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China Trip

TRANSCRIBED NOTES OF A TRIP TO THE CHINESE PEOPLE'S REPUBLIC MARCH 18 TO APRIL 17, 1974

Richard L. Garwin

June 21, 1974

Caution—The reader familiar with modern China is likely to suffer intense boredom on reading these notes. One looking for conclusions or commentary will search in vain.

This is a compilation of source notes, for the most part an almost verbatim rendering of the words of the officials and others with whom I met in China. The rendering of my own part of the conversation is sketchier, since it is quite easy to note fully the other person's words, especially when there has to be time for sequential translation.

Because these notes are somewhat crude and contain more or less accurately the words of informal conversation, I am distributing the notes as numbered copies and count on their not being given extensive distribution. I plan to compile topical excerpts for various purposes.

The travel itinerary was:

The travelers were Richard L. Garwin ("RLG") and Lois E. Garwin (Mrs. RLG "LEG").

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Note 1: The transliteration of names given to me in writing is Wade-Giles; of place names is mostly Wade-Giles or an English name (e.g., "Canton"); of names spoken to me in Pinyin. Regrets.

Note 2: Some typographical errors remain in these notes. Occasionally a "%" may be lacking, or a subscript or superscript. I hope the reader will be able to compensate for these errors.

Note 3: Some of the data herein may have been erroneously translated, or misunderstood by me. If I could not correct such errors, I have noted the data as I was given them, usually with the addition of a "?".

3/18 0926 Hong Kong to Lowu; walk to Shumchun; met by Mr. Hsiao, interpreter of China Association of S & T (Guangzhou Branch). Lunch at Shunchun; train to Guangzhou. Met by Mr. Han Fen–ming (CAST—Guangzhou); Mr. Chang Chu–sen (CAST—Peking); Mr. Kao Cheng–tung (CAST—Peking [our interpreter]); Associate Professor Lin (Physics; Zhongshan U.) [Sun Yat–sen U.], Guangzhou); Associate Professor Liang (Math).

3/18 p.m.—visit to Guangzhou pottery museum.

3/18 evening; dinner given for us by Mr. Han.

3/19 a.m.—visit to Botanical Gardens of Botanical Institute—400 staff, 1/3 in garden; "Guangdong Botanical Garden, Guangdong, China."

Chen Feng–hwai; Wang Hong; Yie Yu–yen.

According to Mr. Chen, the purpose of the garden is (1) choose trees for the afforestation program, (2) bring trees to Guangdong from other provinces, and (3) chemical treatment for fast growth, (4) import from other countries, (5) also medicinal plants.

Furthermore, their purpose is the popularization of scientific knowledge. They go to the poor and lower–middle peasants (hereinafter abbreviated PLMP) to see what they need most: They combine scientific work with practice. There are two ways to popularize: (a) state–owned unit; (b) local commune. A typical problem, for instance, is to have a medicinal plant which is useful for stomach problems and which has flowers but no seeds. How to propagate it?

a.m.—visit to zoo.

3/19 noon—lunch at Guangdong Guest House.

3/19 p.m.—Visit to Institute for the Peasant Revolutionary Movement.

3/19 p.m.—Visit to public kindergarten Tang Fan–ho? 174 children are enrolled and all live there. Age range 3 to 6 years (5 grades). The parents send the children on Monday and retrieve them on Saturday. There are 33 staff. Pre–Great Proletariat Cultural Revolution (hereinafter abbreviated GPCR) the kindergarten followed Liu Shao–chi's revisionist line. Paid little attention to ideological education for the children (only good food, good play); now they emphasize ideology and study simple quotations of Chairman Mao. e.g., not selfishness but selflessness, and how to learn from workers and peasants. Also they have a small vegetable garden where the children do work within their capabilities, such as watering, weeding, picking insects.

There are various physical and play activities—basketball, ping and dancing.

They have also puppet plays, they learn from workers and peasants, they make paper toys, and they have gym activities.

We saw a puppet show put on by 5 year olds(?), with the children presenting the show themselves. It was extremely professionally done and dealt with Chou–chou who received food from his mother when he had dirty hands, got a stomach ache, was lectured by the doctor who showed him microscope slides with microbes on them, and finally got well. Outstanding was the clarity and strength with which the children spoke in the puppet show.

We saw the children playing outdoors, about 100 children handling dumbbells in formation mostly in good time. Then a tug of war. We saw dormitories with a bed for each of the 174 children, and with "cubbies" in which the children put their clothes and things.

Then a theatrical performance featuring a Tibetan dance, a skit on picking grapes for Chairman Mao, a skit on keeping the smaller apple for one's self, and then a performance with two violins. There was also a skit involving pulling radishes, teaching the lesson that if all work together they can pull a bigger radish than anyone by himself. Then a Sinkiang dance, two solo songs, and two–lion dance. When questioned as to whether the violin was taught, they answered that parents found a friend to teach the children. One other child is being taught by his own parents and several are learning, but just beginning.

Where do they get funds for small purchases like lion heads? They can buy them first and report later.

Is there special help for slow children? In the sense that when some are quick to put on clothes when they enter school and some slow, the quicker ones help the slower ones.

Do all parents of the children live in the same neighborhood or work in the same organization? Mostly from the neighborhood. Every district has its own kindergarten run by the state or by the district.

Can one send a child to a school not in one's own district? Yes, if *near*.

How about reading readiness? The kindergarten has two purposes—one to help the parents, and the other to prepare the children to read. So the children *draw* in order to learn to hold the pen; and they recognize a few characters like 1, 2, 3, or "long live Chairman Mao."

3/19 evening—Chinese film. Met Li Ming–te and gave him photographs from David Pines.

Met with Chang and Kao. They contacted Peking about Hangzhou. All the hotels in Hangzhou are occupied, so we go to Guilin at 1:15, 3/21/74. Presented topics I desired to discuss in Peking.

3/20 visit to Zhongshan U. Present are Mr. Liang and Mr. Lin as before (Mr. Lin "teacher in math"), Mr. Chien, technician in physics; Mr. Chiang, technician in physics, and Mr. Liu, responsible member of the office of the university.

Liang—Let's discuss some questions and problems (1) introduction to educational revolution and hear my opinions; (2) learn from my visit.

