program was too large, also in view of the time needed for transportation. Due to the remote location of some institutes this time was sometimes considerable. Great help in realizing our wishes was given by our excellent and friendly national guide, Mr. Tsua Shun Yi (China International Travel Service, Peking).

The general organization was excellent. All means of conveyance were on time, luggage was transported very efficiently, all tickets were in good order. Hotels ranged from satisfactory to excellent. Food was plentiful and its quality varied between good and excellent. Hotel service was prompt and courteous.

In summary: the best possible atmosphere was created throughout for concentrating on our main task: getting to know China and a part of the science carried out there. Our heartfelt thanks are due to all those who made this possible: the student committee, the financial supporters, the Chinese scientists and our guides.

H. de Waard

The composition of the Committee of Recommendation:

Prof. Dr. A. Blaauw	Former President of the European Southern Observatory; Professor of Astronomy; Leiden State Unversity.
Prof. Dr. J. Borgman	Rector Magnificus of Groningen State University; Professor of Astronomy.
Prof. Dr. H.B.G. Casimir	Former President of the "Koninkljke Nederlandse Academie van Wetenschappen".
Prof. Dr. B.I. Deutch	Professor of Experimental Physics; Aarhus University (Denmark).
Prof. Dr. Ir. J.C. Francken	Professor of Technical Physics; Groningen State University.
Prof. Dr. J. Kistemaker	Director of the FOM-Institute for Atomic and Molecular Physics; Amsterdam.
Prof. Dr. J.W. Kuiper	Professor of Biophysics; Groningen State University.
Prof. Dr. J.H. Oort	Professor of Astronomy; Leiden State University.
Dr. A. Pais	Minister of Education and Science of the Netherlands.
Dr. Ir. A.E. Pannenborg	Member of the Board of Directors of N.V. PHILIPS' Gloeilampenfabrieken; Eindhoven.
Prof. Dr. R.H. Siemssen	Director of the "Kernfysisch Versneller Instituut"; Groningen State University.
Prof. Dr. Ph.B. Smith	Director of "Laboratorium voor Algemene Natuurkunde"; Groningen State University.
Dr. J.C. Terlouw	Leader of "Tweede Kamer" fraction "Democraten '66".
Prof. Dr. Ir. A.A.T.M. van Trier	Minister of Science Policy of the Netherlands.
Prof. Dr. B.P.T. Veltman	Professor of Technical Physics; University of Technology Delft.
Prof. Dr. H. de Waard	Professor of Experimental Physics; Groningen State University.
Prof. Dr. Ir. J.C. Willems	Professor of Systems and Control theory; Groningen State University.
Prof. Dr. E. Zurcher	Director of the "Sinologisch Instituut"; Leiden State University.

CONTENTS

I Interview with a Philips-official
1

II General Picture
4

II.1. Universities 6
II.2. U.S.T.C. 6

III Academica Sinica
10

IV Report of the theoretical physics section
11

IV.1. The Preparations 11
IV.2. The Journey Itself 11
IV.3. Conclusions and remarks 12
IV.4. List of persons we met 13

V Biophysics in China
14

VI Solid state physics
18

VII Nuclear Physics group
20

VII.1. Nuclear Physics in China. 20
VII.2. The Institute of Atomic Energy, Beijing. 20

VIII Isotope Physics
23

IX Report of the group of pure mathematics
25

IX.1. Mathemathics education 26

X Algebra and Number-theory
28

XI Differential Geometry and related topics.
29

XII Functionalanalysis in China
31

XIII Report of the Computer Science Group
33

XIII.1. Introduction 33
XIII.2. The academic curricula 33
XIII.3. The Institutions visited 34
XIII.4. Zhongshan University 35
XIII.5. Fudan University 35
XIII.6. Nanjing University 35
XIII.7. University of Science and Technology of China 35
XIII.8. Anhui University 35
XIII.9. The Mathematical Institute (Beijing) 36
XIII.10. Remarks and Conclusions 36

XIV Numerical Mathematics and Mechanics
38

XIV.1. Experiences in China 38
XIV.2. Research in Numerical Mathematics and Mechanics 39
XIV.3. Conclusions 39

XV Systems Control
41

XV.1. Our aim of the China journey 41
XV.2. Preparations 41
XV.3. The journey through China 41
XV.4. The Institute of Systems Science and Mathematics 42
XV.4.1. The visit 42
XV.4.2. The Laboratory of Control Theory 42
XV.4.3. Applications 42
XV.4.4. International relations 43
XV.5. Chinese journals 43
XV.6. Research institutes and universities 44

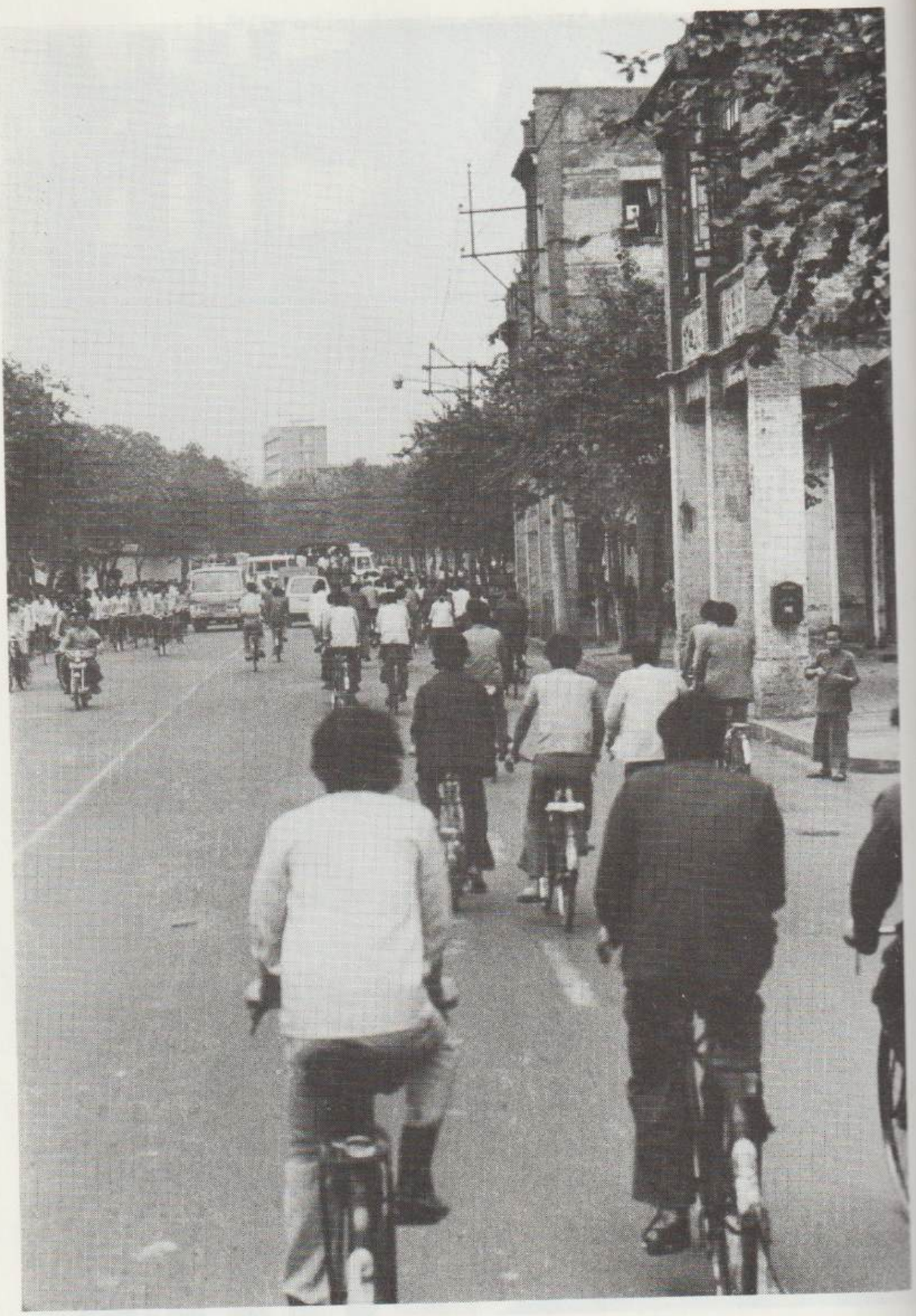
XVI Astronomy
45

XVI.1. Purple Mountain Observatory(PMO) 46

XVII Blunder into China
49

Appendices 57

The group except the photographer Seth Shostak.



Street scenery in Guangzhou.

CHAPTER I

Interview with a Philips-official

China is a huge country, still standing at a very early stage of its industrial development. It is not surprising therefore,that the Western countries are very interested in doing business in what is potentially a very large market.Companies which are trying to penetrate the Chinese market include Philips. To get a better insight into the problems of doing business with the Chinese, we talked to Mr. C.J.M. Raats who represents Philips in the People's Republic of China.The original plan was to hold the interview in Beijing, but in the end it took place in Eindhoven.

- When did Philips start operating in China?

  In 1925, although the contacts have been interrupted from time to time over the years and there were only incidental contacts between 1950 and 1973. More recently, the Chinese market has gradually opened up to foreigners, important events in this context being President Nixon's visit and the end of the Cultural Revolution.

- Why did Philips go to China?

  Philips is an international industrial enterprise. China is potentially a huge market and a country with production possibilities. Therefore, one can hardly ignore such a market.

- Does that mean that Philips is planning to manufacture products in China for selling on the European market, or does that already happen?

  Some small-scale assembly activities are carried out in China today and these may be increased in the future. However, this production is mainly for the Chinese market, although it is possible that part of it will be exported in future, as is the case with the production of other Far Eastern countries.

- Do you consider China to be more a potential customer than an actual one?

  Yes, that is correct.

- Is there a big demand for consumer products?

  Yes, there is a big demand for such products as radios and tape recorders, but the biggest demand is for television sets. Generally speaking, most Chinese families have some savings because they could not always spend all their money in the past. And many famlies have relatives living abroad who send them foreign currency with which they can buy imported equipment.

- What is Philips doing to create interest in its products?

This is still limited, but Philips' specialists visit China pretty regularly, holding seminars. We have set up service centres for repairing equipment already delivered. In addition, we advertise in department stores and in local scientific and technical publications, the timetable of Chinese airways, and on advertising hordings. We have to be selective because, quite naturally, the Chinese want to use their own production capacity and, therefore, they will never import products of this type on a very large scale. Nevertheless, that does not make China any less interesting economicaly. It is difficult to forecast how it will develop and so for us it is really a question of simply being there.

- What do you think about the recent cancellation of West-German and Japanese orders?

That was a rather disappointing development. The problem is that one can invest in a wide variety of industrial enterprises, but a balanced infrastructure is vitally important. That problem has been underestimated.

- Did it damage China's image as a reliable business partner?

Yes and no. Western countries and Japan were too optimistic about the business opportunities in China. They will be much more realistic in future. On the other hand it was fortunate that China realized in time that readjustments were necessary.

- One can argue that the western countries should have warned China about what might happen.

Yes,but it is very difficult to get hold of the right information about industrialization plans,priorities and budgets.

- What is Philips' market position compared with that of other foreign companies operating in China?

Three groups operate in China: Japan, which considers China as its natural hinterland--the relation between China and Japan is comparable to the one between the Netherlands and Germany;the United States and Western Europe. We all know Japanese industry's position vis--vis the U.S.A. and Western Europe and that is strongly reflected in China. It is a difficult market. For Philips it means a relatively large investment for a relatively moderate return.The same is true for other American and European companies.

- How does one obtain a contract in China?

With patience,advanced products and low prices. Generally speaking, I think I can say that the Japenese have more patience and are prepared to stay in China longer to get a contract than Westeners.We are used to doing business relatively quickly.In China one needs time and the Japenese stay put until they have the contract. It involves a great many discussions with Government officials and potential users and that requires a carefuly worked-out procedure which takes a long time to complete. It often starts with a veiled hint or request which can turn into a complete project. Because industrial experience is limited in China, the Chinese like to be kept up to

date.Therefore, they invite various companies which are competitors, to discuss a project and then ask them to provide detailed technical proposals, which enable the buyers to reformulate their demands and put them forward in far more detail, adjusted to what they really require.Sometimes, during the final stages of a negotiation, delegations from competing firms are surprised to find that they are lodged in the same hotel.

- Would you accept such an attitude for western business partners? It sounds as though one should thank the Lord for being given permission to do business in China.

The Chinese realise that the world has great expectations of their market potential and they play this situation very cleverly.

- Can you give a concrete example of a project obtained by Philips?

I am sure you will understand that there are some things I don't want to discuss for purely business reasons, that is one of them. However, I could mention the case of what is known as the Boeing project.As you know, when a project is started in a Western country, certain groups meet and sort out who is going to do what; legal, technical, commercial and so on, and the results follow relatively quickly. In China, however, one has to follow a carefully prearranged chain of events, especially to start with. For example, if the Chinese request airplanes, they will not tell the potential suppliers how many airplanes they want. A few years ago the Chinese were interested in buying Boeing 707s. Boeing sent a large delegation to China so that they could get down to detailed business as quickly as possible. The Chinese reacted by remarking that they didn't even know whether they wanted to buy Boeings, let alone how many seats per plane and so on. Negotiations continued for a year without agreement. Finally, Boeing said they had reached their rock-bottom line and that they could go no further. The Chinese apologized and said they could not afford the price asked. The whole deal was off and the Boeing delegation should leave. Then, two days before the Boeing team was due to fly home, the Chinese invited their leader to visit the Great Wall. He agreed and the trip was made on the following day. The leader of the Chinese delegation also happened to be there, which would not have been the case if it had not been planned, and during the day he started an informal discussion with the Boeing executive. And then he suddenly remarked that if the Boeing delegation could stay for just one more day, the contracts could be signed.

- What about China's future?

The modernization of a huge country such as China is very difficult and it is hard to predict how things will go. The people are clever and they want to work. In my opinion, China will develop strongly, but it will take a long time.

CHAPTER II

General Picture

Both research and education once again seem to have high priority with the Chinese government. The build-up of the People's Republic's research seems to be limited only by financial shortage and lack of properly educated personnel. The latter problem is on its way to being solved relatively quickly. Thanks to institutions like the U.S.T.C., the rapidly increasing numbers of students and lecturers, and an extensive exchange program for students and scientists with foreign countries (especially the United States, but with growing emphasis on European countries as well), the volume of know-how is growing. For the immediate future the first problem, finances, seems to be the most pressing, although this seems to be partly compensated by the enthusiasm of the scientists, who are clearly enchanted that they are able to do research again. It is also quite clear that this leaves little room for thoughts about institute management. Whereas the Gang of Four-period was characterised by the tendency to concentrate all power of decision with the Beijing government, the process seems to have been reversed since 1975, therewith leaving a lot of decision making power with institute administrations without setting standard rules about institute management. This causes many research management questions to be handled mainly by an informal circuit of scientists, while the ultimate power remains with an institute director. For instance, a large institute like the Shanghai Institute for Nuclear Research (under the Academia Sinica)- numbering approx. 400 scientists and as many technical personnel - has for administrative questions an Administrative Group, in which each of the institute's 24 sections is represented, but which leaves "decision making" concerning research policies to a Science Committee, consisting of the 25 "most important scientists" with advisory status. Decision power rests with the three deputy directors and, ultimately, with the Academy. The same picture prevails with other institutes, and also with the universities we visited. One gets the impression of a carefully guided growth in which the participants find themselves too busy to occupy themselves with research or education policies. Still, considering the present situation it is the enthusiasm and ingenuity of students and scientists themselves that is most important of all. In this respect the present picture gives good reason for optimism about China's scientific future.

When our group started preparations for a study excursion to China ,now more than one and a half years ago,we did this for several reasons.First,of course, because of interest for what was occuring in a part of the world we know so little about, (although roughly one quarter of the world's population lives there under circumstances both political and cultural that defy comparison with those of the Western world). Secondly,it is clear that the People's Republic of China is rapidly increasing both the volume and quality of its scientific research apparatus, so that this could be called a unique opportunity to watch the progress of a large country's "scientific build-up".The last,but certainly not the least, important reason to be mentionedis an opportunistic one: the end of the Cultural Revolution,now some years ago,marked the beginning of an era of scientific and cultural exchange with the rest of the world on a level previously unknown,even before the Cultural Revolution. Access to the People's Republic and its institutions is a lot easier nowadays ,and interest in these matters is beginning to grow in the Western world, exemplified by the increase in tourism and scien-

tific cooperation.

The latter impression was confirmed very soon after boarding the Hongkong-Guangzhou express train at the spacious Kowloon station, its newness also illustrates the above sketched picture.Crossing the border at Lo Wu turned out to be a mere formality: the difference with crossing any Western European border by train consists in filling out a tiny "baggage declaration form";passport control takes place in the train,and there is no question of stopping,getting out and walking across the well-known bridge as was usual a couple of years ago.The smoothness of the (quite comfortable) train trip between Hong Kong and Guangzhou was matched by the smoothness of the organisation of our entire trip through the People's Republic. The next day,Thursday April 2nd,our series of visits started off with a reception at Guangzhou's Zhongshan University,one of five Chinese universities we were going to visit.The proceedings of this reception by a delegation of staff members (as well as some students headed by a university executive) followed a pattern which was to be largely repeated during all subsequent visits to universties and institutes.After a very courteous welcome the staff members who were present would be introduced to the group.Then a presentation followed, concerning the history and organization of the institution. During this talk the progress since the end of the Cultural Revolution would be emphasized, and the preceding period severely denounced.Indeed without exception,when given reason to mention the subject, every scientist we met took that opportunity to criticize the Gang of Four and the Red Guards for what they had done to scientific research during the C.R. and,what is more, to express his relief that the government's attitude to scientific research has completely changed since then. However,the general picture that can be distilled from all these explanations cannot be called generally optimistic.Whereas in the past three years the budgets available for scientific work only seemed to increase,the money flow at the moment seems to have been reduced to a steady trickle. Many times university officials even seemed to doubt whether there would be any money available for their 1982 research budget.China's precarious economic position (especially its foreign currency shortage) seems mostly responsible for this research budget cutback.Nevertheless China's determinedness to "catch up" in all important areas of science and technology seems undiminished.