Liu—The university established 1924 by Sun Yat Sen; formerly Guangdong University. In 1926 became Zhongshan University. *Before*, many colleges in the university; *now* it is a university for social and natural sciences—e.g., not an engineering or teacher's college. After liberation and pre GPCR much influenced by Liu Shao–chi revisionist line. In 1966 GPCR was launched. During GPCR, rejected Liu Shao–chi's revisionist line. Have changed from domination by the intelligentsia and implemented Chairman Mao's revolutionary line. In 1968, workers, revolutionary cadres, teachers, students, etc., banded together and since then the working class has controlled the direction of the university. In 1970 began to select students from workers and poor and middle peasants; now 1600 students in the university, 400 already graduated.

Our revolutionary education is in the experimental phase and we try to go step by step. There are eleven departments in the university (31 specialties). In natural science there are mathematics and mechanics, physics, chemistry, metallurgy, geography, biology. In social sciences there are Chinese culture, history, economics, philosophy, foreign languages. Staff of 2100; rely on Chairman Mao's instructions for education to serve the proletariat and to serve society.

In the Department of Social Sciences, the whole society is our factory; in physics, we have associated ourselves with factories and combined classroom work with factory work. Teaching is combined with research and production. Previously there were the three divorces—teaching was divorced from productive labor, from laboring people, and from practice.

The spiritual outlook of teachers, students, and staff has undergone a great change; in part by going to the countryside and to the May 7th School. There are many experiments in new textbooks and teaching methods. The educational revolution in still in the experimental stage, and the teachers and staff will give some details: Now an example on criticizing Lin Piao and Confucius. This is most important. We are "going all out" according to Chairman Mao's instructions. The movement to criticize Lin Piao and Confucius started in August and September 1973 and spread in the last part of 1973. Since the publication of editorials in People's Daily, the movement developed in depth, providing a deep revolution in ideology; the movement has a close link to the future of the country. The doctrine of Confucius and Mencius is one of restoration (to exploit the people). Lin Piao tried to use this doctrine to change the basic line and to restore capitalism. We must thoroughly criticize. A new development in this movement since this term—several hundred meetings large and small among the students and staffs; and special reading rooms for the criticism. Have dealt a heavy blow to the ideology of restoring capitalism.

Mr. Liu came in 1958 (7 years experience before and 3 *during* GPCR).

The time for meetings to criticize Lin Piao and Confucius depends and *cannot* replace the effort normally spent on ideological work.

Liang—First we visit the laboratory, then the semiconductor then the computing room.

We tried to build a factory in the university to combine universit The factory is established to serve the needs of education and of scientific research. Our instruments are not very modern but meet needs. Following Chairman Mao's teaching of self–reliance, we made some of the instruments in the lab ourselves; (of course) bought some from other factories.

Before GPCR, no computers. After GPCR, we added two new specialties in mathematics—computing and automatic control. The computer is manufactured by a factory in Guizhou (province). It is used for education and scientific research; also to solve some factory problems. Who fixes the computer? Local staff. Now we have more experience in using the computer than before, but little in manufacture. Now we are taking part in work to manufacture the computer combined with personnel from other factories.

Teachers of automatic control are also making some digital control (not *produced* here). So we will see one lab, one shop, one computing room. All the equipment is still simple, but reflects educational revolutionary orientation.

Lab visit: Saw an argon ion laser, an ADP modulator, and two mechanically–driven mirrors for large–screen TV. The faster mirror is driven at 60,000 rpms and has 24 facets. There is work on large screen TV at other universities as well. Where does the money come from to buy equipment? partly from the educational fund, partly from factories with which they have relations. Is prior approval required for such expenditures? Not if the amount falls within the annual plan. The argon laser was pumped with an oil diffusion pump and a mechanical pump which was made in Shenyang. They had also some nice–looking 1 milliwatt He–Ne lasers made by the students themselves. I saw a CO_2 laser set up in the lab which is used by students "for study of the effects of different gas mixtures." Its power output is "20 to 30 watts" and it is used by 30 to 40 students per year. The laser burns paper adequately and was heating a thin asbestos stop to yellow heat. There were no goggles, no safety devices to prevent workers or visitors from coming in contact with either the argon ion laser beam or the CO_2 laser beam. There were specularly–reflected argon–ion laser spots all over the room, and I later promised to send people at Zhongshan university a copy of the IEEE draft of laser safety standards.

We then visited the semiconductor workshop which has complete equi of integrated circuits. They use a multi–station transistor sealing machine, for welding transistors into TO–5 type cans. This machine was called P13–1, made in Guang-zhou 1970.12 (December 1970). The QT–1A transistor–characteristic display station was built here. In order to enter the workshop one exchanged one's shoes for sandals.

A large sputtering system was being installed for high–melting metal films "for resistors for sampling oscilloscopes." System type JS–450. They also used vacuum evaporation of aluminum and gold, had an ultrasonic welder, and employed (I believe) thermo–compression bonding. They used a scribing machine with magnetic chuck.

They had an HQ–1A transistor dc test system from Fo–shan city. They had an optical projector and were inspecting masks for Schott An ultraviolet exposure–station and a diffusion room completed the tour

The computer room contained a computer DJS–21 made in Guizhou in 1970. It is a 42 bit machine with 59 instructions and an operation speed of about 32,000 per second. Internal storage 16,384 words. Used for "education and scientific research." About 100 staff and teachers use it, also 20 to 100 students per year. Also factories with which we have relations. They were doing a "problem for the Communication Ministry of Hu–nan Province (involving the calculation of bridge arches). The source language was ALGOL–60, hand–compiled. They have no FORTRAN there although they said there might be some elsewhere in China. Only ALGOL–60 used here as a source language. There are no other computers with the same machine language. Some other locations use ALGOL–68.

There was a very standard dual papertape photoelectric reader. Two magnetic drums each containing 16,384 words were on line and had been working for about one–half year. Two magnetic tapes were not connected ("needed repair") and had 12 tracks. The machine is maintained and repaired locally.

Back to the "guest room" for discussions. Great changes in the departments—the computer introduced into mathematics; laser work in semiconductors and physics; also microwaves and nuclear physics (for instance, the development of CdS detectors for radiation monitoring).

What is being controlled by the digital devices mentioned previously? Some digital control devices for ship building—e.g., the cutting of metal plate. This is installed next to Wen–pu Harbor. Is there a magazine or catalog where they publish the specifications for the devices they make? They design to use. Also they wrote some articles—published in Acta Zhongshan University. What jobs will the students take after graduation? Students go to factories (whether in Guangdong or further depends on the needs of the state).

Liu—The principle is that students go back to the place where they came Origin of students? 1600 now. The first section was enrolled from Guangdong; the second section nation–wide (except Taiwan, which is a province of hina). Of 1600 students how many in social science versus natural science? One–to–two. Courses of study in math? Depends on different specialties—say, in math more kinds of courses than for physicists. A physicist would start with differential calculus, advanced courses like probability and statistics. Physicists would take 1–1/2 years of mathematics; e.g., differential calculus, differential equations, mathematical methods in physics. There are 30 students in the laser laboratory unit.

There were many flies at Guangzhou and at the university. I promised to send the laser safety standards to Mr. Lin, Department of Physics, Sun Yat Sen University, Guangzhou, CHINA.

Twenty–five percent of the students are girls, same split between natural science and social science (1:2). The entering age is 18 to 24. All live here; also all teachers and staff. Unmarried students only (regulation for enrollment!). Is there an entrance exam or other requirement? *Liu*: Four procedures. First the uuniversity says how many specialties they have and how many people are required. Then (1) the student fills out an application, (2) he receives the recommendation of the masses, (3) the department makes its recommendation, (4) the responsible person decides on the basis of three criteria: moral, political, intellectual. Is there graduate study? Pre–GPCR they chose some students for research work in the research institutes of the university or in other universities. They have not yet resumed. How about work study? The universities are "open universities." They spend one–third of the time in the country side (or one–quarter of the time within the term). Mr. Chien asked some questions re gravitational radiation detectors.

3/20 p.m.—Deaf–Mute School. Miss He, principal; also Miss Wang and Mr. Hsu. 290 students, 70 staff and teachers. The government and the PLA (People's Liberation Army) sent a medical team to the school in 1968 and since then they have been using acupuncture to help treat the deaf children. Also since 1973 selected doctors from local hospitals have been helping. The doctor teams give the students acupuncture treatment. After treatment, 70.6%(!) can hear the human voice. So *these* are taught to speak orally and then will learn some common knowledge. After a long period of oral training some of the students can speak. The students here each day get one acupuncture treatment. Do the rest learn sign language? No—simple pronunciation drill. Lip–reading is not most important (but see later discussion). They try to tell the students the location of the tongue, etc., to help them make the proper sounds. Saw a first–grade class. Then saw a third–grade class receiving acupuncture with a needle in the ear and a needle in the arm.

Saw third–grade math—Miss Soo.

Saw third–grade dictation/pronunciation under Miss Li.

How many schools for deaf mutes in Guangzhou? Only one—there are several in Guangdong province. Some children live at the school. Do parents get special training to help the children? Main training is in school, but parents, brothers and sisters help in oral work.

Age range? First grade is 8 to 12 years. *After* the school? Then back to their original areas. The local government makes arrangements to go to factory or to join a commune as a member. How long experience with present methods? Just began to do this kind of work—not much experience. Only four years of medical training while studying.

School established 1946, but the fee was very high before liberation (so few students). Now free, except parents pay for food and clothes. All deaf mute children in Guangzhou have the right to come free.

All parents wish to have children come here. If a family is very far, there is bus.

How much do the children hear of music? The capability is varied. They have a tape recorder to help train the hearing. Is there a central authority distributing information to deaf mute schools? Each place has its own experience, although there are several general principles "set by the government." For instance, there are many local dialects—Peking is chosen as the common dialect, but here we teach both. (Because the children will have to communicate with local people, and unlike normal children they do not automatically learn the local language.)

What is the line of authority to the school? This school under the educational agency of Guangdong Revolutionary Committee. How do the children communicate with each other? They speak or use sign language according to the need. When a student first comes, he can produce only a very few sounds, so we use sign language. When they graduate they can speak.

The first-grade teachers must speak very slowly, loudly, correctly (and use sign language). Later grades can speak faster and *less* sign language.

Miss *Wang*—The ordinary child learns to speak at about one year, but deaf mutes won't learn unless you tell them. Are there centers for the training of staff? No such special centers or university programs—all teachers come to the teacher college or institute and must learn on the job. Suppose a new school started in Kwangsi province, would the teachers go from here to help? Yes, they have good and close relations between different deaf mute schools—they exchange experience and send teachers to help or to learn.

Is there a center for acupuncture research? This method was discovered during the GPCR—man of the PLA in Shenyang unit used the method to teach deaf mutes and then was popularized nation-wide. His name was Chao Pu-un. How teach the other 30 who can't learn with acupuncture? "We are doing research." On questioning, it turns out that they mainly depend on sign language, but they do try to use oral work together with acupuncture.

Before GPCR, *all* of the children would have been taught only by sign language. Do children who can hear help the ones who can't? Yes. Children who can hear well help the others with phonetics, but mainly rely on the teachers.

3/21 Arrived Guilin 1320. Met by a Vice Director of Foreign Affairs Office of the Guilin Province (Kwangsi Zhuang—Mr. Chang). Also Mr. Ma, an interpretor; Mr. Tung; and Mr. Shi. The plan is to visit two caves, spending a half day at each and then a boat trip down the Li-jiang which will take eight hours and then a return by car. The guide for the visit to the Seven Star Caves is Miss Hwu and for the boat trip down the Li-jiang Miss Wang. On the boat trip we go 83 kilometers and pass two scenic areas. The river is low in spring because of lower rainfall and more demands for irrigation. The trip back is 67 kilometers. We leave at 7:40a.m., 3/22/74. Miss Wang has been a guide on the river for one year but was for twelve years a guide in the Seven Star Cave. Guilin has 320,000 persons with a city area of 54 square kilometers. Their specialty is machine building, textiles, chemical fertilizer, rubber, beer, coke, sugar, pepper, and medicine. Gui equals "cassia"; lin equals trees (forest?). We see ducks crossing the Li River both ways; people pulling (and poling) boats upstream. Strings of heavily laden boats pull aside to allow us to pass. There is also a party of four overseas Chinese and friends on our boat, which could hold about 100 persons. The boat is really a barge, pulled by a river tug. It will take twenty-four hours to make the trip back up river.

We see a fisherman fishing with two cormorants. He stands on his bamboo raft, ties one cormorant to the end of a bamboo pole, and dunks him in the water until he catches a fish. Little fish the cormorant eats; big fish the fisherman takes. The other cormorant is drying out on the sampan waiting his turn. We pass various scenic sights: Father and Son's Caves, Lung's Family.