Another reason for optimism is the enthusiasm and inventiveness of the researchers themselves.After the formal part of the reception the group would divide into physical,mathematical and astronomical science groups in order to facilitate informal discussions with staff members of various specialityies. One thing soon became very clear during these discussions: although both scientists and students still seemed to be very conscious of most areas of politics (national as well as local), their thinking turned out to be mainly devoted to doing research and solving research problems. This is contrary to the situation several years ago when discussing national and local politics (not only with colleagues,but also with foreign guests) was compulsory for most of the available time. This naturally did not constitute a fruitful climate for doing research.However,those who keep themselves to research problems and achieve results accordingly,are no longer considered political suspects,and pursuing new ideas and starting new projects is encouraged again.What strikes one mostly in this context is the ingenuity in obtaining results with sometimes the barest means.The changed attitudes of the last years have now revealed the capability of experimenters to solve their practical problems:given the opportunities, the means and the money,the works of Chinese scientists will very probably include the foremost developments in all important areas of the natural sciences

within the next decade.

II.1. Universities

The aforementioned Zhongshau University was one of the five universities we visited.The other four were Fudan University in Shanghai,Nanjing University and Anhui University (the latter in Hefei). Like Zhongshau,these are so-called "comprehensive universities". Further, we visited the University of Science and Technology,which is also in Hefei.The latter differs from the other four in various respects.First,it comprises only science departments,whereas the others are divided into two divisions: "Science" and "Literature&Art" ,the second consisting not only of literature&art departments (and related disciplines) but also containsing law and political sciences departments. Furthermore,U.S.T.C. seems to have as its main function to educate China's future "corps scientifique",taking only the most promising students in order to create an environment from which China's top scientists will emerge.This is indicated by the fact that U.S.T.C. operates under the Academia Sinica(see box) whereas the comprehensive universities are under the control of the Ministery of Education, and even more by comparing the percentages of students that are granted scholarships in foreign (mainly:American) universities. Science departments in comprehensive universities mostly comprise mathematics, physics,chemistry and biology; additionally, various other areas are covered (see table:science depts). Besides the division into departments, most universities also have a number of research groups,or "specialities"; its number roughly indicates the amount of research done at a particular university.The situation seems to be comparable with the entities in Dutch universities,known as "faculties" and "research groups",and was in all four universities we visited the result of reorganizations carried out in the fifties.These reorganizations were part of a " national program of reorganazation of the education system", under auspices of the late premier Zhou En-Lai.

A very remarkable feat is the "science management department" of Fu Dan University. Fu Dan officials explained that in this department studies were being made about consequences of automation and other possible reorganisations within local factories,in cooperation with the factory management involved. Indeed during a conversation at Zhongshou University concerning Guangzhou's sources of income,one of these turned out to be money paid by local industry (mostly electro-engineering we were told) in return for advice furnished by the University research groups. The same thing later turned up at Nanjing University.According to the Guangzhou people the amount of income obtained this way ran up 30% of the available research budget! Although this kind of cooperation with local enterprises appeared quite frequently,in none of these three cases did science management itself seem to be the object of study: even in Shanghai, with a department dedicated to advice and studies in this field ,only individual cases were considered. This seemed to be the only kind of study carried out in direct cooperation with possible users.

II.2. U.S.T.C.

The Hefei based University of Science and Technology of China was founded in 1958 as one of the results of the aforementioned education program, carried out under premier Zhou En-Lai.Being originaly based in Beijing,the institute was transferred almost entirely(with exception of the Graduate School) to Hefei as part of a geographical decentralisation program,which was a policy which prevailed during the period of the Gang of Four. In most respects U.S.T.C. resembles the science part of one of the comprehensive universities. The major differences exist between the

quality of the curriculum offered,and the amount of scientific research carried out. Faculty members total 1500,including some 100 professors and associate professors,approx. 200 part-time professors from various Acadamy institutes, and some 800 lecturers.Its instruction program offers 80 courses leading to B.Sc. ,M.Sc. and Ph.D. degrees respectively, of mostly five years duration. The U.S.T.C. departments are:

- Mathematics
- Physics
- Modern Cemistry
- Modern Mechanics
- Radio-electronics

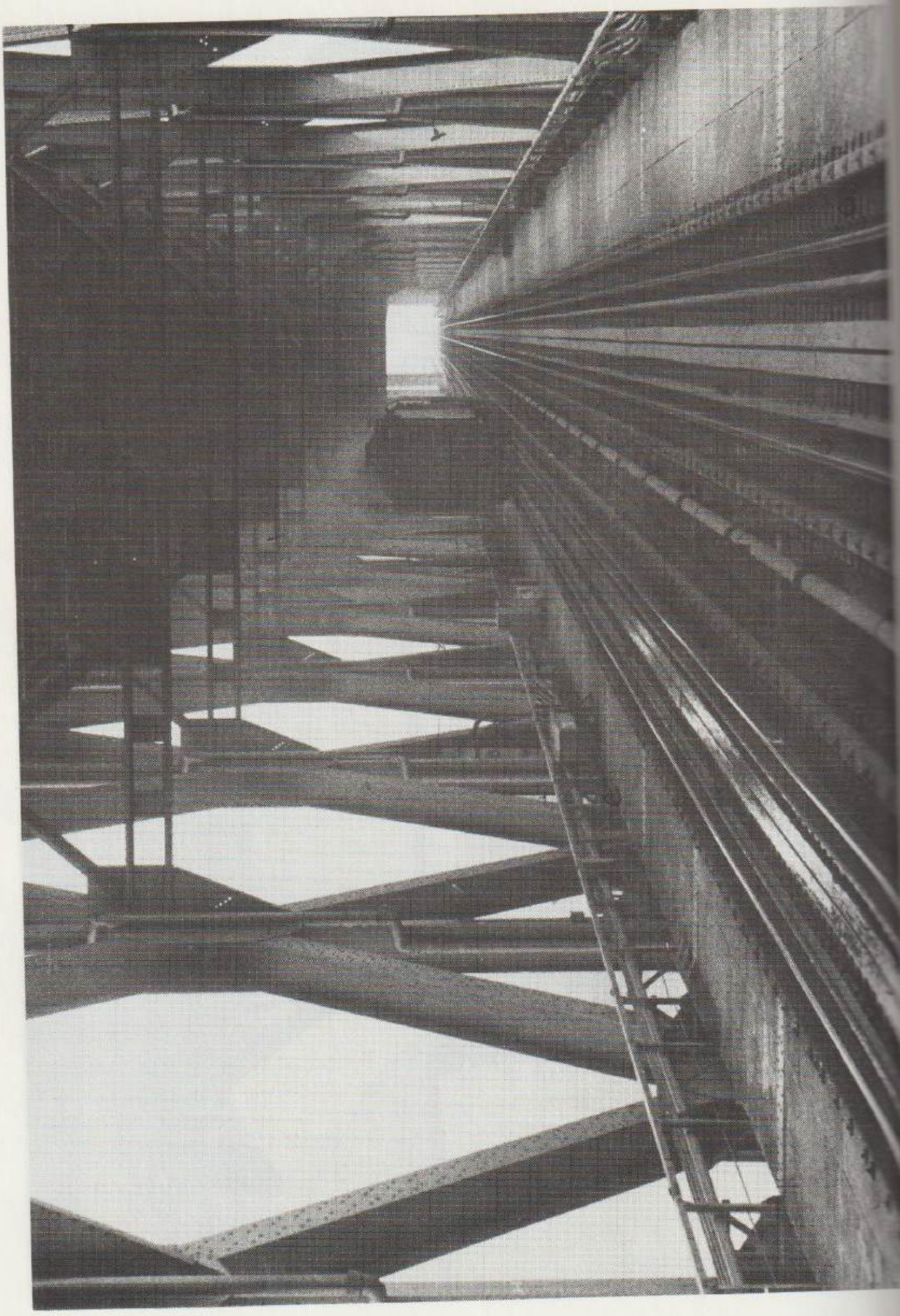
Modern Chemistry
Earth & Space Sciences
Biology
Precision Machinery
Science Management

Unlike Fudan,at U.S.T.C. the science Management Dept. was not in operation yet,but was soon expected to be.The university further includes 30 laboratories. 22 others were under construction or projected. Indeed ,a confirmation that the Academia Sinica's position is quite a strong one was the fact that U.S.T.C. - under the same authority(the State Scientific and Technological Commission) as the Academy,and fully subsidized by the latter- seemed less affected by the recent budget shortage than the comprehensive unversities,which are only partly subsidized by the Academy. Each year U.S.T.C. accepts some 600 undergraduate and 200 graduate students, who must have demonstrated qualifications far exceeding the average in the preliminary examinations.Total number of students exceeds 3000,10% of whom are graduates. A further sign that U.S.T.C. is a high-quality education institute is the existence of a so-called Juvenile Class,occupied by "exceptionally gifted youngsters" in order to give talented pupils early access to high-level studies. "Youngsters" is not really overstated in this case, because the average age is fourteen and minimum age is eleven!

Some Figures:

University	Nr. of depts science	lib.arts	New since 1977	Students(1981) und.gr.	grad.	Staff	Budget 1980
Zhongshan (Kanton)	9	6	sociology anthropology philisophy	5100	260	1300	Y 2 Million (all science)
Fudan (Shanghai)	15		science management	6000	300	2000	$ 200,000 Y 600,000 (physics)
Nanjing (Nanjing)	8	5	economics philosophy law	6000	350	1700	Y 2 Million (science)
An-hui (Hefei)	5	6	history philosophy economics law	3200	200	740	??
U.S.T.C. (Hefei)	9			2600	140	?	?

Barbers in Nanjing.



Bridge over the Yangtze Ciang (Nanjing).

Beijing Observatory.

CHAPTER III

Academica Sinica

Like its counterpart in other socialist countries, the Academy's main function is to provide necessary facilities and a suitable environment for scientific research on a national level. It naturally also serves as a body that coordinates scientific research efforts by institutions under other authorities' control, as a channel for the central government's research budget.Although it is not the People's Republic's only organisation of this kind- there exist,for the coordination of other kinds of research, the Chinese Academy of Medical Sciences and the Academy of Agricultural and Forestry Sciences it may be considered the most important one in China. The Academy itself is under control of the State Scientific and Technological Commission which also controls various Industrial Departments, and the University of Science and Technology of China, situated in Hefei.

According to most reports on scientific research during the time of the Cultural Revolution or immediately thereafter, for example the 1976 OECD-report (OECD Committee for Scientific and Technological Policy: Science and Technology in the P.R.C.), the Academy went through a period of strongly decreasing influence, most of the institutes under its control being transferred to local or regional authorities, and money flow through Academy budgets coming to a near standstill. From 1975 onwards, this trend seems to have been reversed: many institutions were brought back under Academy control and this has been accomplished by a considerable increase of money being granted for research projects. More recently the Academy budgets even seem to have been suffering less than those of the Ministry of Education.

As for "providing a suitable environment for scientific research" the Academica Sinica stimulates and arranges contacts between scientific research institutions (both Academic and non-Academic) and exchanges of scientists and information, not only within China, but also with other countries: most Chinese scientists visiting foreign institutes or universities are sent there through the Academy. Consequently, the most efficient way of getting into contact with Chinese scientists or research institutions for foreigners, is to be invited by the Academy. Such an invitation can be obtained by sending a request to the Academy to that end,stating one's intentions in visiting the institutions and the People's Republic's benefits in granting the request. With an official Academy invitation every visit to a Chinese institution will be considered important and meaningful, which is yet another sign of the Academy's prestige.

CHAPTER IV

Report of the theoretical physics section

Our group consisted of the following:

Prof. Dr. Nico M. Hugenholz, expert on statistical mechanics.
Henk Corporaal, student of theoretical physics(specialising on super-symmetries)
Folkert Tangerman, student of pure mathematics.

IV.1. The Preparations

The major part of our preparation comprised the study of the following subjects in theoretical physics:

1. The interacting boson model.
2. Magnetic monopoles.
3. Gauge theory.

Our choice of these subjects was motivated by arguments such as the following:the interacting boson model is a recently developed theory which has practical applications in nuclear physics,leading to very accurate results.The work is partly done by F.Iachello who works at our institute.

Magnetic monopole theory was chosen mainly because Folkert found many papers on this subject in "Scientia Sinica",the only English written Chinese Journal concerning theoretical physics available in our libraries.Especially C.N. Yang and T.T. Wu (from State University of New York,respectively Harvard University),who regularly visit Fudan University(Shanghai),have done a lot of research in this field and gained many new insights. We hoped to meet some of their disciples.The last subject,i.e. gauge theory,was chosen because of its use in so many fields in theoretical physics(for instance in supersymmetry-theory).

IV.2. The Journey Itself

Let us first point out that it is hardly possible to write a smooth story of what we have seen,basically because in theoretical physics there is not much to look at. One has to talk to many people of one's discipline and even then it is difficult to make accurate, general conclusions. As a rule, we did not profit greatly from our preparations.People we expected to meet weren't at the spot or couldn't be reached.Some of them such as Hu-He-Sheng and Tu-Tung-Sheng(both in magnetic monopole theory) of Fudan University (Shanghai) were apparently (we were told) working in the USA with C.N.Yang. Of course we were able to meet other theoretical physicists at most of the institutes we visited,but we often were greatly obstructed by the fact that their research wasn't in our field. Other times lack of proficiency in speaking English gave huge problems of communication.

But let us concentrate on the information we acquired from the various universities and institutes we visited. First of all Dr. Sun Yat-Sen University in Guang-zhou(Canton). Here Henk talked with a postdoctoral student in elementary particles. He was preparing a journey to the USA where he intended to obtain his PhD.He related that he had done together with his teacher some research on gauge theories but Henk couldn't learn any details. At the moment this student's main concern

was to improve his knowledge of English. Our impression was that the level of research at this university was rather low,most time being spent on teaching and attending lectures. In Shanghai at the Institute of Nuclear Science there was a special division studying group theory and using it for describing collisions between small nuclei.Of course we gave them a lot of material about the I.B.M. model in which they were interested.

At the Fudan University, Henk spoke with two persons of the theoretical divisions. One of them used graded algebras (as in supersymmetry) to relate strong interaction to el. magn. and weak interactions in order to get closer to grand unification, but here the lack of English was a big problem.The other person did research in the theory of vacuum stability of the quantum model,related to dynamical symmetry-breaking.In fact he was using the B.C.S. model from superconductivity in elementary particle physics which has been done before in the early sixties but according to him not thoroughly enough. Hugenholtz conversed with Prof. Zhou,who once studied with N.N.Boguliubov.He is leading an active group in statistical mechanics,doing modern research.This was also the case at the Nanking University,where we met a similar group,led by Prof.Cai Jianhua.Its main research topic was phase transitions, such as the Kondo effect,using Green functions.The professors Cai and Lee worked during the sixties in Moscow.

In Hofei the situation was completely different.At the University of Science and Technology,recovering from the damage caused by the "Gang of Four", we had poor contacts except for one profesor working in abstract stat. mech. Nevertheless we had the impression that they worked hard to raise levels to modern standards.This in contrast to the Anhui university where the theor. physics department seemed only interested in our means of education.

IV.3. Conclusions and remarks

As we wrote above, it is difficult to draw hundred-percent safe conclusions.We only want to give some global impressions of what we have "seen" in China. At every institute apologies were offered for the fact that only during the last four years is science being seriously practised again.During the period of the Cultural Revolution(1966-1976) the role of universities and research institutes was limited to an absolute minimum. Equipment wasn't used or was even destroyed.As a consequence, the population of these institutes can be divided into three classes: people who have had their training before,during or after the Cultural Revolution. Professors and lecturers who belong to the first class have mainly an educational task for the younger generation and have less time for research activities.People from the second class have had defective training and have to fill up this gap in order to make contact with present research. Chinese science has set its hopes on the younger generation to play soon an important role in the scientific community.The best of these young students get the possibility to study abroad.We must realize that this is quite expensive by Chinese standards.We were told that students get a one year salary from their government and after that period they have to care for themselves.One hopes that these students will be so good that a job will be offered them by the university.

IV.4. List of persons we met

Sun Yat-Sen University Guangzhou

Prof. Mo	Semiconductor physics.
Shi Long-Pei	Solid state physics.

Fudan University Shanghai

Tao Rui-bao	phase transitions and group theory,
Zhou Shi-xun	spin wave theory.
Sun Xin	scaling laws,B.C.S. theory
Li Sin-zhou	
Gu Ming-gao	graded algebras and gauge models
Yin Peng-cheng	

Institute of Nuclear Science Shanghai

Sun Hung Chin	group theoretical methods in nuclear physics

Nanking University

Cai Jian-hua	head of the statistical mechanics division.
Gong Chang-de	
Shui Luu-dao	statistical mechanics.
Lee Cheng-chung	
Shiao Hookang	

University of Science and Technology Hofei

Fang Li-shi	gravitation
Wang Ke-lei	elementary particles
Wang Bin-hong	statistical mechanics
Wu Hang-sheng	statistical mechanics: critical phenomena

CHAPTER V

Biophysics in China

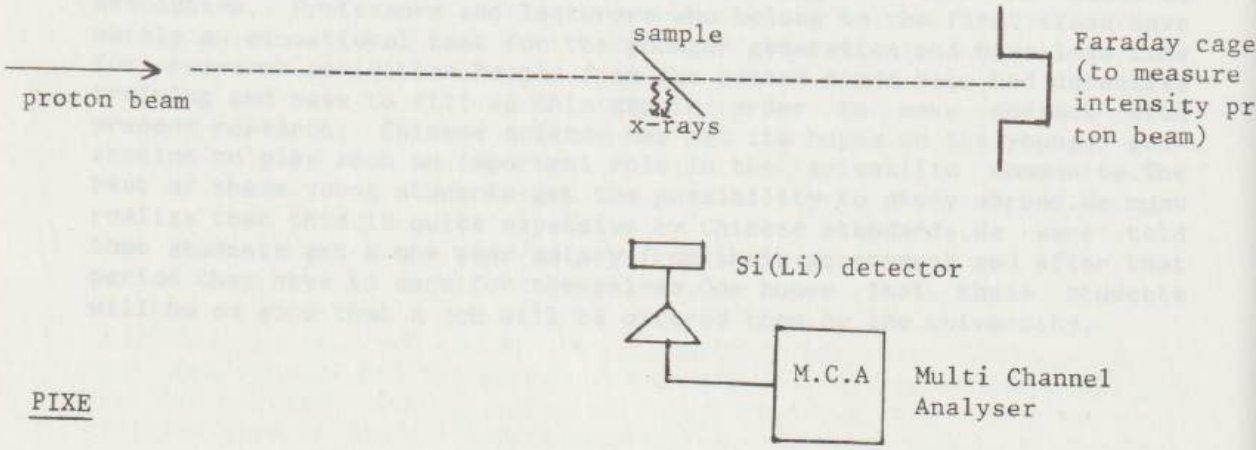
Members: Hans van Hateren, Bert Metz.