We pass "Watching Husband Stone," "Fish Wall." The boat and the people belong to the travel agency of the city of Guilin. We pass beautiful stands of phoenix-tail bamboo (for rafts and poles), also "Picture Mountain."

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Invent lever–sea anchor for river travel to aid downstream and to make possible upstream travel with smaller effort than at present. The faster the river, presumably the easier it will be to do this.

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Our boat trip ends at Yang–suo a delightful town with a Ming gate and Tang pagoda. The town itelf is Song Dynasty with Ming gate and Tang pagoda. Inside the town gate there is a scale for recording the height of the river in flood. The high water mark is from the year 1908 at 13.3 *meters* above river level. Mr. Chang gave us a banquet during the boat trip.

After dinner we see "On the Docks," a film of the Peking Opera performance. The dockers wear life jackets, and concern for safety is evident in the opera.

3/23 a.m., visit Lu Ti cave, welcomed by Mr. Chien and Miss Wang (another one). The cave was discovered in 1959 and opened to the public in 1962. Its name means "reed flute." It is a very beautiful cave, well arranged and illuminated sensibly for visitors.

We leave Guilin Airport (a base for two-jet bombers) for Shanghai.

3/23 p.m. arrive Guangzhou and long drive 140 kilometers to Wen–shuen Guest House (hot springs). We passed a sign in English and Chinese "Out of Bounds for Foreigners Without Special Permit." The land around Guangzhou is strikingly better than the hilly land around Guilin. The karst structures around Guilin, seen from the boat down the Li Jiang and on the auto ride back from Yang Suo are striking.

It seems to me that the bicycle has transformed China. The bicycles are very sturdy "lightweight", for the most part single speed. They easily carry loads of 500 pounds (whole live pigs in baskets, agricultural produce, etc.). The plots here are flat and level as a billiard table. We stay at the Liu–shih Wenshuen Guest House which has 40 buildings (two for foreign guests). It is in Tsung–hwa County, adjoining a PLA base on the Liu–shih He River. On the left bank of the river is a short–period convalescent home for workers (one to two months—longer if prescrib d by a doctor). Such convalescent homes exist at the *district* levels, and there are therefore nine in Guangdong Province. This is one of the two most beautiful. We see a poem by Kuo Mo Jo on the occasion of his visit to the Guest House in 1961. We see a beautiful lichee orchard. The lichee is propagated by cuttings, as is bamboo. "Old trees" are eight to ten years old. We see catalpa–like trees which lose their leaves in December or January and grow new leaves in April and May. The gingko are doing very well here.

I inspect a bicycle closely. It has rod brakes; heavy–duty front springs; rear–platform; license number 3 million plus, and it is heavy (50 pounds plus).

3/24 a.m. After walking for an hour and a half around the Guest House, we have an early lunch and drive to Guangdong where we visit the Seventy–Two–Martyr Monument. Then fly to Shanghai and have lunch. We are received by "Dr. Hu," the biochemist we knew as Hu Shih–ch'uan when he visited IBM in November 1972. He is for two months now head of the unit of the Association for Science and Technology in Shanghai, formerly in Biochemistry Insitute there. Also Mr. Tu Xing–en, head of the Computing Sciences Research Institute in Shanghai, Professor Wang Te–lun, head of the Metallurgy Research Institute in Shanghai. Also Mrs. Hwa Hun–di (a woman about 40) and Miss Mao Lun-di a girl of about 20 who speaks English. Both Hwa and Mao are cadre (staff) of the Shanghai sub–branch of the all-China Association of S & T. The plan is to visit three factories—Shanghai Iron and Steel Works Number 1, Shanghai Shipbuilding Plant, the computer factory—(Telecommunications Factory Number 13) Shanghai Industrial Exhibition; Shanghai Computing Center (which belongs to Shanghai S & T group of Shanghai

Revolutionary Committee); Shanghai Metallurgical Institute where they do low-temperature superconducting work. I am to speak on gravity waves to an audience of about 50 for various organizations at the Shanghai Center for S & T (a set of rooms for the exchange of scientific and technical information). Plan for the evening: several performances:

> puppet show—boy whose sister was killed by the Japanese and who joins the Eighth-Route Red Army
>
> ballet—"Red Detachment of Women"
>
> Peking Opera—"Fighting on the Plain"
>
> dinner party by Mr. Hu.

This evening we are to go to the Friendship Store.

Mrs. Garwin will visit a Children's Palace; a handicraft workshop; jade carvings; the West Garden of Shanghai to see things of interest to children in the US.

Aside from banquets, Lois and I eat in solitary splendor. After the first day in Guangdong, we have managed to have Chinese breakfast as well as Chinese food at every meal.

3/25 a.m.—Leave at 8:30 to visit the Shanghai Telecommunications Plant Number 13. Our host is Mr. Tu who is the responsible member of the Computer Science Institute. Introduction: part of the computer design is by the factory, part is by the Institute. This is the policy of 3-in-1—university, factories, and research institute. The cast is Hsu Lin-fang, Vice Director of Revolutionary Committee of Radio Factory Number 13; Lu Chin-yi (staff); Kwang Hui—technician; Fang Pin—worker; Miss Chien—another vice director of the RC. Confident my visit will "promote friendship between peoples and scientists and improve relations between our countries."

Introduction: factory was built at the beginning of the Cultural Revolution. Then they had only about 200 workers and were making middle and small computers at that time. "During eight years, we have made a lot of development in the factory owing to the leadership of Chairman Mao and along the line of Chairman Mao. There are now 880 workers. Have manufactured ten different types of computer from the beginning until now. First was a transistorized small computer X-2. Also transistorized process control computer for chemical factories. Also integrated circuit computers, and small integrated-circuit process-control computer for cutting steel. They do fabrication of IC and PC modules. Also computers for control of wool textile factory.

Now manufacturing three computers:

1. 110,000 operations per second (OPS) computer—general purpose
2. 900,000 OPS large computers—general purpose
3. computer used with milling machine—numerical control.

Last year another American guest saw only the 110,000 operations per second computer. At that time the 900,000 OPS computer was in test. How many are manufactured? Of the type (1) ten per year; (2)—"according to needs of the state"; (3)—"the purpose of *our factory* is to manufacture computers." (I don't understand this last answer).

We visit four workshops: (1)—precision machining; (2)—assembly of boards; (3)—computer memory; (4)—debugging. Mr. Yu heads the precision machining, workshop of about 100 people [no pictures allowed (the only factory in China I was not allowed to photograph!)]. Miss T'ang heads the assembly workshop (130–160 people). I see (a) test of transistors; (b) life-test jigs in the oven; semi-automatic tester of I.C.'s—testing a single-gate silicon chip. The tester is capable of "testing five or six items, of which two or three can be tested simultaneously." Ninety percent of the I.C.'s pass the test. The tester is made here (three in use). Some of the wiring is "nylon insulated." I see an ultrasonic soldering bath for tinning the leads of components.

Mr. Lin is in charge of the storage. Mr. Yen is a sub-manager. Magnetic cores are 0.8 mm outside diameter and are being tested on an automatic tester at 10 per second rate. Sixty percent pass the test. Those which pass are later tested again before assembly into core planes. Three automatic testers are in use. Previously 70 workers were required to test the cores manually, now only seven.

Core stringing takes place as follows:

> First cores are stacked on a needle manually simply by probing a random pile of cores. The proper length of a stick of cores is obtained, an insulated copper wire is pulled through, scraped, and soldered to the core frame. After all the X lines have been installed in the frame in this way, a comb is applied in the Y direction and the cores are vibrated down against it. The first cores are then threaded with a needle, and in this way the Y stringing is completed. The Z stringing is done in a complicated pattern by hand. They scrape each wire before soldering. They say that "solder-eze wire *is* used in some other factories." I see the assembly and test of current decoders for storage (48 bit by 32,000 word). Core plane testing takes ten minutes to test 1/5 of a plane. One core in 10^4fails. Its wires are cut and the core and wires are replaced. The memory speed is 2 microseconds.

The head of the debugging operation is Mr. Ch'u.

We visit the eight-function numerical milling control. There are three pulse motors on the machine, so no sensors of position are required. It uses about 3000 low-speed I.C.'s. Its display is a panel of lights and its number is TQ-14A. There are ten thumbwheel switches as well as input data tape.

The TQ-16 is shown us by Mr. Ch'un. It is a 110,000 OPS general-purpose scientific computer. It occupies three frames, the left being internal storage, the right peripheral control. It takes five types of peripherals:

- paper tape input;
- dual-photoelectric tape reader;
- JY-80 line printer using a character drum and printing 10 lines per second at 80 character per line;
- two to four drums of 14,000 words by 48 bits. 40 microsecond per word transfer time at 1500 rpm;
- DL-2 tape—16 tracks at 20 bits per millimeter and 2 meter per second tape speed.

I see the TQ-6 computer of about "one million OPS". memory cycle time 2 microseconds and 180,000 words of internal storage, extendable to 260,000 words (additional?) 48-bit words.

The computer has three channels to the memory, 15 channels to peripheral equipment. It has four line printers of 20 lines per second at 120 characters per line. It has two XY plotters of large format, but no paper hold–down. It has a teletype *and* an ouput papertape punch. The machine has a "compiler for our *own* language, similar to ALGOL but including parts of BASIC." The TQ–6 is manufactured by "workers and technicians in movement to critize Lin Piao and Confucius." It has 64 instructions (85 total?). It has three levels of interrupt and can overlap tape–to–drum and drum–to–memory (I believe). "The TQ–6 is a prototype—the fastest in the factory." It will be used by users in Shanghai. It was designed in collaboration with the Institute for Computing Sciences, but the main force in the design was the technicians and workers in the factory. On the other hand the TQ–16 was built according to the design of the Computing Institute in Shanghai.

Regarding reliability of the TQ–16, its MTBF depends on the quality of the components. Some computers do better than others. Every computer before shipping "must operate for two months to seek out failures. Our users have their own repair personnel. The TQ–16 repair team consists of six people. One can shut off a TQ–16 and have it resume operations (mostly)." Debugging proceeds 24 hours per day.

The factory has a clinic, kindergarten, dining room for workers. ("In China every factory has its *own*.) Each worker works 8 hours per day with two intervals for outside exercise of 1/4 hour each. Half–hour for lunch. The work is very tedious and the workers need a break. Three–quarters of the 880 workers work the day shift, six days per week. The factory is closed one day per week. Workers use their spare time to improve their technical knoweldge and to learn culture. There are classes organized by the factory and usually taught by older skilled workers and technicians. There are a lot of new young workers, girls and boys, who participate in technical and political study. These graduates of the secondary schools study for two or three years to become skilled workers. Of the "technicians," some are students graduating from Chinese colleges and universities; some are workers with long experience.

If a large order for TQ–6 computers were received, to whom would the factory apply for more workers to produce them? If a large–scale order for a lot of TQ-6s were obtained, the factory can select workers from other factories in Shanghai and other parts of China. Can also get technicians from universities and institutes. E.g., the founding of the factory was organized by several small workshops. They did get some workers from other factories.

If workers from other parts of China were obtained, where would housing be provided? Since the factory is located in the center of the large city, there is no problem. The leaders in the factory pay much attention to the living conditions of the workers.

Does a worker get additional work points for major contributions to a new computer? Perhaps there is a misunderstanding about the system in our country—in the countryside, people in communes are paid according to work points. In the factory, payment is fixed per month, and the only reward additionally is the honorable feeling to have contribu ed to the revolution. Our country pays greater attention to safety in the workshop and to living conditions of workers. If the worker is ill, he can see a doctor and have rest.

3/25 p.m.—Conversation with Professor Wang on way to visit Shanghai Number One Iron and Steel Plant. Regarding Professor Wang's Metallurgical Institute, I will see two projects: (1) semiconducting devices and materials and (2) cryogenics. They receive journals, books, and also proceedings of international technical meetings.

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Promised to send him some NSF progress reports as examples, also proceedings of the NATO Conference last fall.

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About 1000 people in the Metallurgy Institute in two places: (1) in the western suburbs of Shanghai and (2) in Zhiadin County 35 kilometers away. *In* Shanghai, the administrative offices, semiconducting research, and metallurgy research. Superconductivity and low temperature is in Zhiadin. They have had recent visits from Mendelsohn from England and by a man from Holland who is Chairman of the Low Temperat re Association of Europe.

3/25 p.m.—Visit to Shanghai Iron and Steel Plant Number One. Cast: Lu Shien—responsible member of the factory; Tsai—member Revolutionary Committee; Lin—engineer; Djin—technical branch (looks exactly like my uncle Joe); Hsu—technican from the central branch of the laboratory of this factory; Wang—ibid; Ma—staff of the factory.