We have seen biophysical research at the following universities and institutes visited by our group. At the Zhongshan University in Guanzhou haemoglobine is investi- gated by means of Raman spectroscopy. At the Shanghai Institute of Nuclear Research,the influence of cancer on the stucture of proteins is being investigated. In the cyclotron isotopes for medical and biological purposes are being produced. Furthermore research on Yin- and Yang disease is going on, and efforts are being made to find a medicine against radiation damage. At the Fudan University in Shanghai the Van de Graaff accelerator is used for investigations of dental disease and the chemical composition of hair. At the University of Science and Technology of China in Hefei one is studying the biophysics of the ear and the eye. The institute of Atomic Energy near Peking is producing radioactive isotopes for medical purpose, supplying about 800 hospitals in China.

A lot of biophysical research is done at the Institute of Biophysics, situated in Peking. We already knew something about this institute before we went to China, for reports of various groups which had previously visited the institute were available (ref. 1, 2, 3). Moreover several research papers of scientists working at the institute were published in Scientica Sinica. This journal(in English) is published by the Chinese Acadamy of Science, and avalaible in Groningen. We concentrated especially on research on the biophysics of (visual) sense organs, as this subject in particular,is investigated in Groningen. Moreover we tried to get an impression of the technical means available for biophysics research in China. In the following various aspects of biophysics research in China will be presented: physical techniques for biological research, radiation biology, and the biophysics of sense organs.

I. Physical techniques for biological research.

At both the Institute of Nuclear Research and Fudan University (both in Shanghai) the PIXE method was used. PIXE stands for Proton Induced X-ray Emission. The principle of PIXE is that a beam of protons hits the sample to emit x-rays characteristic of the chemical elements in the sample. By means of this method very small quantities of "spore" elements can be determined.



PIXE

At the Fudan university the protons are accelerated by a Van de Graaff accelerator, whereas at the Institute of Nuclear Research a cyclotron is used. At the Fudan University PIXE is used for diagnosis; for example the presence of arsenic in hair can be detected. Moreover dental diseases are investigated by this method. We had an interesting discussion with Mr. Sheng Kang-Long, scientist at the Insitute of Nuclear Research. He told us that at this institute PIXE was used to detect differences in the protein of healthy rats and rats with cancer. Moreover PIXE was used to investigate the differences between the so called Yin-disease and Yang-disease. According to the ancient Chinese theory all illnesses can be divided into two groups: the Yin and the Yang group. Now one is trying to give this theory a more scientific basis. For example one found differences in the Cu- and Zn-contents of the serum of the blood of animals having diseases from these two groups.

II. Radiation Biology.

Investigations concerning radiation damage were persued in Shanghai at the Institute of Nuclear Research and in Peking at the Institute of Biophysics. In Shanghai efforts were being made to find a medicine against radiation damage. Rabbits were radiated by a 10 kCi-60 Co source with 400 rad a day. The changes in their blood serum were investigated with the PIXE method. As we already knew from a publication in Scientica Sinica (ref.4) at the Institute of Biophysics the effects of long term low-dose radiation (2.17 rad/day 60Co) on Rhesus monkeys was being investigated.

III. The Biophysics of the sense organs.

At the University of Science and Technology of China (Hefei) we visited the department of biophysics, part of the biology section. We were welcomed by Mrs. Liu Jing, head of the biology section. At our request we saw see two investigations in the field of sense organs. One of these investigations was performed by Mr. Sun Yu-Wen; the subject was the ear of the guinea pig. By means of a brass electrode (less than 100 micron in diameter) electrical signals of the hearing nerve were measured and displayed on an oscilloscope. In particular the influence of the Ca 2+ concentration in the liquid in the inner ear on the conversion of sound to electrical nerve signals was examined. The other investigation, lead by Mr. Rua Di-Yun, was aimed at the visual system of the cat. A visual stimulus (mostly a stripe pattern) was generated on a television screen by means of electronics built in the institute. The electrical signals in the cortex of the cat looking at the stimulus were measured by means of tungsten or glass micro-elec- trodes (tubes with a very sharp point, typically 1 micron or less,filled with a conducting liquid). Mainly the spatial and temporal properties of the cat's visual nervous system were studied.

On the last day of our stay in China we visited the Institute of Bio- physics in Peking(Bejing).Received by Prof. Pei Shih-chang, the director of the Institute, we first got an introduction to the main research areas.Afterwards,that part of the Institute where sense organs were investigated was shown. Before going into detail, we first give a survey of the activities of the Institute. Research fields:

- I. Molecular biology; especially biochemical research in the field of DNA and RNA, enzymes etc. (ref.6,7).Use is also made of X-ray diffraction
  for the determination of the crystal structure of bio-molecules

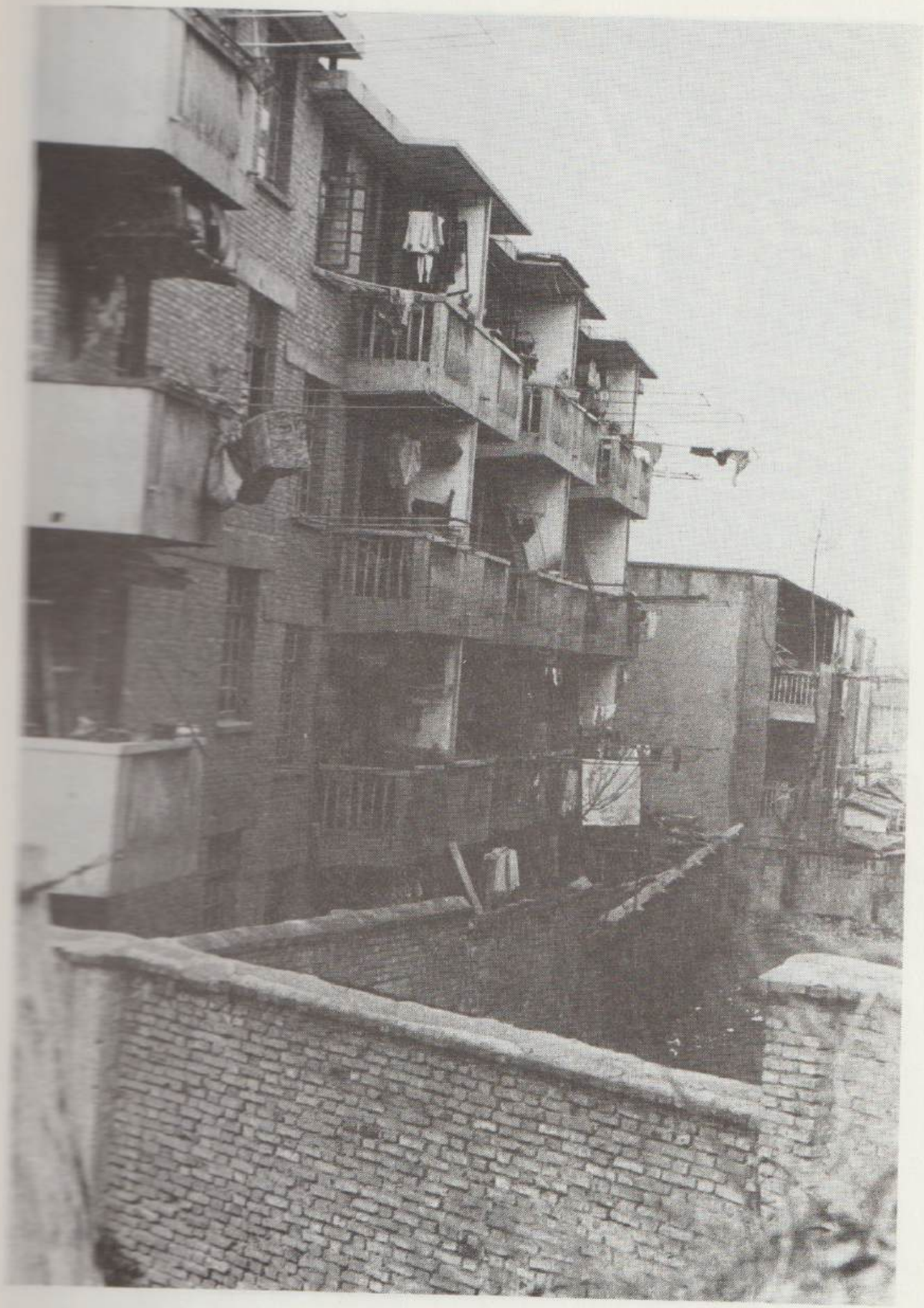
(such as
insuline and a Chinese herb, see ref. 5 and 8).

- II. Biophysics;
  - -radiation biology and chemical processes induced by radiation are studied, as well as dosimetry.
  - -biophysics of sense organs;studies include the visual information processing in the fly's compound eye, and a mathematical model of the receptive field of the mammal retina.
  - -cell biology; investigations of the structure of cells, as well as the mechanism that transforms a normal cell into a cancer cell. Part of this research is the study of the genetics of cells in relation to radiation.
  - -theoretical biophysics; a.o. thermodynamics, statistical mechanics and quantum biology.

- III. Technological projects;for example development of scintillation counters,fluorescence counters,high speed centrifuges, etc.

In the laboratories we saw the following projects: Mr. Hsia Fa Sheng was investigating the ampullary organs of the Catfish. These sense receptors are sensitive to electrical fields. The research was concentrating on the time coding of the signals (spikes) from the nerves of the receptors, that is to say the way in which the stimuli registered by the organ are coded in a so called spike train. The spikes Mr. Diao Yuncheng was studying were relevant to the binocular pathway of cats, rats and marmots. This pathway is a series of connections between the parts of the brain that receive information from each eye seperately. Like the project we saw in Hefei,a television screen could be used for stimulus generation. Some experimental techniques used were electrical stimulation and cooling of one half of the brain. An investigation of the visual system of the fly was being persued by Mr. Guo Aike. He had worked two years in Munich on this subject. He has published various relevant articles in Scientica Sinica (ref. 9.10,11,12). We saw some photographs,made in the Institute,of the anatomy of the compound eye and the brain stuctures belonging to it. These pictures were made with a light microscope, but progress was being made on using an electron microscope.Efforts were also being made for measuring intracellular potentials in the sense cells by using glass electrodes. However, because of the still too large diameter of the electrodes (presently about 1 micron) the results were not yet satisfactory.There were plans to eventually investigate the medulla (one of the parts of the fly's brain for visual information processing). As stated before,the department of Biophysics in Groningen is thoroughly investigatingthe visual system of the fly, so we could give Guo articles and theses in the field published by scientists from Groningen. Guo in turn gave us reprints of his recent publications.

To conclude we offer some general remarks about the biophysical projects we saw in China. Most techniques used were similar to, and as sophisticated as,those known to us from the Groningen laboratory. Techniques such as making very sharp microelectrodes, using advanced electronics for stimulus generation and processing is still in a developmental stage. One has to take into account of course the very serious drawback the Cultural Revolution imposed on the development of science in China. On two occasions we found that scientists did not know of similar research being done within China at some other institute. The scientist we spoke with in the Shanghai institute of Nuclear



Nanjing.

Chinese photographers at the Sun Yat-Sen Mausoleum (Nanjing).

Research,who worked on radiation biology,appeared to be ignorant of similar research at the Institute of Biophysics in Peking. The same was true for the scientist in Peking working on the spatial and temporal properties of the cat's visual system, who didn't know about the project we saw in Hefei. Maybe the large distances in China and the small mobility of the scientists accounts for these difficulties. Although some of the research is purely applied research (such as a project in Peking on mechanical receptors in the pigeon's leg in connection with earthquake prediction), we also saw a lot of research that is not immediately applicable, such as the time coding of nerve signals and the study of the vertebrate and invertebrate visual system.

References:

1. Tien, H. Ti: Biophysical research in the People's Republic of China, a report to the council of the biophysical society. Biophysical Journal Vol. 15 621-631 (1975).
2. Institute of Biophysics. From: Natural Sciences in China, report from a visit to the PRC by a delegation from the Royal Danish Academy of Sciences and Letters, p.43-44 (1976).
3. Institute of Biophysics (Peking). From: Directory of the National Council for U.S.-China trade, p.151-155 (1978).
4. Effect of chronic irradiation of 60 Co-g-ray at low dose rate on Rhesus Monkeys (Macaca Mulatta). Scientica Sinica vol. XXIII no.9 (sept. 1980).
5. Crystal structure and absolute configuration of Qinghaosu. Scientica Sinica, vol. XXIII no.3 (march 1980).
6. Zhao Kangyuan, Lian Yongning, He Yansheng, Zou Chenglu: Effect of modification of cys-149 on the ligand binding properties of d-glyceraldehyde-3-phosphate dehydrogenase. Scientica Sinica vol.XXIII no. 12 (dec. 1980).
7. Yang Fuyu, Xing Qingru, Wang Shuya: Cyanide-insensitive respiration in corn mitochondria I. Scientica Sinica vol. XXIII no. 6C(june 1980).
8. Wu Bomu, Wang Jiahuai: Female cadaver in the Han tomb no. 1, X-ray diffraction studies on two kinds of fibrous protein. Scientica Sinica vol. XXIII no. 7 (july 1980).
9. Guo Aike: Elektrophysiologische Untersuchungen zur Spektral- und Polarisationsempfindlichkeit der Sehzellen von Calliphora Erythrocephala I. Scientica Sinica vol. XXIII no. 9 (sept 1980).
10. Guo Aike: id. II Scientica Sinica vol. XXIII no. 11 (nov. 1980).
11. Guo Aike: id. III Scientica Sinica vol. XXIV no. 2 (febr. 1981).
12. Guo Aike: id. IV Scientica Sinica vol. XXIV no. 4 (april 1981).

CHAPTER VI

Solid state physics

Member:Jeroen Langevoort.

In China we did not see many people who worked only in the field of solid state physics.Most physicists we met were specialised in the field between nuclear and solid state physics.Above all the Moessbauer effect was applied frequently. It seems that China is prepared to give more money to applied physics than to fundamental physics. In most of the universities and institutes we visited the instrumentation was old fashioned: mostly from the sixties. A lot equipment was made in China.The absence of industry makes it often nessecary to make one's own instruments.Therefore the set-up of an experiment sometimes takes very long.We were not able to see many experiments.

The universities and institutes are, in the first place teaching institutes. Due to the Cultural Revolution there is only a small staff of qualified physicists.They have had their training before the Cultural Revolution, and there are some staff members who are self-trained. The first university we visited was the Zhongshou University in Guangzhou. Here we met Prof. Mo Cang,who specialised in semiconductors. Prof. Mo Dang studied the optical properties of semiconductor films and surfaces with ellipsometric absorption end electrical measurements. He investigated radiation damage and annealing effect in arsenic ion implanted silicon.The refractive index depth profile exhibits a plateau form,indicating the existence of an amorphous layer.The temperature needed to recrystallize this layer was at least 700 degrees Celsius. In Shanghai we went to Fudan University.At Fudan we saw some experiments on radiation damage and laser annealing of GaAs.There was also research done on defects in crystals.The first experiments are very important in the HMOS technique,because in this technology it is very important to get a very pure single silicon crystal layer.Here they used proton induced X-ray analysis to obtain information of the elements in the silicon crystal. Proton induced X-ray analysis is not very different from normal X-ray analysis but the sensitivity is very much higher. The amplitude of the proton induced X-ray signal is higher than in normal X-ray analysis.Therefore one can detect parts per million instead of parts per hundred.At Fudan, there were also experiments on the blocking effect.(see nuclear physics) In Nanjing we met Mr. Duang Feng.His group had special interest in crystal growth.Here they measured differences in polarisation in crystals grown under periodic temperature variations.The polarisation is said to be coupled with impurities in the crystal.With the aid of an electron microscope they study the phase transitions in a crystal.Radiation damage produced by electrons induces a phase transition: the crystal changes to an amorphous state. During this transition there exists an instability.The Curie-point is almost at the temperature of this transition. There were no conclusions yet made,because the experiments were still unfinished. In the Moessbauer group they did some experiments on exchange and excitation processes,phase transitions and acoustic double resonance in magnetic materials and microcrystalline minerals.A quartz-film bonded with steel was used in the acoustic double resonance experiments.In the future they want to look at the surface acoustic waves in the quartz-film. In Hefei we went to the Institute of Science and Technology.This institute had the most modern instruments we have seen in China.Most of these were made in Japan.A modern scanning electron microscope, however,came from a factory in

Beijing. At the solid state department there was work done on the determination of the orientation and polarisation of crystalline polymers. Small angle diffraction was only in the beginning stages, so there were no results to show. In my opinion the most impressive things in China were to be seen in Hofei.After visiting the Institute of Science and Technology, we went to Anhui University.Here they had nothing.During the C.R. the instruments and an accelerator were smashed by young Chinese.So this university now was only a teaching institute.That is why we only talked about the lectures given at our university. The last stop in China was Beijing,but our two day visit was far too short. In Beijing we did not have a chance to see any on solid state physics.

This is only a limited view of the experiments done in China,and gives only a partial impression of Chinese solid state research. I hope that our contacts may contribute to the further development of physics and to better mutual understanding.

CHAPTER VII

Nuclear Physics group

Members: Prof. Dr. A. v.d. Woude,Paul Huygen.

The nuclear physics group wanted to find out how and why nuclear physics is done in China. Is it competitive with the rest of the world? How is their equipment? What topics are studied? A study of Chinese scientific journals was made before the trip.Most of the topics in these journals are in molecular physics. In China we visited two of the three major nuclear laboratories. In most of the universities no nuclear physics is done, except for Mossbauer spectroscopy in some cases. In the future annual reports will be exchanged between the KVI (the Nuclear Physics Institute of Groningen) and several institutes in China.

VII.1. Nuclear Physics in China.

In China the study of nuclear physics started in the years 1950-1958 with help of the Russians. The emphasis was originally on military applications. Three major institutes were founded under the administration of the Chinese Academy of Sciences: The Institute of Modern Physics in Lanzhou, The Institute of Atomic Energy in Beijing, and the Institute of Nuclear Research in Shanghai. In these institutes both reactors and accelerators were built. The Cultural Revolution has done much damage to the progress of the sciences. Instruments were destroyed, scientists were scattered over the country. For students it was impossible to be educated to a reasonable level. After the Cultural Revolution physics research had to make a new start. Equipment had grown obsolete and not many qualified students were left. Research with accelerators is very primitive because they are small and do not have analysis systems.Therefore many fields in nuclear physics are not persued. The accelerators are mostly used for studies of three body systems and for isotope production. Many of the produced iso- topes are for research in applied fields. Many institutes have Mossbauer equipment.Mossbauer research in China is not so primitive, but still suffers from some technical shortcomings,especially as regards availibility of suitable sources,enriched absorbers and liquid helium crystals. Efforts are being made to raise the scientific level in China, and to bring it to that of the rest of the world.

China is a poor country and cannot afford to spend much money on scientific equipment. On a modest scale reactors and accelerators are improved, and new ones are being built. Other necessary equipment, ,like electronics, computers and detectors is being developed. Most of these are not as good as commercially available material, but the latter are expensive and therefore seldom bought. In conclusion it can be said that at this moment nuclear physics is in a primitive stage, but there is much enthusiasm in order to get ahead. It is to be hoped that these people are capable of creating really modern laboratories.

VII.2. The Institute of Atomic Energy, Beijing.

This institute was established in 1958, primarily for nuclear energy and military research. Today 3000 people are working there, including 1500 engineers and scientists, of which 100 are senior staff members. The institute has several divisions: nuclear physics and applications, nuclear fusion, accelerator operation and development, radiochemistry

and techniques, stable isotope separation, radioisotope research and production, and reactor physics and technology.
The major equipment available includes:

- a 1.2 m diameter cyclotron, capable of producing protons of 3-15 MeV
- a 2 MeV van de Graaff generator
- a 600 keV Cockroft Walton machine for neutron research
- a 10 MW heavy water reactor, with a thermal neutron flux of 2.8*10^14 n/ cm2.sec. This reactor,originally built by the Russians,has been successfully improved by the Chinese.
- a swimming pool materials testing reactor with a thermal neutron flux of 3*10^13 n/cm2.s.

The research involves mainly neutron physics. For instance,measurements have made on fission-neutron multiplication of Pu-239 and Cf-252. The elastic and inelastic scattering of neutrons on C-12 and Be-3 has been studied. Also studies on three-body systems are performed. The reactors are used for isotope production and neutron studies of condensed matter such as inelastic neutron scattering and neutron diffraction, reactor technique studies and training of reactor personnel. A great deal of the work at the institute is in applied fields. Isotopes are produced for radiochemistry, biology or medical purposes. Research is done on nuclear fuel processing and radioactive waste. In construction are a 100 MeV LINAC and a 13 MeV tandem Van de Graaff generator with a Q3D mass seperator.

Institute of Nuclear Research, Shanghai.

Here we were received by the deputy-director Cheng Hsiao-Wu. This institute, founded in 1959,has a staff of some 800 people of which 400 are scientists. There are 6 divisions:-theoretical physics, radia- tion chemistry, accelerator development,and nuclear electronics and de- tectors. A substantial part of the work is in applied fields. The main instrument in the lab is a cyclotron with a diameter of 1.2 m. It was built in 1963 and improved in 1978. It is essentially a locally built copy of the (Soviet) cyclotron in the I.A.E. The maximum proton energy is now 8 MeV. Plans are being made to convert the cyclotron into an AVF machine with a maximum proton energy of about 33 MeV. At the moment 50 % of the available time (4000-5000 h/yr) is for nuclear physics. A 6 MV tandem Van de Graaff accelerator is in development. It is hoped to finish this in 1983. There is a 200 keV neutron generator, capable of delivering 10^19 n/sec with an energy of 14 MeV. We saw a very small (zero energy) nuclear reactor of the swimming-pool type. The swimming-pool had a diameter of about 1 m. The reactor is used for critical mass research, and neutron flux distribution measurements.
The small reactor is the predecessor of a planned larger one (300 MW and 10^14 n/cm2.sec). The experimental group consists of about 60 people. They work on three and four-body interaction, scattering phenomena, physics of fission products and gamma/spectroscopy. With the neutron generator (n,n) reactions are studied. Other topics are the Moessbauer-effect, channeling and laser- annealing. The theory group consists of 14 people. They work on group theoretical methods, reaction mechanisms in light nuclei, and heavy ion scattering. The accelerator development group services all the accelerators in the country. The radiochemistry department uses the cyclotron for the production of isotopes. Sometimes the isotopes are used for research, but mostly for medical applications. The radiation chemistry department uses the Van de Graaff generator or a Co-60 source for irradiations. The nuclear electronics department produces most of the available electronics (amplifiers, ADC's,

MCA's oscilloscopes, etc.) , and semi conductor detectors. Most of the detectors are inferior to commercially available ones, but sometimes they achieve good results.

University of Science and Technology, Hefei.

In this University,a 400 MeV electron Linac,coupled to an 800 MeV electron storage ring for synchrotron radiation is being developed. This machine should be running in 1985 (total cost: 30 million Yuan)
Being tested are:
- 15 kW Klystron(Chinese) and associated wave guides for Linac
-pumping system down to 2,5*10^-10 Torr, including linear sputter ion pump built into accelerator section (manufatured by Shanghai vacuum system factory)
-first section of Linac(corrugated waveguide) (Chinese)
-magnet section

In this university, the only one directly administered by the Chinese Academy of Sciences, a 400 MeV electron LINAC, coupled to an 800 MeV electron storage-ring for synchrotron radiation is being developed. The LINAC will be finished in 1985.

Fudan University, Shanghai.

Among the universities (where teaching has priority over research) Fudan University is the most active in research. A Van de Graaff accelerator is present. This machine was built in 1955, with 2.2 MV potential. Recently it has been upgraded to 6 MV. For analysis there exist a Canberra MCA and a PDP 11/34 computer, which is very exceptional in China. Topics are beam-foil- spectroscopy (stimulated by Deutch from Aarhus, Denmark, who had been a guest of the institute), PIXE (Proton Induced X-ray Emission) , channeling,backscattering and lifetime measurements by blocking and gamma-fluorescence(to which Prof. G.Temmer from Rutgers University,N.J. U.S.A. contributed). Several other foreign scientists have been guests of Fudan University.

Nanjing University

The physics department of Nanjing University has a nuclear physics section. Topics are neutron physics (for which a Cockroft Walton accelerator is available), Moessbauer-effect-spectroscopy,and group theoretical studies.

CHAPTER VIII

Isotope Physics

Members: Doeke Oostra,Sido Sinnema.

In visiting China our aim was to investigate what kind of research is done in the field of isotope physics,make contact with Chinese scientists,and to exchange scientific information with them. The kind of research that we usually call isotope physics in Groningen,primarly concerned with radiocarbon (14C) dating, which has also applications in the fields of archeology and geology.A lot of work is also done on isotope techniques which are useful in the study of natural circulation mechanisms and which are for instance useful in hydrology . The isotopes used in these studies are both radioactive (3H,14C) and stable (mainly 2H, 13C and 18O). During our preparation we searched for information about isotope-physics in various journals, such as: "Scientia Sinica", "Acta Physica Sinica", "China Informatie Bulletin" and "The Directory of Scientific Research Institutes in the PRC". Although we definitely learned that there were 14C-laboratories in China - at least one in Beijing - we were not able to trace any scientific publications about Chinese isotope physics. While visiting China we got in touch with scientists in Nanjing and Shanghai who were working in our field of interest. We will give a short desription of their experiments. Due to lack of time, we were not able to visit any of the three 14C-laboratories in Beijing.

Institute of Nuclear Research Shanghai

Tritium dating with a cyclotron / Dr. Zhou Shan Zhu

At this institute research is done in isotope physics by four staff members. Because the project was started only in January 1981 the research still was in an experimental stage, but in the near future one intended to date several deep ground water samples.

The 1.2 m cyclotron of the institute is used as a high energy mass spectrometer for measurement of the 3H-content of the water samples. The age of the water is estimated by comparison with samples containing a known 3H concentration. A blank sample containing no 3H is used for the determination of the tritium present(due to the contamination of the cyclotron interior). The 3H ions were identified and counted by a silicon detector telescope. The dE/dx detector, which is about 30 microns thick, is necessary because of the fact that an amount of 3He is accelerated together with the 3H. The product E*dE/dx is proportional to MZ^2 and thus it is possible to separate the 3H and 3He peaks. During our visit,the experiment to date deep ground water samples collected in the neighbourhood of Shanghai was being set up. The results will probably be published in August,1981. We were told that this laboratory was the only one in China working on tritium dating,and so far no publications have been made in this field.

Nanjing University Nanjing

Carbon-14 dating / Dr.Shen Dexun Dr.Dai Kaimei

In Nanjing University there is an isotope laboratory in which geological samples from different origins and different ages are dated by

means of 14C using a liquid scintillator. The samples range from buried old wood in glacier deposits at 4200 to 3900 meters above sea-level in Xie Chang, the wood in the karst cave of Qui-Zhhow province,and charcoal in civilisation layers in Li-Yang in Jiang-Su province with geological ages which vary from some 1,000 to 7,000 years ago. The samples are treated chemically and counted for 1,000 minutes in a double coincidence scintillation counter. For samples older then 20,000 years the noise in the amplifiers becomes a limiting factor. The double coincidence circuit reduces this background noise and samples of age 30,000 years can be dated. For the liquid scintillation counter used,one half to one third of the background counting rate is due to so-called 'crosstalk' background noise. For a 14C pulse the channel I pulse of amplitude V1, and the channel II pulse of amplitude V2 are nearly the same, whereas the crosstalk V1 is much larger than V2, or V2 much larger than V1. By means of such differences an on-line 14C dating system has been made, which can eliminate the crosstalk background count. A new method of monitoring scintillation counter stability,counter stability,and the crosstalk count background has been found . All the equipment used is made in China. The laboratory has existed for three years and besides geological samples tree rings are also studied. In the future some study may be made of stable 13C .

As anticipated considerable attention is being paid to 14C-dating. The 14C-laboratory we visited had not yet achieved the dating accuracy available elsewhere. In the field of isotope hydrology we saw only seen one experiment (probably unique in China), which was in a very early stage of development and could therefore hardly be compared with the tritium experiments in Groningen. We hope that the contacts we have made with Chinese scientists working on isotope physics may contribute to a further scientific co-operation between China and The Netherlands.

Here we give a survey of 14C-laboratories which, to our knowledge, exist in China:

- Radiocarbon Dating Laboratory,
  Institute of Geology,
  State Seismological Bureau,
  Beijing.

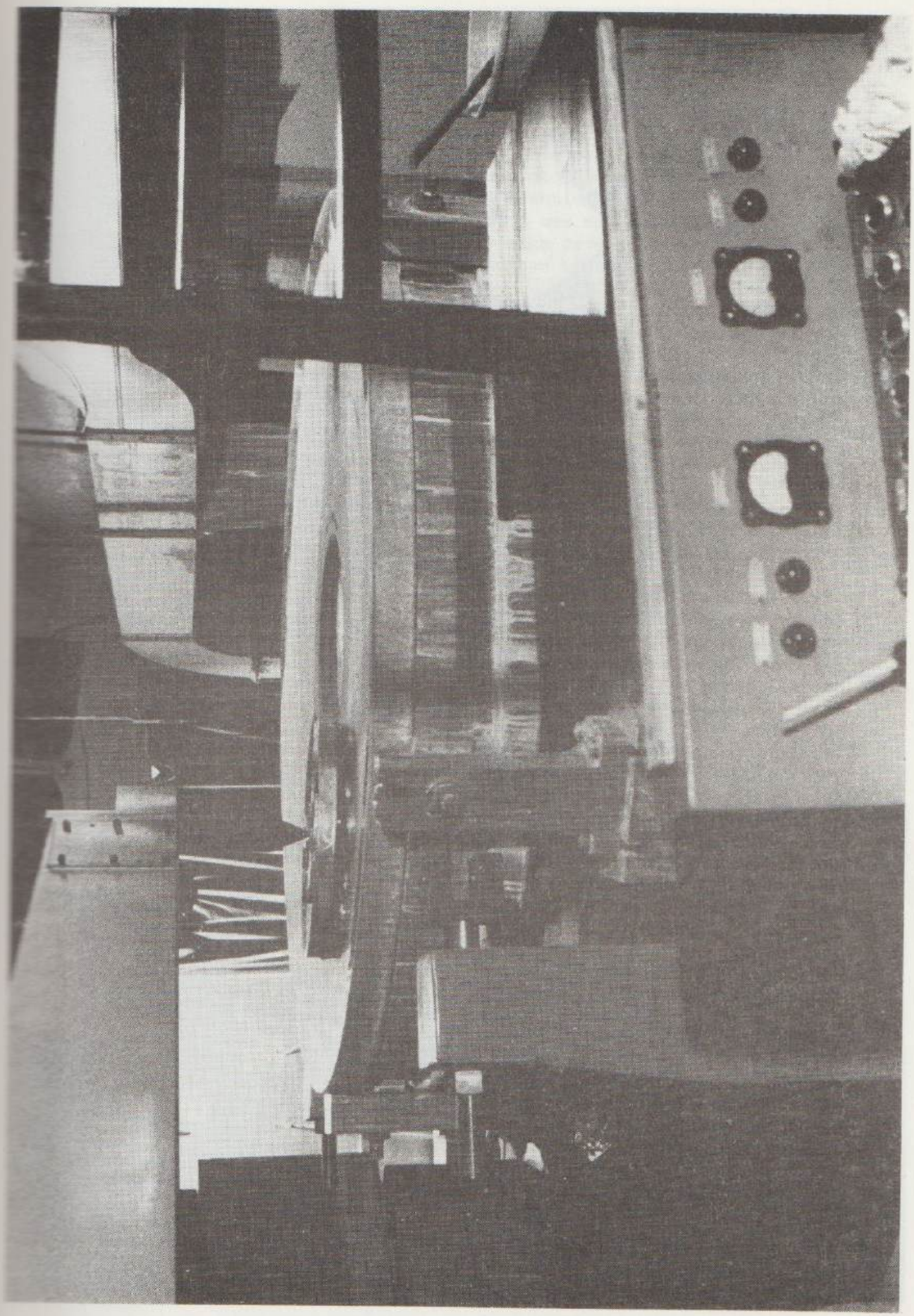
- C14 Laboratory,
  Scientific & Technical Research
  Institute for the Preservation
  of Cultural Relics,
  National Cultural Relics Bureau,
  Beijing.

- Dr. Shen Dexun
  Dr. Dai Kaimei
  Radiocarbon Laboratory,
  Nanjing University,
  Nanjing.

- Dr. Ch'ou Shih-hua
  The Institute of Archeology,
  Chinese Academy of Social Sciences
  Beijing.

- Dr. Shen Chen-teh
  Radiocarbon Laboratory,
  Institute of Geochemistry,
  Academica Sinica,
  Guiyang,
  Guizhou Province.

- Radiocarbon Laboratory,
  Shanhai Normal University,
  Shanghai.
  (no further details known)



Grinding machine (Nanjing Astronomical Instruments Factory).

Physics Laboratory, Shanghai.

CHAPTER IX

Report of the group of pure mathematics

The group of pure mathematics consisted of five people, and investigated differential geometry (Tangerman, Westra), functional analysis(Thomas), and algebra (Bakker and Polderman). The most complete impression that we got was that of differential geometry; the most incomplete that of algebra. Unfortunately it was not possible for us to study two of the subjects which are very high developed in China, namely complex function theory and (analytic) number theory.

The places in China we visited and were of interest with respect to mathematics were: Guangzhou (Sun Yat-Sen University), Shanghai (Fudan University), Nanjing, Hefei (University of Science and Technology of the Chinese Academy and Anhui University) and Beijing (Mathematical Institute of the Chinese Academy of Science). Our main interest was to get an impression of the development of both research and education in pure mathematics since the end of the Cultural Revolution. In China we were everywhere told that that period was a black page in Chinese scientific and intellectual history. Many people told us that in those days they didn't do any research and some were sent to the countryside to work there. Students were not selected on the basis of their intellectual skills, but on their political and ideological reliability. For instance somebody told us that one had to work on the countryside or in a factory for at least two years and needed recommendation from his "brigade" to enter the university. After '76 this situation changed, and nowadays all the universities we visited again have the system of regular examination (including entrance examinations). This change had the effect that many people who had the ambition but not the permission to enter the university during the Cultural Revolution, have taken the entrance examination and passed... So there is a relatively high number of older students in China. Another effect of the C.R. is that many staffmembers obtained their degree (which wasn't called a degree when they got it) between '66 and '76, and because of the rather low level of education at that time, they had to re-educate themselves. So a lot of teachers spend a great deal of their time in self-study, which leaves them little time for doing research. The Chinese still consider this a big problem. We had the impression that the number of students in mathematics has strongly increased during the last few years. In '77 the National Council of Teachers of Mathematics (an American delegation visited the PRC) mentioned three hundred students in total, for Beijing and Shanghai. Now there is an average number of more than 200 students in mathematics at every institute we visited (not including computer science). The number of students is still increasing, but there is a capacity-problem. We also had a look in some mathematical libraries. They seemed well equipped with books on the usual subjects and from well known (western) authors, furthermore they were well stocked with current journals. We noticed that most of the journals were Chinese reprints on cheap paper; apparently the Chinese do not pay any copyrights for these reprints. The ordinary students are not allowed to use the institutelibraries without special permission. There is another problem at the Chinese universities: books and journals are relatively expensive, but are needed more to improve education and research.