Tsai welcomes us himself, also on behalf of the workers and the Revolutionary Committee. A brief introduction: The enterprise produces iron, steel, and rolled products. There are fifteen workshops and units. One iron–making workshop (250 cubic meters? per furnace); three steel–making workshops; three rolling workshops; eight supporting workshops of a total of 2.3 million square meters. Last year produced 1.6 million tons of steel altogether.

Before liberation, only a very small factory with only one open hearth producing 2600 tons per year. After, relying on the doctrine of "Independence and Self–Reliance" we have made some progress. Now we have built another open hearth and the workshop for steel making. At the end of 1957—247,000 tons; 1958 under the guidance of the general line of Chairman Mao—"all out, aim high, working faster and better and more economically" we have obtained the following results—great leap forward in the factory. In 1958 added five workshops; Bessemer converters and rolling mills and basic oxygen furnaces ("BOF"). In 1960—740,000 tons. In 1966 changed two converters to BOF. It took only three months to change over, and all the work was done by the workers in the workshops. After that, automatic control was added and it needed only several workers to monitor the operation of the BOF. The production of new workshops equals the over–all productivity before liberation (?)

After GPCR, raised production of the factory *and* could manufacture many different types of steel—150 different types now; before only 60 kinds. Before mostly general carbon steel, now low–alloy steel, according to the need of socialist construction building prog am for steel sheet. This workshop is in pilot use.

Post–liberation, after GPCR, there were still some weak points in our work. The technique remains low; the level of modernization is not very high. We still need some very heavy manual labor and will try to solve these problems. The leaders of the factory pay much attention to this question. Now three BOFs which before 1966 were side blowing. Now requires two workers to control (previously eight) all manufactured and produced in Shanghai. Previous cycle was 25–30 minutes; now 10 minutes in the BOF.

What happened to the six displaced workers? A lot of new workshops were built and needed experienced workers. Now there are really five workers, of which two are in the control room.

Saw 1500–ton hydraulic shear built in China, shearing the continuous billets produced from the continuous casting furnaces. If production stops because of needed repairs, the workers take time to study political ideology and technical ma ters.

Post–liberation, the workers are the masters of the factory. The level of class consciousness is high; they try to keep things in order by planned repair.

(The final inspection station of the tube mill is very noisy.) How about ear plugs for the man at the final inspection station? "We are trying to do automatic control of the production process. Those workers are trying to make noise–reducing devices." In the meantime? "There are periodic health examinations and the workers ears are all right." But examinations cannot repair damage; how about the workers because of their socialistic consciousness making one another wear ear plugs? "Workers in that group are summing up their experience and are making some plan."

Does the plant move workers from one post to another to get the benefit of creativity which comes from contact wi h new problems? "The longer in a post the better." Where does the plant get the money to modify or modernize the equipment? "If we need money to buy a machine tool or to modernize the equipment, can get money from the factory, and the leaders actively support it. The authorities of the factory every year put aside a certain amount of funds for this type of effort. Actually they only spend 40 of the funds which are set aside for modernization (I don't why the other 60 is not expended—whether there is a shortage of ideas or whether the leadership does not approve some of the ideas). *Expansion* depends on a plan made by the government (but not modernization?). "Workers raise several projects with the leadership in the factory, and the factory tries to do these things one by one in order of importance." We try to keep the workers involved. "Self reliance (workers do everything in the factory), spend less money trying to do a better job." For instance, we just now visited the blast furnace workshop. By charging *simultaneously*, oil, oxygen, and coke, we can save 100 kilograms of coke per ton steel (590 kilograms formerly, 490 kilograms now). The workers raised this question themselves. A second advantage is that it raises the temperature of the furnace (to shorten the time?).

What is the job of the central laboratory? Three–fold: (1) to do some research to produce new type of iron/steel, (2) quality control, (3) some research work to change the technology—some examples:

(a) Our state will tell the factory "This year you will produce this new type of steel." So first the research work, then pilot production, e.g. stainless steel or low–alloy, weldable shipbuilding plates and pipes.

(b) Quality control– sample and physical and chemical examination; in stainless steel we used to need a lot of stainless steel import. Now we produce our own but must check to see that it meets the need of our country.

(c) All automatic control we saw in the different workshops were the r work of the central lab. What is the next project? To carry out the plans set by workers and leaders for automatic control of iron and steel making.

We have seen the tube mill which used to produce 40,000 tubes per year and now produces 55,000 tubes per year of a size ranging from 57 millimeters to 150 millimeters. Minimum length about 3 meters and length more commonly 6–7 meters. Materials; carbon steel, low–alloy steel, and bearing steel. The continuous casting billet is 150 millimeters by 1050 millimeters in cross section.

3/25 18:20—Discussion of plan for Tuesday, Wednesday, and Thursday in Shanghai. Tuesday a.m. visit the Industrial Exhibition; p.m. Computing Center and "small neighborhood factory" associated with Radio Plant Number Thirteen (the so–called door handle factory). Tuesday p.m. Mrs. Garwin will visit the Primary School of Happiness Village. Evening puppet show. Wednesday a.m. I visit Professor Wang's Metallurgical Institute. Mrs. Garwin visits natural history museum. P.m. I visit shipbuilding factory; she visits Children's Palace organized by the local women's association in Shanghai to use the children's spare time to learn cultural and technical activities. Evening ballet—Red Detachment of Women. Thursday a.m. RLG lecture on gravity waves *and* on the future of computer development. P.m. Fu Tan University. Evening invited by Mr. Hu to attend a dinner party. Mrs. G.— a.m. worker's new village, gardens of this village, primary school nursery. P.m.—Lu Hsun Park.

3/26 a.m.—Visit to Shanghai Industrial Exhibition; met by another Mr. Wu, responsible member of the Revolutionary Committee. Shanghai exhibition was built in 1955 in a total time of ten months. There are 5000 items displayed and I shall list some of them:

300 megawatt turbogenerator (1971);

slant milling machine;

multi–station cold heading machine (operating—making 13–millimeter diameter allen–head bolts;

250 ton powder–metallurgical press making gears of steel number 45 (presumably 45 kilogram per square millimeter);

30–ton N/C turret punch press number JK92–30 with a turret of 20 punches;

XC–35 automatic punch with drive below;

photoelectric tracing machine guiding a spark–erosion cutter with wire electrode and 80 millimeter throat;

electronic instruments which were not labled with Engish titles;

12,000 ton press;

vacuum refining and casting machine (5 ton) made by Shanghai Iron and Steel Works Number Five in collaboration with Mr. Wang's Institute;

some gold of 99.99% purity;

a fine exhibition of textile machinery including: warp knitting–machine, double jacquard loom producing 5 meters per hour of fabric, double velveteen air–jet loom, interlock knitting machine making 4 kilograms per hour of fabric, heavy duck rapier weaving machine, double–head shoelace knitting machine (100 meters per hour), spinning machine (using magnetic forces rather than weight to squeeze the thread from 22,000 rpm spindles, air–jet towel loom, auto-warp tying machine, auto–thread winder.