IX.1. Mathemathics education

There were no essential differences among the various curricula at the universities we visited, so we will give a general description. Except perhaps for the University of Science and Technology of China (Hefei), which is a kind of elite university, this description will hold for the average Chinese university. The universities in China are situated on campuses. Those campuses are spacious and quiet sites when compared with the crowded cities. It is usual that most of the professors and other staffmembers and all the students live on the campus. Students live with six to ten people in one room. They get less than 25 Yuan (about 40 guilders) per month, which is just enough to pay their food (housing is free or very cheap). Since they do not have private rooms they are supposed to study in classrooms, libraries or even outside. Before they come to the university they have had twelve years training in the elementary and high school. At the high school we visited on an agricultural commune in the neighbourhood of Guanzhou, the pupils studied (as far as mathematics is concerned) subjects like systems of linear equations, quadratic equations with complex roots, complex plane and Boolean algebra. Only five percent of the pupils who finish high school get the opportunity to enter the university. Since 1977 they are selected by a national entrance examination. Although they can have preferences, it is a central committee which decides who can study what subject. (As an example, a problem from the (local) entrance examination of Beijing, 1977: "Given that log2=0.3010, log3=0.4771, find log 45 "). Although the Chinese claim that women are emancipated, the ratio men/women at the mathematical departments in China is approximately 5 to 1. The study takes four years until the bachelors degree. Since a few years ago there are once more postgraduate courses; two years for the masters degree and another two years for the Ph.D. This summer the first students after the reintroduction of postgraduatecourses will get their masters degree. Some of them will have the opportunity to go abroad (U.S.A. , France, Germany) for further study, which the Chinese consider very important. At USTC(Hofei) the situation is a bit different. There is a basic curriculum of 5 years and postgraduatecourses for two years, which will be increased to three years in the near future. Only the best students can enter this university which was founded in 1958 in Bejijng and moved to Hofei in 1970. Students get three and a half years of basic courses, then specialise and do some research on their specialisation. Students are supposed to work (attend lectures and study) six days a week, ten hours a day. At the end of every semester there are examinations, but if people don't pass they get at least one more chance. After finishing university most of the students can get a job at the university (especially at their own), but this situation will change as soon as the universities have enough qualified staffmembers. At the universities there is a relatively large number of staffmembers. Most of them teach, and only a few do research. Research programs, if they exist, are conceived by the main professors, but in general everyone does the kind of research he likes. Teaching programs are conceived by the specialists of the various fields. There is no official influence from the students, but they may evaluate the teaching program and the staff decides whether or not to do something about their complaints.

As an example we give the mathematics curriculum at Nanjing University:

Obligatory:	Optional:
philosophy	real Functions
political Economy	approximation-theory
history of the Communist Party	functional Analysis

(mathematical) analysis
analytic geometry
linear algebra
complex functions
ordinay differential equations
physics
a foreign language
Chinese language
physical education

modern algebra
topology
probability theory and statistics
differential geometry
ordinary differential eq. (continue)
partial differential equations
mathematical logic

remark: the obligatory subjects are taught in the firts two years.

CHAPTER X

Algebra and Number-theory

Members: Jan Willem Polderman, Harm Bakker

During our stay in China we unfortunately only spoke with a few algebraists and no number-theorists. Perhaps this was due to the fact that at several institutes we visited it was unknown that members of our delegation were interested in algebra and number theory. From the interesting conversations we had, we understood that the main subjects of research in algebra are ring-theory and homological algebra. In the field of ring-theory we should mention Prof. Xu Yonghua (Shanghai), who is also working on Lie-groups. For six years he worked in the D.D.R.. Besides his scientific work he is coaching five postgraduates. In Hefei (Anhui University) people are working on the unique factorization of elements in infinite rings. Prof. Bai-Shun Chow (Nanjing) is one of the best known algebraists in the field of homological algebra in China. He received part of his education in San Francisco. Two of his postgraduates are also working on homological algebra. Another postgraduate studied colourable graphs, in particular problems connected with the four-colour problem.

We are happy to see that after the Cultural Revolution an increasing number of people is interested in and is receiving the possibility to work on pure mathematics. Probably the most important institute with respect to pure mathematics is the Mathematical Institute in Peking. We were told that the subjects that are studied there in algebra are Classical Group-theory, Lie-algebra`s, K-theory and Algebraic Geometry. We saw many well known books on algebra and number-theory in the libraries. In algebraic courses books by well- known authors are used, for example "Homological Algebra" by Northcott. Interesting as well is the existence of a Chinese translation of the books "Algebra I & II" by B.L. van der Waerden.

CHAPTER XI

Differential Geometry and related topics.

Bart Westra ,Folkert Tangerman

This paragraph will deal with differential geometry , theory of dynamical systems, differential topology, singularity theory and (algebraic) topology as we have encountered it in China. Before presenting our findings we urge the reader not to jump to hasty conclusions based on this account, for our stay in China was short,and so our overview of the field will be incomplete and unlikely to be flawless.

As for the history of Chinese diff. geom., one can discern two sorts, as there are abroad. The classic form which mostly deals with local problems, is the eldest branch. Its techniques consist of the calculus of tensors and linear algebra. We did not observe very much of it, partly because it is mainly worked on in the smaller universities which we hardly visited, and partly because it has been pushed to the background by modern differential geometry. This branch is most often concerned with global problems, but the main difference lies in the applied techniques, which are taken from modern analysis, topology, Lie-groups etc. Its present development started after the downfall of the Gang of Four (1976). Striking are the strong contacts abroad. A large role in it is especially played by Che Nin Yang and Shiing S. Chern, who regularly visit China from the USA, and have made some major contributions in the field. Other western mathematicians who more or less have contact with Chinese colleagues are N.H. Kuiper (IHES, France), F. Hirzebruch and W. Klingenberg (Bonn, Germany) and M. do Carmo (former president IMPA, Brazil). At the Beijing symposium on diff. geom. and partial differential equations (Aug - Sep 1980) many more foreigners were present. In fact its success was big enough to warrant the organization of another international conference in summer 1981. So much for the relations abroad. Let's now concentrate upon Chinese universities and institutes we visited.

In Zhongshan University (Guangzhou) we met Wang Zeke who is concerned with topology. During the Cultural Revolution, when research had to serve economical progress, he became engaged in fixed point algorithms.

Fudan university (Sjanghai) is one of the centres for diff. geom. Important professors are Su Buchin and Gu Chao Hao. We spoke with Y.L.Xin. Main topics of research are Yang-Mills (SU 2) fields and their solutions, e.g. instanton solutions (extremal energy). Application of techniques from global variational analysis and removable singularities (algebraic geometry) is studied. More generally, people are interested in gauge theories , diff. geom. and fibre bundle formalisms. Xin's main activity lies in harmonic maps, especially as a non-linear generalisation of Hodge theory. Other topics considered in Fudan are characteristic classes and manifolds.

Our host at Nanjing University was Hen Chi Cheng. His speciality was cosmology; his problem the finding of exact solutions of Einstein and Yang Mills field equations, especially in Walker and Taubnut spaces. Besides him, two mathematicians worked on algebraic topology.

At Hofei's USTC, Chia Kuei Peng surprised us with his many foreign contacts (Chern, Hirzebruch, do Carmo, Kuiper). His research subjects are (1) the problem of self duality of solutions of Yang Mills equations, (2) soliton solutions of the Korteweg - de Vries equations (application of Lie-groups), (3) the Bernstein problem (in his case minimal submanifolds with mean cuvature zero in E4 and S4). His colleagues are another differential geometer working on (2), a differential topologist (singularities and catastrophe theory) and a distance geometer.
In Anhui university we did not encounter any differential geometers.

In the Beijing Mathematical Institute of the Chinese Academy our spokesman was Qi Min Wang, who is interested in self-dual 4-dimensional Riemannian manifolds. Another topic is isoparametric hypersurfaces. However, more important than differential geometry seems to be differential topology and the theory of dynamical systems. Several people work in these fields, but we lack more information.

With regard to the afore-mentioned, we have probably seen quite a lot of Chinese differential geometry, especially in Fudan and in the Mathematical Institute and University of the Academy in respectively Beijing and Hofei. Not visited but important too, seem to be Beijing University and to a lesser extent Tientsin University. It is remarkable that work is done nearly everywhere on Yang-Mills theory. Consequently Chinese differential geometry risks having spent much energy in vain, in the event that somewhere else in the world a fundamental break-through occurs.

Relations with other scientists most often lie within mathematics, e.g. for differential topology in systems theory. Gauge theories are used in theoretical physics. This situation differs a lot from that in the period of the Cultural Revolution. Then mathematics had to be justified by its applications and as a result mathematicians had to cooperate with scientists in other fields.

Remarkable was the fact that everywhere the research groups were relatively small: about 5 people or less. However in our view the field of differential geometry and related topics is developing very fast. Not least because of the intensive contacts abroad, of which not only settled professors benefit: noteworthy is the large quantity of postgraduate students who are sent abroad. The fruits of this will doubtless soon bring differential geometry to the front line of Chinese mathematics .

CHAPTER XII

Functionalanalysis in China

By Prof. Dr. G.E.F. Thomas

In analysis the most prominent subjects are: Partial differential equations (P.D.E.), functions of several complex variables, approximation theory (A.Th.) and functional analysis (F.A.), with much emphasis on nonlinearity and the relation with differential geometry and theoretical physics.

In Nanjing University we met Professors Wang Sheng Wang and Zhen Yuan Yun (F.A.) who were working on generalised scalar operators, and Go Ji (F.A.) who was interested in the Geometry of Banach spaces. In this area, where a great deal of worldwide progress has been made since 1973, the lack of information reaching China was quite noticeable (although we were able to find some recent literature in the library). In Fudan University (Shanghai) we met professors Gur Chaohao and Tan Yongji (P.D.E.), Xia Dao Xing and Yian Chongzong (F.A.), and Cheng Tion Ping (A.Th.).

In the Mathematics Institute of the Academy of Science (Beijing) we met Professor Wu (P.D.E.), formerly a student of Hadamard, with whom we dicussed the relation between pure and applied mathematics in China. It was now no longer felt that applications must be the guiding force, although some links with applications were desirable. In the case of partial differential equations, the links with differential geometry and several complex variables were emphasised. The latter subject has great importance at the Institute (Professors Fangtseng, Chang and Dr. Jin). Its link with partial differential equations via Sato's hyperfunctions seems not to have been exploited however. We also learned about the national science committee of the Academy, with representatives from all the major universities and institutes, which decides on the directions research ought to take nationwide (initiating,forexample, the study of non-linear problems).

At Anhui University (Hofei) we met professor H.H.Chow (in the past a student of J.E.Littlewood) and his younger collegue,Professor Li Shi-Young, who was heading a group working on harmonic analysis. Their subject of main interest at present is harmonic analysis on the classical compact groups. The book by L.K.Hua and K.H.Look on the theory of harmonic functions in classical domains appears to have had an important influence on their work. They extended an invitation to Professor Thomas to give a lecture on the applications of integral representation theory to harmonic analysis. Professor Li was also working on lecture notes on distribution theory with applications to communications science. This common interest may give rise to future co-operation between our departments. While visiting Professor Li in his apartment on campus it turned out that Mrs. Li was also a mathematician, teaching complex function theory, and doing applied research (solving integral equations connected with the earth's magnetic field in order to find iron ore).

Given the close links between probability theory and functional analysis it may be mentioned here that we have met probabilists in most departments (Teng Yen Lu (point processes) in Canton, Y.Q.Yin at the U.S.T.C. in Hefei, Xu Yi Sen at Anhui University) and that it is our impression that, thanks to the influence of K.L.Chung(among other

things), probability theory has a considerable importance in China. Although on the whole,analysis in China seems not to be as advanced as in the western world, the Chinese are well organised to catch up, inviting such mathematicians as Brezis, Lions, Nirenberg, Treves, and in the past Petrovski, to help put them abreast of recent developments.

Observatory, Shanghai.

Shadow Boxing, Shanghai.

CHAPTER XIII

Report of the Computer Science Group

Members: Ed Brinksma, Matthijs Kuiper, Henk Ziemerink.

XIII.1. Introduction

As we started our journey to China we were almost completely ignorant about the position and development of computer science in the People's Republic of China. This being so, we had a list of very straightforward questions regarding both volume and sophistication of the computers under operation in the P.R.C. at present, and, assuming that the Chinese did not yet meet the western standards in this field, we were also interested in their plans to bridge this gap and bring China in the front line of important technological and scientific developments in computer science. Although our questions were not complicated, this did not mean we got answers to all of them in an satisfactory way. Like the other groups we ran into a lot of unexpected difficulties, the most notorious being the problem of communication: we had not anticipated spending so much time on explaining to our friendly and always patient Chinese hosts many basic concepts of the science (e.g. bootstrapping, compiler, type checking), since they were often only familiar with the Chinese terminology. Because of the highly technical character of the conversations, the help of interpreters was often of no avail, Still, we did gather some information, especially concerning the computer science courses at the universities we visited. About the state of the art at other institutions we only have a very dim picture. Also, because of the communicative problem and the relatively short time spent at each institution, it was very hard to verify our impressions and the things we were told in any definite way. Therefore this introduction must contain a caveat: the information contained in this report may not be entirely accurate in all cases. We will try to arrange our findings in such a way that a reliable global impression concerning the academic activities in computer science in the P.R.C. may emerge.

XIII.2. The academic curricula

At the universities the computer science curricula were only started a few years ago, in 1979, as result of a nationwide initiative. It is therefore not surprising that the courses are quite comparable in contents and duration. At the majority of the universities visited there were independent computer science courses with a nominal length of four years. The exceptions to this rule were the two universities at Hefei, the U.S.T.C. and Anhui University. The former is the elite university founded by the Academia Sinica, offering only five years' courses and at the latter computer science is offered as a specialization within mathematics.

We present here an outline of the four year course taught at Zhongshan University in Guangzhou (Canton) which is a representable example:

1st year:	english	analysis	program design
	politics	linear algebra	(i.e. an introductory
	economy		course in Algol/Fortran)
	physical		
	education		

2nd year:	english politics economy physical education	probability theory & statistics numerical analysis	advanced programming assembly languages
3rd year:	english politics economy physical education	discrete mathematics	fundamentals of hardware computer architecture
4rth year:	english politics economy physical education		compiler building operating systems information processing optional subject *)

*) a choice from: database theory network theory
file organisation

At the other universities the courses are only minor modifications of this one. It must be noted that we had no opportunity to verify the contents of the courses since most of the teaching material was in Chinese. As far as the practical parts of most curricula are concerned: some small calculations with the number of students enrolled and the available equipment show that they must be completely inadequate (some figures are presented in the next section). At Fudan University (Shanghai) we were told that in most courses one could allow each student only two hours of terminal time per term!

XIII.3. The Institutions visited

First, we present here a table with some information about the universities we visited. Afterwards we will give some more detailed information for each of them.

University	Nr. of students	Nr. of staf	Computers available **)
Zhongshan (Canton)	250 undergr. 14 grad.	+/- 80	DJS 121 DJS 130 (computer centre)
Fudan (Shanghai)	400 undergr. 16 grad.	+/- 90	DJS 130 RT 11 microcomputer
Nanjing	400 undergr. 10 grad.	+/- 80	DJS 130 PDP 11/45 ***)
U.S.T.C. (Hefei)	180 undergr.	+/- 50	DJS 8/32 (?) PDP 11/70
Anhui Univ. (Hefei)	120 undergr.	+/- 80 *)	DJS 130 DJS 050 microcomputer (?)

*) including mathematics staff

**) DJS is a Chinese computerbrand, produced in Soochow near Shanghai
- DJS 121 is a second generation computer, 32 Kwords (8 bits) 300,000 instr/sec
- DJS 130 is a third generation computer,

equivalent to the NOVA 2 computer.

***) At the computercentre of Nanjing University, there was a Bulgarian equivalent of the IBM 360/45.

Before we go on, we want to make a comment on the size of the staff. The number of teachers seem to be disproportionately large, compared to the number of students. We were told this was mainly an inheritance from the Cultural Revolution when many incapable people were given a tenured position at the universities. As a result, the number of staff actually involved with teaching and research at the moment is only a fraction of the official numbers.

XIII.4. Zhongshan University

We did not succeed in getting information about the research done here, although it seemed that one specialises in software engineering. The computer science department wrote administrative programs for the Chinese customs service in Canton. The university is allowed to use the city's IBM 370 from time to time. Currently two members of the institute are studying in the U.S.A.

XIII.5. Fudan University

Here we have spoken to professor Qian Jia Hua. The main research here is the designing of a new computer, the FT 753. It will be a 130 Kword stack machine with 16 registers with a speed of approximately 2.10^6 instr./sec and will be able to support a timesharing system. Gudan is one of the best Chinese Universities and therefore has a relatively comfortable budget. The computer cience department has an annual budget of about 100,000 Yuan. With financial support from the U.N. world bank one hopes to be able to buy a VAX 780 for the department in the immediate future. At the time of our visit one had already ordered the delivery of 10/20 American microcomputers (Comeco?).

XIII.6. Nanjing University

Here we met with the associate professor Zheng Kuo Nijing and the teacher Zi Lun Zhu. The main direction of research here was in theoretical computer science, mainly in connection with mathematical logic. Furthermore research is done in compiler theory (design of compiler-compilers) and operating systems theory.

XIII.7. University of Science and Technology of China

We could only speak to the people from the computer science department for one hour. The main directions of research seem to be data base theory and high level implementation languages.

XIII.8. Anhui University

We spoke to Professor Chang Wen-Sha who was vice-president of the department. As a research project one was developing an Algol 60 compiler for the DJS 050 microcomputer. There is an operating systems project together with Zhong-Xie Shing from Nanjing University. In the future one hopes to realise a Pl/1 compiler and develop a data base system. There is a possibility that new microcomputers will arrive in the department before long.

XIII.9. The Mathematical Institute (Beijing)

Here we spoke to the professors Lu Ru-Qian and Lu Wei-Ming. This institute is a centre for research and therefore only stafmebers and graduate students are present. The research done here ranks among the best in the entire P.R.C.
There are four research projects:

- I Software engineering.
  The group has developed a high level system implementation language called XHY. This language is used for hierarchical software development. One also works on methodologies for developing portable languages.

- II Symbol and formula manipulation.
  Here research is done on the development of software packages for symbol manipulation. A LISP-like language has been developed for this end. Also a package for mechanical theorem proving has been realised.

- III Database management systems.
  The leader of this project was in Germany at the time of our visit. So far a database management language has been developed.

- IV Design and Analysis of algorithms.
  This group is the smallest of the four. Most of the research is done on hashing algorithms.

XIII.10. Remarks and Conclusions

In general, we can say that as far as computer science is concerned, China still has a long way to go. This is true for both "hardware" and "software" knowledge. In the technological field the country is more than a decade behind the western world.

- chip-technology has not yet been mastered; one can only produce relatively low density integrated circuits.
- the country has only one (as far as we know of) computer-network in Beijing, consisting of three computer units.
- the Chinese themselves regard their own products (e.g. the DJS computer series) as less reliable than their western counterparts.

The upgrading of Chinese computer science research is hindered by mainly three facts:

- the small amount of qualified scientists in the field.
- the small amount of computers available.
- because of the latter and the fact that a lot of the work that still has to be done in wellknown software implementation which would not qualify for publication, many scientists only do work in the theoretical field.

Reading these lists, the cure suggests itself:

- a good education program for future computer scientists.
- more computers.

The former is to a large extent dependent on the latter because of the earlier mentioned lack of practical training that the students get now. The Chinese government has decided that the development of computer science is essential for the country's future and has made this development a part of the country's program of the "Four Modernizations", which intends to make the P.R.C. a modern, developed country before the year 2000. In particular young, bright students are being sent abroad for training and western scientists invited to spend some time at Chinese universities for lectures, research etc. Furthermore the country is trying to increase the number of computers by importing them. These

computers are both financed by the state and by other countries through development aid (the world bank plays an important role in this). China can profit from the current tendancy of decreasing prices and increasing number of small, cheap computer systems that do not call for the huge investments of, say, ten years ago.

If the P.R.C. will persist in this policy and even expand it then, no doubt, the present troubles will be overcome. It is to be doubted, however, that China will join the ranks of the western nations before the year 2000, because of the many, huge problems it still has to face.

CHAPTER XIV

Numerical Mathematics and Mechanics

Member: Stefan Spekreijse.

Purpose

The reader may be surprised that this report deals with both numerical mathematics and mechanics. The reason is that these sciences are related closely to each other because the mathematical models which appear in mechanics can often be solved only numerically. Of course, numerical mathematics can be applied in other sciences as well, but it is a fact that many numerical methods are developed for solving mechanical problems. Therefore the reader should understand that we were first of all interested in which way these sciences interact in China today. Another interesting question was how the Chinese numerical mathematicians manage to work effectively and successful without the aid of modern computers. Could these scientists solve complicated, practical problems?

There were some problems in getting a good idea of mechanics and numerical mathematics in China. First of all, there was only one member of the group who studied these subjects, another difficulty being that mechanics was not always a subdepartment of the mathematics departments. This situation occured at the Zhongshan University , the University of Science and Technology and the Chinese Academy of Sciences. It even happened that in essential branches of mechanics, for example fluid mechanics, there were no courses and no research at all. This was the situation as we found it in Nanjing. The main reason for this was that at this university there existed many colleges offering comparable courses, such as the colleges of agriculture, engineering, aerodynamics and hydraulics. Students interested in fluid mechanics partcipated in the course given at the college of aerodynamics.

XIV.1. Experiences in China

Education in numerical mathematics and mechanics

In China the undergraduate study takes four years (Hofei's University of Science and Technology, being a notable, elite exception: 5 yrs.) The possibility to specialize in either numerical mathematics or mechanics occurs during the last one and a half years. Most courses in mechanics deal with classical subjects such as fluid mechanics and solid state mechanics. It is a remarkable fact that we never encountered courses in one of the more modern topics such as continuum mechanics which is, in fact, the unification of fluid and solid mechanics. The courses in numerical mathematics deal with numerical analysis, numerical algebra, spline functions and elementary finite element and difference methods. After the coursework, the students hardly get a chance to put their newly acquired knowledge into practice. As a typical example, practical work after one of the above mentioned courses would not be more than half an hour. The postgraduate study takes about 3 years, but there hardly are any postgraduate students in China: about 5% of the total number of students. This can partly be blamed on the Cultural Revolution, but is probably a temporary situation which will disappear in a few years. The interest in numerical mathematics is very impressive; relatively a lot of students in mathematics choose this subject as their specialization. The following figures are illustrative: At Nanjing

University there are about 100 undergraduate students in pure mathematics and some 200 in computational (= num. analysis and ??) mathematics. Of the postgraduates there are 15 in mathematics, 6 in numerical mathematics and 8 in mathematical logic. Another illustration of this fact is exemplified by the situation in Hofei.At the University of Science and Technology students specialize in their last one and a half years of study. The specialized courses vary from year to year, the specialisation in numerical mathematics as a perennial option being an exception.

XIV.2. Research in Numerical Mathematics and Mechanics

When practicing numerical mathematics one needs to have a computer at one's disposal. In comparison with European or American computers, the ones operating in China are relatively small. Further different departments have to share the same computer. Even in the best cases such as at the USC at Hofei the numerical department has only one channel at its disposal and thus is confronted with long runtimes. Thus it is often very difficult to work effectively. On the other hand it forces one to develop quick, judicious algorithms. In China, research in numerical mathematics is dealing at present with the following subjects:

- ordinary differential equations
- partial differential equations
- integral equations
- optimization
- finite element method

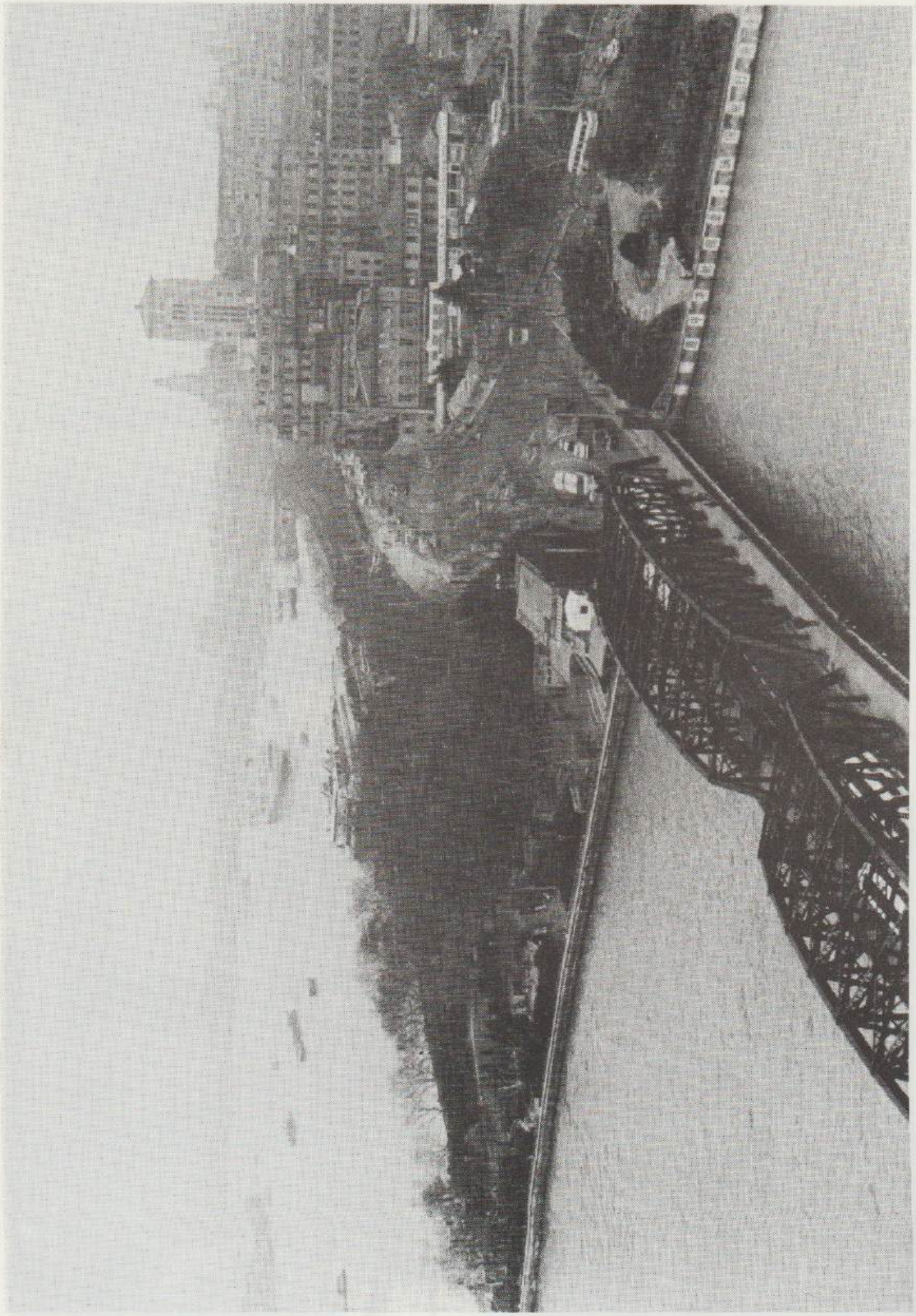
Research done in the finite element method is especially aimed at the development of finite element computer packages. The Mathematical Institute of the Chinese Academy of Sciences in Beijing is the most important representative of this research. But certainly other institutes investigate this branch as well, for instance in Nanjing. In Hofei the Academy's packages are used. At Fudan university the numerical department uses American software. It is our impression that the research in numerical mathematics in China is mainly concerned with the development of better numerical techniques to be tested in concrete mechanical problems. Yet the development of new techniques remains the more important goal. We heard that there was a cooperation with colleagues from the Mechanics Department on a regular basis but there was no evidence of such co-operation with people or institutes outside the universities. In China there exists a journal in numerical analysis and it is to this journal that most Chinese reseachers submit their articles. Rarely do they publish in foreign journals. Symposia are held rather regularly (about once in a year) but only few of the participants are foreigners. Nevertheless, as we were informed, there is a strong co-operation with foreign countries, especially America, France, Japan, Norway and Sweden. Finally it is to be mentioned that the numerical mathematicians, like their colleagues, have a great deal of lost time to make up, owing to the Cultural Revolution. Very aptly this period has also been referred to as the ten years of sabotage.

XIV.3. Conclusions

Since the invention of the computer, numerical mathematics has developed into a more and more important science. The last decade's development of this branch of mathematics has been a rapid one. Good computer facilities are necessary if one wants to keep up with the progress made. In China these facilities do not exist at the moment. Partly this state of affairs can be blamed on the standstill of all science during the Cul-

tural Revolution. We can consider the present period as one of restoration in which one is trying to undo the harm done and make up for the last years. It is clear that the future of numerical mathematics and the applied sciences in China is intimately connected with the sophistication of the computer equipment available to the Chinese scientist in the years to come. If the Chinese can succeed in realising these improvements, real progress can be made in view of the great enthusiasm and faith displayed by their scientists.

Mr. Suei, our National Guide, Nanjing Road Shanghai.



View from the Hotel (Shanghai Mansions), Shanghai.

CHAPTER XV

Systems Control

Member:M.Houtman

XV.1. Our aim of the China journey

We were interested in several issues:

- To get a survey of the chinese activities in the area of systems control, concerning schooling and research.
- How about international relations?
- Which chinese journals publish developments in systems control?

XV.2. Preparations

Our professor in systems theory Jan C.Willems has written a letter to W.M.Wonham, University of Toronto, Dept. of Electrical Engeneering, Canada. Wonham, who is specialised in multivariable control made a lecture tour through China in the autumn of 1979. In his reply he mentioned several institutes we could visit. Among them we choosed the Institute of Systems Science and Mathematics in Peking, because this institute covers an important area of the theoretical research. We wrote a letter to professor Kwan Chao-chih, assistant director of the institute and director of the Laboratory of Control Theory in which we presented our wish to visit his institute.

XV.3. The journey through China

We got comprehensive information about systems control in the Institute of Systems Science and Mathematics, Peking. The visits at the remaining institutes on the program were too short to approach scientists in systems control and we were mainly concerned by our other subject, computer science. A short summary of those institutes where schooling or research in systems control was done:

- Guang Zhou
  - Zhongshan University
    Mechanics Dept.
    Schooling in automatic control.
- Nanking
  - University of Science and Technology
    Radio and Electronics Dept.
    Information Processing and Control Laboratory
    Schooling and some research specially in stochastic systems.
  - Nanking University
    One professor and two assistant professors in probability theory are specialising in stochastic systems. We had a talk with one of the assistent professors, who did read the article about stability and lyapunov functions written by Willems.
  - Purple Mountain Observatory
    Control theory is used for satellite tracking.

XV.4. The Institute of Systems Science and Mathematics

XV.4.1. The visit

Kwan Chao-chih did receive our letter and we were welcomed by six scientists of his laboratory. Among them was the assistant professor Chen Han-fu. Chen did graduate work in Leningrad around 1960 and currently specialises in stochastic control. Besides stochastic control he did theoretical research on differential games, system identification of discrete systems and distributed parameter systems. It was a pleasure to hear that he had read the book Infinite dimensional systems, written by our prof. Ruth F.Curtain in Groningen. After some talking we met prof. Kwan. He gave us information about his institute and we hand over the articles written by prof. Willems we brought with us. Kwan was a student of Frechet in Paris in 1947-48. Around 1960 he solved the transport equation of neutrons in plane geometrics.

XV.4.2. The Laboratory of Control Theory

The Laboratory of Control Theory is the biggest of the six laboratoria which belong to the Institute of Systems Science and Mathematics. It consists of 26 scientists: 1 director, 5 assistant professors and among the remaining part there are 6 graduate students.
They do research in:

- distributed parameter systems
- stochastic systems
- lineair systems
- non-lineair systems
- applications

The laboratory has been founded in 1962 on the insistance of Tsien Hsue-sen. Tsien received in 1956 one of the highest awards for contribution to science, presented by the Academia Sinica for his book Technical Cybernetics. In 1961 he proposed to the Academia Sinica and the ministry of industry to set up together a laboratory of control theory. At that time he foresaw that for a prosporous development of the control theory it was necessary to create a strong cooperation between mathematiciens and engineers. He underlined that this theory would need more and more the use of modern mathematical tools and that for a maximum use of these tools the mathematiciens must have knowledge of the developments in control theory. Consequently the laboratory of control theory was made part of the applied mathematics department, the Mathematical Institute in Peking. Since 1979 this department is changed into the independent Institute of Systems Science and Mathematics.

When the laboratory was founded a studygroup was formed, which studied orbits of artificial satellites to prepare their lift-off. Several years later artificial satellites were brought in their orbit succesfully. At the time of our visit Jia Pei-zhang, member of the laboratory was working on satellite tracking in Purple Mountain Observatory, Nanking.

XV.4.3. Applications

Besides the theoretical research there are applications in the following areas:

- data processing
- guidance and navigation
- astronomy
- orbit determination
- quality control and others

Some examples of recent work:

- data
  digital filtering, treatment of radardata.
- navigation
  navigation systems for ships and airplains.
- guidance
  optimal guidance for exo-atmosferic interception, a guidance system for a space vehicle near earth, a non-lineair filter for the lift-off of space vehicles.
- orbit determination
  satellite tracking, determination of the return orbit of space vehicles.
- distributed parameter systems
  optimal control of the power supply of a nuclear reactor, temperature control of a floating gyroscope.

XV.4.4. International relations

The laboratory has bilateral relations with American universities and with the French Institute Nationale Automatique et Informatique (INRIA). Prof. Kwan Chao-chih has visited institutes and universities in Sweden and Denmark in 1978. Chen Han-fu was participator of the IFAC congres in Helsinki and visited Holland in 1978, where he met prof. Eickhorst. He visited Eindhoven, Twente and Delft. Each year several foreign professors pay a visit to the laboratory. The Academia Sinica has to give her permission and takes care of their stay. There has been a number of American and Japanese professors, and Wonham from Canada. There are new invitations for Astrom, Lions and Kalman. For international scientific exchange each year a review of the work done by the laboratory is published in the Rapport d'Activite in French, of which the first issue covers 1978-79. In august 1981 the first issue of Systems Science and Mathematics will be published, which contains the recent work done at the Institute of Systems Science and Mathematics.

XV.5. Chinese journals

Some chinese journals containing subjects about systems control:

- Acta Aeronautica Sinica
- Acta Automatica Sinica
- Acta Mathematica Applicata Sinica
- Acta Mathematica Sinica
- Scientia Sinica, Special Issue on Mathematics

Most articles are in chinese but abstracs are in English.
Journals from the Institute of Systems Science and Mathematics in Peking:

- Systems Science and Mathematics
- Rapport d'Activite

XV.6. Research institutes and universities

Important chinese research institutes and universities in connection with systems control:

- Laboratory of Control Theory
  Institute of Systems Science and Mathematics
  Academia Sinica
  Peking
  [director: Prof. Kwan Chao-chih]
- Institute of Data Processing and Control
  Peking
  [Director: Prof. Song Jian]
- Dept. of Automation
  Qinghua University
  Peking
  [Director: Prof. Wu Qi]
- Control Theory Group
  Dept. of Mathematics
  East China Normal University
  Shanghai
  [Director: Prof. Wu Qi-di]
- Dept. of Mathematics
  East China Engineering Institute
  Nanjing
- Dept. of EE and CS
  Jiao Tong University
  Shanghai
  [Chairman: Prof. Zhang Zhong-Jun]
- Laboratory of Control Theory
  Dept. of Mathematics
  Nankai University
  Tsientsin

CHAPTER XVI

Astronomy

Members:Dr Seth Shostak,Peter Teuben,Sietse van Netten

China has a rich history and an active present in astronomy. We had the reports of several astronomers who had made visits to China during the last 5 years at our disposal in advance of our visit. Our impression that Chinese scientists are very eager to learn from western scientists was confirmed. Before the trip started we already had a good impression of the research currently being done in the 5 major research centres in China. Prof. W.M.Goss, who visited China in the summer of 1977, provided us with useful names and places. This proved to be very helpful,since it motivated the sending of 6 letters to chinese institutes of which 4 were answered enthusiastically within 3 weeks. In preparing our study trip we also surveyed the Chinese journals available in our library: Studia Astronomica Sinica (+engl.abstr.), Chinese Astronomy (transl.of SAS, but 1 year behind!) and Publ. of the Beijing Astronomical Observatory (engl.abstr.). We were also interested in the teaching programs in astronomy. To our knowledge there was no material available about this. In China we learned that the programs have been changed recently.
Chinese research in Astronomy is concentrated in 5 centres and 2 Institutions:

- (i) The Ministery Of Education supervises research (and teaching) done at the 2 Universities. These are the Astronomy Section of the Geophysical Department of Beijing University and the Astronomy Department of Nanjing University. As mentioned earlier the Astronomy Department of the USTC has a somewhat special place.
- (ii) The Academia Sinica supervises research at the 4 Observatories (Beijing Obs.,Purple Mountain Obs.in Nanjing,Shanghai Obs. and the Yunnan Obs. near Kunming) and the Dept.of Astronomy of the USTC in Hefei.

Teaching programs also exist at the Beijing Normal University.