In shipbuilding exhibit saw a model of 10,000 ton ship Dong Feng built 1959 which was the only one built before 1966. Since 1966 they have built 26 ships above 10,000 tons. In 1971 a 13.5 thousand ton bulbous–bow ship. In 1971 20,000 ton bulk cargo ship of length 175 meters and 25,000 ton ship.

Model of a 12,000 horsepower diesel, 6 cylinders at 115 rpm. Also 500 cubic meter per hour dredger (bucket dredge); 4500 cubic meter per 20 minutes suction dredger.

— Saw also a contactless auto helm which has been incorporated since 1969 in all ships built in Shanghai and which holds a straight course to better than 1°.

In the automotive exhibit saw 32–ton dump truck of 400 horsepower and 22 ton weight and a 2–cubic–meter shovel truck. These are both prototypes, of which a few are in the field for experimental use.

"Large quantities of 2 and 4–ton trucks are in production; a few are 15 tons."

Discussion with Mr. Wu. Steel production now about 40 million tons per year (Shanghai?). My question re mechanization: Suppose 50,000 workers are now in a commune, and only 2000 will be needed when mechanized. Who has been thinking about what will happen to these other workers? "All will happen according to *plan*. The spare time of the workers will be used in rest and culture, sports, etc." Who plans? "Local governments tell Peking what are their needs and they make proposals. Central government collects all these and makes plans according to the local needs *and* for the country's needs."

Saw an outstanding hall of medical exhibits. Acupuncture anesthesia has been used in 80,000 operations in Shanghai to year–end 1973. Film shown (in an operating theater format) was very impressive. Was surprised to see exhibit on therapy for extensive burns and took several pictures. Some photographs of before–and–after condition of Chinese who have recovered from third–degree burns over 90–98% of the body. They have discovered that the scalp regenerates particularly rapidly and often transplant scalp fifteen times. Exhibit also on the restoration of severed limbs and fingers. Can rejoin severed limbs which have been disconnected as much as 36 hours by the use of cold storage from 0–4°C. The survival rate of limbs is now 80%; fingers 50%.

Impressive exhibit on product of Shanghai petrochemicals industry, textiles, packaged food (including Ma Ling brand available in the US). Also saw Chinese bicycles and typewriters (2100 characters plus auxiliary tray of 1800 characters).

3/26 p.m.—visited Shanghai Computing Center, Mr. Tu host as responsible member. Met with Mr. Li responsible member of first laboratory, Mr. Wang responsible member for computer room, all others are technicians in the Institute. Introduction: Established 1969 after victory of GPCR. GPCR promoted development of science in China; raised need to establish a center to support scientific calculation; center is *result* of GPCR. At beinning of center, only small computer which I saw yesterday in the factory—X–2, a transistorized 25,000 OPS machine. After establishing the center, an X–2 was there and many people came to ask the center to calculate.

Soon found it inadequate for the needs of the users in Shanghai. In 9/70 technicians and workers suggested the design and manufacture of a new computer, according to Chairman Mao's principle of self–reliance. Support of the leadership of this center and of local government organized people from this center, from local factories, from universities (Fu Tan) according to the principle of three–in–one and designed the new large computer.

The local factory concerned is the "door–handle factory." Before it was a neighborhood factory, now it is the Ching Jiang Radio Factory.

People from here and the door handle factory had a mathematics background. They knew nothing about the manufacture of computers. It took fifteen months to design and manufacture the new computer type "709." It is "just a prototype of this kind of computer." The 709 and the X–2 are the two computers in operation at the center. 709 is an I.C. machine of 110,000 OPS. We work to popularize knowledge of computers and to teach people how to solve problems. We critize the principle that theoretical work must be separated from practical work (striking resemblance in size, mission, and philosophy between this center and the old IBM Watson Laboratory at Columbia University in the 1950's.

The center often sends personnel to local factories to bring knowledge how to use computers; also learn from the workers—reeducation in the class struggle. They also have training classes for workers, peasants, soldiers, and workers from other organizations.

After our efforts of the last few years, we have changed the situation. *Before* other units asked the *center* to calculate the problem for them. Now they *borrow* the computer to calculate the problems themselves. It has raised the percent of utilization of the computer. The center has 50 persons in mathematics of 70 persons total (including repair personnel, etc.).

In the last five years they have computed about 1000 problems for different organizations and units in Shanghai and elsehwere. The computers run 24 hours a day on a wide range of problems: "astronomy, climate, geodetics, shipbuilding, mechanical engineering, textiles, medicine, optics."

The users pay for the use of the machine. How does the income compare with the expenses, say the total salary paid the workers? The computers are very busy, 24 hours per day all year. Even so, often cannot meet the need. The work has just begun. Could we have Dr. Garwin's opinion's after the visit as to how to improve and also a brief introduction as to how the computer is used in the US?

The 709 was completed 12/26/71 on Chairman Mao's birthday.

If the computers are so busy, why not build a second 709 which should be easy? It was designed and manufactured with the door–handle factory, and the factory has now specialized in computers and has manufactured several of them.

Saw the X–2 which was equipped with two line printers and two drums.

709 is an I.C. machine and has 48 bit by 32 K of core memory, four vertical drums at 15 K words per drum; two line printers; dual photoelectric tape reader; 48–bit single–address machine with no interrupt. Does it have internal checking? Parity checks for peripheral equipment. It is completely repaired once per year and there is also some planned maintenance once per month. What is the over–all plan for computerization? (No answer.) How is the productivity of the center measured, so that it can be improved according to the teaching of Chairman Mao? The center has a job to popularize use of the computer. Last center we held 12 training classes with about 100 to 200 persons per class. (Obviously no quantitative measure of productivity has been devised by the center.)