From the literature we knew of several Institutes and Departments that have cooperated in Astronomical research, e.g. the I. of Mechanics, I. of Mathematics (both Ac.Sin.,Beijing),and the Physics Dept. of Nanjing University (solar radiometry). At the Physics Dept. of the Sun Yat Sen University (Guangzhou) we saw a gravitational wave detector under construction, a large block of aluminium shaped like a Maltese cross,to be installed in an evacuated box. There exists a copy of this instrument in Beijing. During our trip we visited Shanghai Observatory (both stations), the Purple Mountain Observatory, Nanjing Astronomical Instruments Factory and the Astronomy Departments of Nanjing University, USTC and Beijing University. Lectures were given by Shostak in Nanjing, Hefei and Beijing. The students also showed interest in this: in Beijing the lecture was recorded, partially to improve their spoken english. The Beijing Astronomical Observatory has a small headquarter (Zhongguancen) at the N.edge of Beijing, not far from Beijing Un. and the Friendship Hotel. Besides this administrative centre the Observatory has three observation sites:

- 1)Sha-he Station, which was visited by Shostak and Teuben, is situated some 20 km N of Beijing. It is (mainly) an optical observa-

tory, with 200- 250 clear nights per year. The main research divisions are: (i) astrometry as part of the Chinese time service chain. For this purpose they have transit instruments, (photo-electric) astrolabes, all of the same kind as we saw in Shanghai, but somewhat inferior in quality. A few quartz and Rb clocks were present. They are also developing a time signal comparison capability using tv-channels. (ii)The Solar Physics group is observing the sun on a full time schedule in the optical as well as the radio regime. Two small 60 cm reflectors and a refractor are used to observe sunspots, solar flares (eruptions) etc. in Ha (a particular spectral line of hydrogen,the most abundant element in the sun) and white light, as well as measuring magnetic field strengths via Zeeman splitting. (iii) The above mentioned is done in cooperation with the radio astronomers who observe the total solar flux at 3 and 10 cm wavelength with three small (ca.1 m) dishes. We also noticed some interest in microprocessors. (iv)Satellite Observations, including theodolite measurements and laser ranging.

- 2)Miyun Station, some 100 km NE of Beijing at the Miyun Reservoir. A large array of 9 m dishes was built here in the seventies. It is a synthesis intrument, operating at 450 MHz for solar work. The array consists of 22 dishes on a 1 km baseline, and is currently being converted to an earth-rotational synthesis instrument (similar to Westerbork).
- 3)Xin-lung Station,some 160 km NE of Beijing, Hopeh Prov., is the new optical site. Seeing here is very good . They plan to locate their 2 m optical telescope here.
- 4)Tientsin Station, SE of Beijing, is their latitude observing site.

Note that the last three stations were not visited by the group,but important information was taken from previous reports.

The Purple Mountain Observatory is situated on a beautiful mountain overlooking the city of Nanjing and the River Jangtse. At the foot of the hill is located the Astronomical Instruments Factory, which we visited two days later. Besides all the "modern" domes with their 60 and 40 cm reflectors/ refractors the beautiful ancient (17th.century) Chinese Astronomical Instruments were shown to us.

XVI.1. Purple Mountain Observatory(PMO)

PMO is a big observatory with 150 staff members divided into 11 research divisions. Their main interests are solar physics, radio astronomy (solar), astrometry, planetary science, space astronomy and satellite tracking. They also are developing a 3mm receiver (15 m dish) and an astronomical satellite (solar X-ray and ultra violet). Because of the relatively poor seeing here,in the future large telescopes will be located elsewhere (Beijing,Kunming). Shanghai Observatory is divided into 2 station, both were visited by us.

- 1)Zo-Se Station,situated in an old Jesuit Church (ca.1780) on a hill which rises above the perfectly flat area around Shanghai. Here there are two research sections: photographic astrometry and stellar astronomy. For this purpose they have a few small (40 cm) reflectors and refractors to determine proper motions. A 1.5 m reflector is planned to determine parallaxes. Satellite tracking is also an important part of the their work. Laser and doppler receivers are used to determine the distance and velocity of the satellite. Comparison with theory shows deformations in the shape of the earth.
- 2)The Za-Ko-Wei Station is the biggest part of the Observatory, and China's centre for time-keeping since the 1950's. It is situated at

the S edge of Shanghai. The work is divided into 5 research divisions: (i) rotation of the earch (ii) extended time section (iii) manufacture of astronomical instruments (iv) VLBI experiment for geodynamics (v) balloon borne Infra Red Telescope

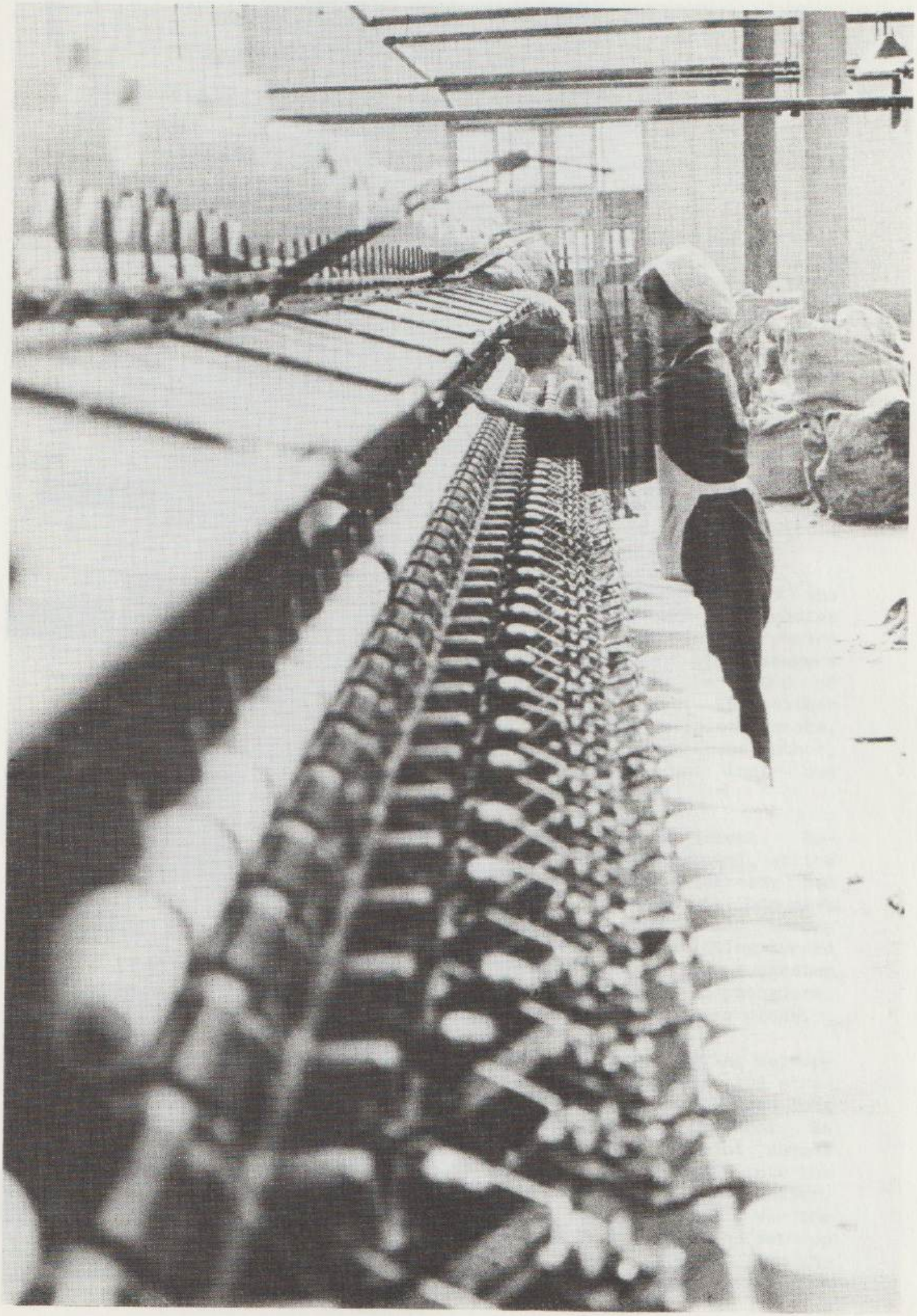
The main endeavor is (classical) positional astronomy, for which purpose they have a few astrolabes and transit instruments. We also noted their new interest in radio (VLBI) and infra red (balloon) work, although at present only in connection with geodynamical and atmospheric research. The Yunnan Observatory near Kunming was not on our visiting schedule. It is China's new optical observatory (1972), and it is an excellent site. At the moment China's biggest telescope (1 m) is operative here. The work is mainly solar physics and astrometry. Astronomical education in China is concentrated in Beijing (2 universities): Nanjing and Hefei. The USTC in Hefei is a somewhat special university,as we mentioned elsewhere. The research there is theoretical astrophysics (density waves, quasars,pulsars,double radio sources). The Astr.Dept.in Hefei has no observatory near the city, as the other universities have. This was then the first place in China where we saw no "classical"astronomy being done.

The Astronomy Dept. in Beijing is somewhat smaller than the one in Nanjing. We compare their main research and teaching interests in the following table:

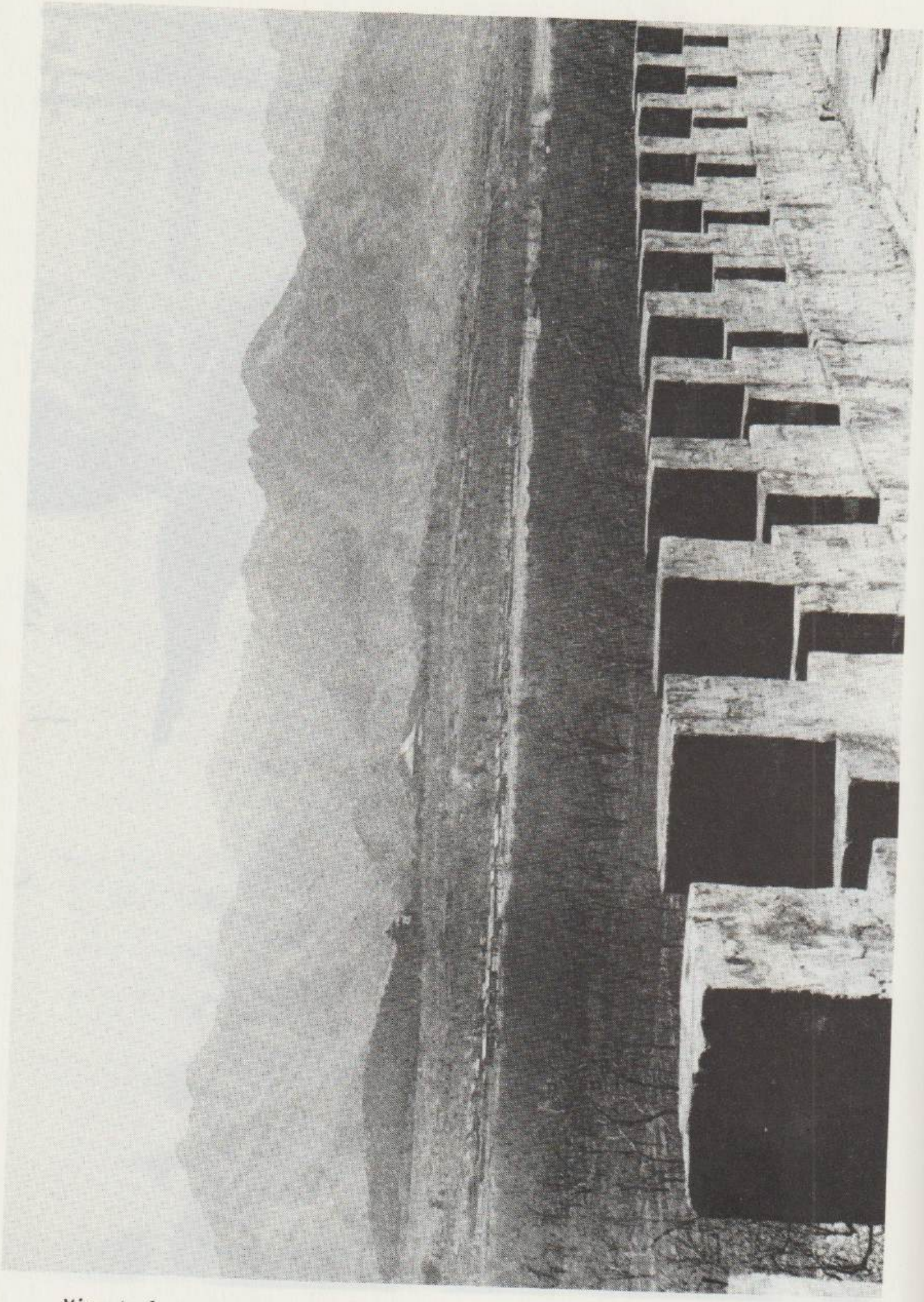
Nanjing	Beijing
- 70 teachers: - 4 prof. - 11 ass.prof. - 65 lecturers	- 19 teachers
- astrophysics celestial mechanics astrometry radio astronomy	solar physics radio astronomy cosmology
- 120 undergraduates 11 grad.	7 grad.

We were told that about 60 graduate students are currenty working in astronomy, and each year about 10 finish their study and can start their work at an Institute or University. In 1980 the Universities started a new study program of 8 years, which will produce students. It is also promising to see that advanced students (e.g. after their M.A.) and also staff are being sent to western research centres to get some experience in western methods. At Nanjing University we met a student in astrophysics who had been selected to continue his study in Tuscon (U.S.A.). Concluding remarks: Compared with Dutch or other western institutes, Chinese Research centres are quite large. Although the Chinese could not always give exact figures, we suspect however that they actually have a smaller fraction of scientists. In general the instruments are old and/or small, compared to western observatories. However,we must not forget the enormous impact of the Cultural Revolution,and the consequence that their main work is still primarily of practical interest(time-keeping, satellite tracking, geodynamics, atmospheric research) A very large amount of observing time is spent observing the Sun and researching artificial satellites. An interesting point is that nearly all problems are attacked analytically. Although most places have a computer (the Chinese made TQ is almost everywhere to be found)

they are single-user systems and apparently not very stable. However the last 5 years we note a growing interest in non-classical astronomy (e.g. galactic and extra-galactic astronomy), but still in a literature surveying stage, because their instruments are too small and/or insensitive to detect these much fainter signals as compared with those of the sun, planets and bright stars. The planning of a 2 m optical telescope and transformation of their interferometer into an earth-rotational synthesis instrument evidence these trends.



Knitwear Factory, Hefei.



Ming tombs, near Beijing.

CHAPTER XVII

Blunder into China

by
Seth Shostak

We made our entry into China via Hong Kong. On a muggy April Fools' Day, our party was bussed to Hong Kong's Kowloon Station for the train trip into China. Our first destination was Guangchou (Canton), a three hour ride northwards, paralleling the Pearl River. It used to be that passengers were required to change trains at the border, walking across a bridge connecting China and Hong Kong, but improvements in service have mirrored improvements in diplomatic relations, and today a modern train rides nonstop between the two cities. Even before pulling out of the station, our group was ushered into an airy dining car where we were served an ample lunch. The train was altogether comfortable and clean, and was serviced by uniformed young Chinese selling newspapers, tea, magazines, and western cigarettes. At the ends of each car, located above a conspicuous plate informing us that the train was of Chinese manufacture, were color televisions variously playing ballets, or films with a revolutionary motif.

Our train tunneled its way through the crumpled geography of the China coastline, and within an hour we were passing through rice paddies and terraced gardens. So impressive was the sight of this storyboard Chinese landscape, that virtually the entire contingent of passengers lept to the windows, cameras in hand. For twenty minutes the sound of focal-plane shutters drowned the music piped from the TV's. The weather cleared, and the passengers returned slowly to their usual blase' state, picking up books, newspapers, or, in the case of the present author, this narrative. Outside, the Chinese peasants, unaware of their own quaint photographic nature, continued to work the paddies.

Our reception in Canton was cordial and relatively efficient. Before long, we were ensconced in the high-rise Baiyun Hotel, at the northern edge of the city. Completed in 1977, the Baiyun already had the dilapidated look characteristic of many structures in Communist countries, with peeling wallpaper, missing window hardware, and intermittant bathroom caulking. The highly-touted air conditioning turned out to be a desk-top oscillating fan, and the shape of my bed suggested that it had served as the final resting place for a dead pachyderm. Nonetheless the shower had lots of hot water and the rooms were clean.

From our 22nd-story room we could look down on the sprawling metropolis, with its low buildings stretching to a hazy horizon. Being strategically located at the head of the Pearl River delta, Canton has long enjoyed (or suffered, as you prefer) close contacts with the West. In the last century the Opium Wars began here when a local patriot dumped 20,000 casks of the European and American-supplied narcotic into the river. His thanks for this noble effort was execution by the Kaiser. The latter was not interested in provoking the British into a war the Chinese could not win. In later years the British and French set up their headquarters on Shamian Island, in the center of Canton. On the two bridges leading to the island were posted signs reading "No Chinese or Dogs Allowed."

Today, relations between East and West are less crass, and there is a close affinity between Canton and Hong Kong. We saw billboards everywhere, advertising everything from hair cream to bilge pumps, and Western products were available in abundance.

Although the city offers an occasional scenic wonder (the Sun Yat-Sen Memorial Hall, the zoo, and various pagodas), the most interesting aspect of Canton was the street life. An endless conglomeration of people oozed over the sidewalks, passing dimly-lit shops and one-room factories. Narrow, darkened alleys lead off to depressing dwellings, their balconies invariably festooned with drying laundry. Walking through the center of town, we noted that virtually EVERYTHING could be bought (in marked contrast with the USSR), although luxury goods were highly priced. Televisions, for example, were over $2000 for color models, and that should be compared with the average monthly salary of $45. Rent and food were cheap, however, and we were told that most families could save about $10 to $15 a month.

We were always looked at, with our caucasian faces and fancy Japanese cameras. Often we were approached by Chinese citizens who wished to practice their English. These people provided an interesting opportunity to talk with the local populace, and we found them remarkably open and well informed. It seemed as if they had no fear of being seen talking at length to foreigners, although one fellow made a hasty exit when our Chinese interpreter approached.

Canton is famous for its cuisine, and we sampled some of the town's better restaurants. The meals consisted of about a dozen offerings. served in sequence. These included soup, pork dishes, shrimp, shredded chicken, freshly cooked vegetables, and many other items whose identity remained unclear. Drink was a choice between beer and orange soda pop. The Chinese are not big on table etiquette, and by the end of the meal most tables resembled battlefields, complete with soya sauce blood. Our ineptness with chopsticks ensured conformance to local custom, as we spilled and splattered our way to the undramatic finish of every meal. I noted that the tables were always round, as appropriate for a classless society.

On the afternoon of the second day, we visited Sun Yat-Sen University, where we were warmly welcomed. Following talks with various faculty members and students, we were shown around several laboratories of the physics department. While the buildings and equipment were sometimes primitive, the experiments were most cleverly arranged, and left a very favorable impression. As our tour ended, around five in the afternoon, many of the students could be seen playing basketball, badmitton or volleyball on courts in the center of campus. We talked to some of these students, and they painted a spartan picture of university life: up at 6:30 for exercises and breakfast, classes lasting to 5:00 p.m. six days a week, and dormitories with ten students to a room. No frivolous youth here, but on the other hand a university education is considered a privilege: only a few percent of the students go to college.

On our second morning in Canton, we were taken to a peoples' commune, located about forty kilometers from the city. Since this was an organized tour, the group suspected, perhaps wih justification, that what we were to see would not be very representative. After an hour's ride through brilliant green rice paddies, we arrived at the central buildings of the commune. There we were received with tea, peanuts and lychees. The commune was large, comprising 32,000 people. When com-

pared with Holland, the number of farmers per hectare of land worked was nearly a factor of a hundred greater. We saw the childrens' school and the local hospital. The facilities were rather primitive, but the clientele of neither institutions seemed to mind. We were then invited to "have a chat" with a local farmer. An attractive woman in her forties politely answered all questions as two dozen Dutchmen occupied her sparsely furnished house. Later inspection showed that this simple cottage was far larger and more nicely outfitted than any others we could find. Nonetheless, no questions were refused, and the answers seemed honest.

After the official part of the tour was over, we were treated to an excellent lunch, and then spent some time dodging pigs and water buffaloes on the commune's main thoroughfare.

Our ride back to town was serenaded, as usual, by the heavy-duty horn blowing so beloved by drivers in China. The claxon was sounded at least five times per minute, serving no discernible function. The intention was undoubtedly to give fair warning to other vehicles, of which there were few, and cyclists, of which there were many. But I never saw much attention paid to the horns. A blind man from the West would greatly overestimate the number of vehicles in China, based on the annoying cacaphony. Our general reaction to traffic in Canton was one of horror.

Later the same day we flew through cloud-crowded skies to our next stop, Shanghai, 1600 km northeast of Canton. Despite its subtropical location, Shanghai was wet and cold. The darkening overcast conspired with the heavy stone buildings of the wharf area to give the city a sinister look worthy of its reputation. For a hundred years Shanghai had been partitioned by the British, French, Americans and Japanese. It became, as a result, the most European of the Chinese cities. The downtown area looked a bit like old Chicago; no buildings more recent than the thirties could be seen.

We checked into the Shanghai Mansions Hotel, facing the waterfront. The building dated from the colonial era, and had the solid looks and comfort only an old hotel can have. After a quick walking reconnaisance of the city, we retired to the hotel bar. It was eclectically decorated with christmas lamps and plastic flags from a Chevrolet dealership.

The following day we were bussed to an observing station of the Shanghai Observatory, which was located an hour's ride from the city on a lonely hill. As usual our visit was friendly and informative. And once again we encountered the odd combination of primitive equipment and sophisticated goals.

A free afternoon gave us the opportunity to do some shopping. Several of us fought our way up Nanjing Road -- the famous shoppers boulevard -- to Department Store Number 1. On the way we encountered about one hundred thousand Chinese, most of them attired in blue or grey Mao jackets, and all of them curious to see Westerners. As in Canton, we were frequently accosted by those who could speak a little English.

As the days went by, we found ourselves more and more at home in Shanghai. One evening three of us set out alone (and without our Chinese speaking guide) to take in a local movie. We arrived at a theater on Nanjing Road five minutes before the last showing of the evening. A crowd of about two hundred people was milling about in front

of the entrance. Many of these were offering bank notes, and we assumed that they wished to buy tickets from others. The film itself, of unknown title and subject matter, was sold out. Tamme-Siert, the most audacious member of our small group, quickly pulled a couple of one yuan notes from his wallet, and began waving them about. By offering several times the normal ticket price ($0.15), he thought we might yet gain admission to the attraction within. Instead, we immediately became the attraction without, as two hundred Chinamen crowded around to witness the odd sight of three very tall (by local standards) white men waving money and gesturing inscrutably. The mob soon spilled into the street, and I feared we had generated a lethal sideshow as I saw several busses advancing up Nanjing Road. Fortunately the local police quickly dispersed the most dangerously displaced members of the crowd.

Having no success with the purchase of tickets, we moved on to another theater. It was also sold out, but we elected to buy advance tickets for the following evening's performance.

The next day began with a visit to the downtown section of the Shanghai Observatory, were we saw the various instruments and equipment used to generate time standards. Two of us remained during the afternoon for further discussion with the astronomers, eventaully to be driven back into town in a Shanghai Sedan. The ride through city traffic made the car chase in "Bullit" look like a children's kiddie kar attraction. We heard that on average one cyclist a day is killed in Shanghai, but first-hand experience in Chinese traffic lead us to believe that this must be a gross underestimate.

After dinner, we made a second pilgrimmage to the cinema, this time with tickets in hand. The theater was a voluminous rectangular hall, once painted in inoccuous light green. About a thousand patrons took their seats, which I judged dated from the Ming Dynasty. The houselights were abruptly cut, and a few slides from local advertisers made their way across the screen. We were amazed how quickly the audience could read the complicated Chinese characters. After about a minute of this, and without further disruptions from advertising, previews, newsreels or other nonsense, the feature began. The title was "Tank 008" -- an action-adventure- amour film of the first water. A young couple, both members of the Red Army, pitted their courage in battle against enemy Vietnamese. The film would not win any awards for either technical excellence or subtlety, but the audience accepted it for what it was. Afterwards we returned to the hotel, where two technicians pitted their skills in a one hour battle against the radiator in our room, trying to shut it off.

The train out of Shanghai left at 1:30 in the afternoon, and took five hours to travel the 300 km up the Yangtze River to Nanjing, for nearly a millenium the historical capital of China. We traveled first (=soft) class, sharing our coach with a group of American tourists. The Chinese were packed like tomatoes in a dozen second-class cars in front of us. Foreigners always got priority in this country, so much so that one was sometimes embarassed.

The railway was double-tracked, and laid with modern concrete ties. Given the quality of the roadbed, I was surprised that our train rolled along rather slowly. The frequent sight of a steam locomotive immediately caused a flurry of activity as lenscaps were ripped off, and cameras jammed against the windows.

We arrived in the early evening, and were bussed to a modern motel-style residence near the edge of the city. The hotel had been built by a foreign investor, and featured British plumbing, German air conditioning, and Dutch televisions. Not all contact with foreigners has been so benign for Nanjing, however. The city is rich in tragedy. During the Second Opium War, the British killed 100,000 residents here, a feat that was repeated by the Japanese in 1938. Additionally, 44,000 Chinese women were raped during the Japanese invasion. I asked our guide how the locals felt toward the Japanese today, especially since they make up about one-third of the tourists in Nanjing. He replied that there was still some resentment, but the Japanese tourists were very friendly.

Nanjing, like Canton, was built in an open style, with low buildings and frequent shrubbery. Our first morning in the city was spent walking through Yuan Wu Park, situated on a large lake which in earlier times was reserved for the imperial court. The weather was cloudy and cool, and we had the grounds nearly to ourselves. It was the first time in a week we could walk freely without the immediate attentions of curious Chinese. Across the still waters of the lake I saw the white plume of a steam locomotive sliding behind low factories. Its whistle broke the heavy air, and I again felt like I was in the America of the thirties.

Later we were taken to the famous Yangtze River Bridge, an imposing double-deck structure carrying both rail and road traffic across the broad river. The bridge has both strategic and symbolic significance for the Chinese. On the one hand, it's the only overland link between Peking to the north and Nanjing and Shanghai to the south of the Yangtze. On the other hand, the Chinese are justifiably proud to have constructed the bridge without outside assistance. (The Russians, originally involved in the project, withdrew in 1960 with the souring of Sino-Soviet relations). An enormous white statue of Mao, his arm outstretched like a traffic cop, occupies a large chamber in one pier of the bridge. A postcard of the construction printed in 1970, when revolutionary rhetoric was relatively unmoderated, read "The majestic Great Bridge of Nanjing on the Yangtze is a brilliant reflection of the great spirit of enterprise which animates the Chinese people armed with the thought of Mao Tse-Tung in their battle against imperialism and revisionism, and in the application of the principle of self-reliance." It's a nice bridge.

Once again we spent an evening at a local theater to enjoy a program of music and dance. The audience, as usual a sell-out crowd, was about one-quarter tourists, primarily Japanese. The offerings were of variable quality, generally of a level suitable for high school vaudeville, but enthousiastically performed and even more energetically received. An off-stage director judged the audience's reaction to each artist, and like a Roman emperor, gave either "thumbs up" or "thumbs down" to an encore. It was amusing to watch the anxious faces of the performers after each song or dance as they looked at the director to see if they were to remain on the battlefield or be hauled off. Whenever a Japanese song was attempted, the three patriots in front of me armed themselves with, respectively, a film camera, a cassette recorder, and a single-lens reflex.

Two of the dance numbers featured revolutionary themes, but the audience was either too sophisticated or too familiar with the propagandizing to receive them with enthusiasm. Herein lay the crux of the problem for the Chinese Communists: Mao was adamant that the people remained, above all, committed to the spirit of revolution. On the oth-

er hand, Mao needed and encouraged the development of a class of technicians capable of rapidly bringing China into the twentieth century. But the two goals wer incompatible; they had their own dielectic, as it were. Specialists naturally develop more interest in their own fields than in promulgating revolutionary fever. They become pragmatic. The ten-year long Cultural Revolution was Mao's attempt to forestall this development on the eve of his death. The result was a disaster for China's elite; the educated, urban class upon which economic progress largely depended. One professor at Nanjing University spoke bitterly of the time he spent working on the Yangtze River Bridge. The universities especially were decimated during this period.

At the moment, the pragmatists appear to have the upper hand in China, and the very fact of our visit was evidence of this. The level of publicly displayed propaganda is low, particulary if one makes comparison with the Soviet Union. Instead of large billboards featuring workers looking determinedly toward a bright socialist future, the Chinese have erected advertisements for local and imported products. At an historical museum in Nanjing, the Communist Revolution of 1948 was hardly represented, with one painting and a small display case. In Russia, at least half the museum would be given over to events since the Revolution. Western literature (including newspapers and magazines) is available, albeit only to the educated elite. China clearly regards the West, especially America, as an ally (one Chinese told me of the need for China and America to join forces in defeating Russia). Many university students are being sent abroad (again, mostly to the U.S.), and American computers and laboratory equipment were frequently in evidence. One can only hope that the present opportunity for the West to improve its relations with a country comprising a fourth of the world's population will not be missed.

The next stop on our study tour was the city of Hefei, famous for its universities, but otherwise unremarkable. The train ride from Nanjing took six hours, although the straight line distance between the two cities was only 120 km. China's still limited rail net didn't yet offer a direct connection, and our route formed a giant semicircle through the countryside north of the Yangtze. The last half of the trip was effected under steam power, which provided an opportunity for the group to ashen their faces by means of the open windows.

In Hefei we were treated to the by-now familiar tourist offerings: historical museums, pagodas and temples, parks, and an evening concert. The last was so similar to our earlier experiences that I began to recognize the Chinese folksongs. The most popular Western song in the country seems to be "Jingle Bells".

While interesting, the scenic sights once again failed to compare in excitement with the curiosity of the local inhabitants. Hefei was only opened to tourism a year or two ago, and the half-million city dwellers still found tremendous novelty in caucasian faces. By standing still for a minute on the sidewalk, we were able to cause massive traffic jams as hundreds of curious Chinese gathered in globs to watch and stare. Coming to Hefei made us all movie stars for a day.

The highlights of our stay in Hefei were the visits to the universities. One of these, the University of Science and Technology, is perhaps the most prestigious institution for higher learning in the country. Only one in ten thousand students is good enough to be accepted. Like many of the universties we'd seen, it boasted a very extensive

and complete library, a high staff-to-student ratio (1:5), and an attractive campus layout. Also like other universities, the physical plant was in a fairly sad state, a situation which had been greatly augmented during the Cultural Revolution. We repeatedly heard stories of how the Red Guards had destroyed laboratory equipment and educational materials (even a cyclotron), as well as vandalizing many of the buildings. Most of the professors had less research experience than an average postdoc in the West, thanks to the ten years spent in the rice paddies or steel factories.

The universities are rebuilding now, and currently five percent of the high school graduates have the opportunity for further education. One method used by the schools to rapidly upgrade their level of research is to send students and staff abroad. Most study trips are to the United States, as mentioned, and when I inquired why more students weren't sent to Europe, I was told that "America is a new land". A more satisfactory answer may simply be the historical relationship of China vis a' vis the West. When, in the last decades of the nineteenth century, Europe, Japan and Russia threatened to partition China, the Americans announced their "Open Door" policy in opposition. This was probably less out of concern for China's political integrity than out of considerations of trade. The fate of Africa, chopped up into dozens of European colonies, was fresh in the mind of the American government, and no such barriers to commerce were to be welcomed in China. Additionally, America had a history of accepting emmigration from China; first for the building of the transcontinental railroads, and thereafter for California agriculture. Finally, the role of the Americans in removing the Japanese from China during the Pacific War should be noted. Whether these factors have consciously influenced the present-day rulers of China or not, the truth remains that America is the currently preferred model for science education and study.

We departed Hefei on a rainy morning, flying north to the capital city, Bejing. The plane was a small Russian jet-prop, which began ominously pouring smoke into the cabin shortly after takeoff. As meals are not served aboard domestic flights, we descended for an hour at Jinsan to have lunch. Flying northward, the landscape became progressively drier. Small villages, separated by no more than a kilometer, were everywhere sprayed over the ground. From the air they looked like archeological ruins.

Shortly after landing at Bejing's modern airport, we were shown to the bus that brought us into the city. One's first impressions of Bejing is that it is largely new, and considerably cleaner than the other cities of China. The streets were broad and lined with plane trees. Unlike Hefei, the locals were indifferent to foreigners.

One obligatory trip for those staying in Bejing is the 80 km trek to the Ming Tombs and the Great Wall. Situated in the foothills north of the city, the tombs comprise the final destinations of thirteen Ming Dynasty emperors. The tombs were designed and built (at impressive cost) while the emperors were still alive, thus assuring the monarchs that they would get the treatment they deserved after death. One of the more recent tombs has been excavated in modern times, and endless crowds of visitors now snake their way down concrete stairways to the underground burial chambers. At a depth of twenty meters they innocently file into stone-lined vaults which were never intended to be opened. For one brief moment I was left alone in one of these crypts, and as the echoed screams of schoolchildren faded down a nearby passage, the tomb

was suddenly still; the air cool and damp. For these few instants the large coffin which hunched on the stone paving in front of me seemed to regain possession of its own dominions. The central figures of the world's longest-lived imperium lay quietly at rest, undisturbed, as they were meant to be. Their peace was brief, for the chamber soon filled again with the noisy curious.

The Great Wall, largely the work of these same Ming Dynasty emperors, lay further northward, snaking along a high ridge of mountains. Its purpose was defense against Mongols and other aggressive tribes north and west of the Middle Kingdom. For several thousand years, danger to China always came from these directions, and building walls was a traditional, if largely ineffective, countermeasure. The total length of the Wall is 6,000 km, and its construction required literally hundreds of thousands of men.

Even if the defensive value of the Wall was dubious, its effect upon the modern-day visitor is not. Despite tremendous publicity, the Wall still impresses most tourists more than they expect. We saw, as many tourists do, a refurbished section at Bedaling Pass, still within the extended municipality of Bejing. Climbing from tower to tower in the bright mountain sunlight, we could see the slowly decaying edifice slithering its way over distant mountains to the east and west. Unlike our experience at the Ming Tombs, the abundant tourists did not manage to dampen our enthusiasm for this, China's best known attraction.

Our stay in Bejing, and thus China, ended undramatically after only a few days in the capital city. Several members of the group were daring the overland train trip back to Europe while the rest of us jetted prosaically back to civilization-as-we-know-it.

We are very thankful towards the following corporations and persons who supported the excursion financially:

PHILIPS
Control Data B.V.
Quartz en Silice Holland
Rietschoten Houwers
Berenschot B.V.
Cordis Europa N.V.
Huygen Beheersmij B.V.
Huygen Raadgevende In.
Tamson B.V.
Cemsto B.V., fil. Groningen
I.B.M.- Nederland
J. Maassen
Ver. Instr. Salm & Kipp

In order to present an idea of incomes and costs of the excursion, the following figures are given:

Income		costs	
members of exc.	fl 68,150.-	excursion	fl 132,951.82
corporations	fl 17,650.-	preparation	fl 2,192.99
Gron. University	fl 18,000.-	saldo (a.o. this report)	fl 1,448.24
G.U.F.	fl 5,000.-		==========
Min O & W	fl 10,000.-		fl 136,593.05
Ned. Natuurk.Ver.	fl 2,000.-		
Fys. Math. Fakver.	fl 5,400.-		
Funds	fl 10,393.05		
	==========		
	fl 136,593.05		

List of members of the excursion:

Stafmembers:

Prof. Dr.N.M. Hugenholtz	Professor of Theoretical Physics
Dr. G.S. Shostak	Astronomer
Prof. Dr. G.E.F. Thomas	Professor of Pure Mathematics
Prof. Dr. H. de Waard	Professor of Experimental Physics
Prof. Dr. A. van der Woude	Professor of Nuclear Physics

Students:

Harm Bakker, Math '77

Jos Birken, Math '75

Ed Brinksma, Math '75

Henk Corporaal, Phys '74

Hans van Hateren, Phys '75

Martijn Houtman, Math '73

Paul Huygen, Phys '72

Matthijs Kuiper, Math '77

Jeroen Langevoort, Phys '73

Bert Metz, Phys'76

Sietse van Netten, Phys, '75

Doeke Oostra, Phys '77

Jan Willem Polderman, Math '75

Sido Sinnema, Phys '77

Stefan Spekreijse, Math '76

Folkert Tangerman, Math '77

Peter Teuben, Astr '76

Bart Westra, Math '76

Tamme-Siert Wierenga, Phys '76

Henk Ziemerink, Math '74