What language is used by the users? ALGOL 60. The compiler is a three–pass compiler. There are no machine language programmers, no BASIC, no FORTRAN, no assembler. The 709 has 48 different instructions.

For instance, lens design is done by a general purpose program which is maintained in the center. The user "gives requirements and the center gives the answers."

How does this jibe with the user borrowing the machine and doing his own programing? There are two cases: For simple programs we popularize the use, but for complicated things like lens design, *we* have the programs. They made the programs with a camera factory. The camera factory then gives many parameters, like radius of curvature, separation, etc., then we run the program and make suggestions. Regarding shipbuilding, is it a center program or a shipyard program?

Also two cases—the ship people learn one kind of language and how to do their own program. Second case we make the programs together with members from the factory (they do not know how to write programs themselves). On the X–2 machine, program was made by *us* and them. In this way, *we* know some details of shipbuilding, and *they* know some details of programing.

After many years of calculation, we have accumulated much knowledge of shipbuilding and teach *them*. Are the programs available to other shipyards? Yes. Is there a list of application programs? (Not a good answer, but there are more than ten standard programs, all in ALGOL.)

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I promised I would send a list of IBM Application Programs and description, explaining how they were available on rental in the United States. Also promised to send a description of APL, with which they are not familiar.

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Gave a small lecture on the use of computers in the United States, with the two directions toward individual minicomputers on the one hand, and large computer systems on the other, especially including virtual storage and virtual machines.

Professor Wang commented that there is a three–in–one group for each subsystem, e.g. the vacuum furnace which I saw at the exhibition.

3/26 p.m.—Visit the door–handle factory, Mr. Hsiao host. Cast: Comrade Tse—responsible member in workshop. Miss Wang—peripherals; Mr. Wang—cpu; Miss Tao—storage; Miss Ma and Miss Yung—staff of factory.

Introduction: Welcome. The present factory was established 1970 when together with the Research Institute in Shanghai (9/70) designed and manufactured the integrated circuit computer type 709, 100,000 OPS; first one completed 1971.11 (which is how they give dates); second completed 1972.12. Now this type put in large production. Success is due to the formation of the "three–in–one" group. The factory is a collective factory; not owned or governed by the state. There are 450 workers. The factory used to manufacture window and door handles, originally established 1958 as a neighborhood factory—all workers were housewives. Now 80 are housewives. They have not been educated and know nothing of computers. Owing to the needs of production and the need to build socialist society, they sent 74 workers to work with the Computing Research Institute at Fu Tan University to design and manufacture 709 computers.

During design and manufacture, the workers critized the principle that workers could not take part in such jobs jobs—"knowledge comes from practice." Of course, have successfully completed the 709 which is now in large–scale production. But there remain a lot of weak points—must improve. We have trained a team of workers who have know–how.

Have manufactured six 709s in all. The task of the factory is to manufacture, not to design. They have no other machine in production. Can you change anything if you have ideas as to how to improve? Yes, but not the language and only little changes—otherwise it would correspond to a change in type.

Saw a core plane test (4 hours). We averaged one bad core per plane. Component acceptance test allows some selection of components. All components are tested and aged. Cores are tested manually but in a quite efficient manner (RLG observation). Will buy an automatic machine (actually will make it themselves).

Who sets the specifications for the components? There are three sections in the factory: (1) control and computation, (2) storage, (3) peripheral. Each determines the specifications for its own needs.

How long after assembly to completion to debugging? Three months. No use of computer in debugging. Twenty people on a debug team. Number of errors found for the different parts varies and are mostly interconnection errors. "For instance, regarding the ALU, the I.C. is very good, so few errors. Debug is very quick. Main problem is soldering."

Is the money received from sale of computers sufficient to pay the salaries of the workers? There are two sources of income: state and computer sales. The computer price is set by the state, and the factory keeps 15% of that. The wages of the workers remain in the other 85%. One part of the 15% is used to improve worker's welfare—some is given to the state. We manufacture according to plan and deliver according to needs (this is in answer to question about priorities).

3/27/74 a.m., Shanghai, Professor Wang's Institute. The cast is Wang Te–lun, responsible member of the Revolutionary Committee at the Institute; Yang, responsible member of the Revolutionary Committee at the Institute; Chou, responsible member of the Science and Technology Group at the Institute; Ch'ien, leading member of the Research Office at the Institute; Mr. Chang and Mr. Chin, researchers at the Institute. Mr. Wang himself and on behalf of the Institute welcomes Dr. and Mrs. Garwin. Also the Revolutionary Committee and the staff and the workers. The Institute was established in 1928. Before liberation, the Guo Min Dang reactionary government paid no attention to our work. In 1949 Shanghai was liberated by the PLA, and the institute had only 28 persons.

After the new China was formed and under the leadership of Chairman Mao, the local government paid much attention and we developed very fast with people, skill, and range of work. Also helped found *new* institutes in other parts of China—e.g., "Noble Metal Institute" in Hunam Province, also Changsha "Mining and Metal Institute".

Until 1960 this was called "Ceramics and Metalurgy Institute". Now the Ceramic Institute is independent and this Institute has more than 1000 persons. The researchers number about 600. About 300 are graduates of Chinese Universities (before GPCR). Also have set up a 200–person factory within the Institute. The task is to repair instruments and tools for the Institute and also to manufacture tools and instruments for the Institute according to Chairman Mao's principle of self–reliance.

Previously the Institute was concerned with "iron and steel and light metals," but owing to the need to develop, our country began metallurgy research for electronics. After the cultural revolution, we often sent research personnel to the countryside for manual labor. We learned from the poor and lower middle peasants, worked, and studied. We combined research work with production in industry and agriculture, especially in the movement to criticize Lin Piao and Confucius. *Everybody* is very active in this movement and in high spirits.

Our country is still a developing country. "We depend on self–reliance and spend less money to do better work." Technicians and research personnel do research work for the revolution. We aim to catch up soon to advanced technology in the world. China and U.S.A. are separated by the Pacific Ocean, but have a close relation in respect to exchange of knowledge and culture between peoples. Also there is a deep friendship between the people. Hope RLG's visit will promote friendship between the people and scientists, and also further exchange of science and technology between our two countries.

The Institute is separated into two parts—one here, the other in Zhiadin County (near Shanghai). So we'll see two items here—electron beam exposure and ion implantation. In Zhiadin County 35 kilometers away we will see some work on superconductivity.

E–beam exposure is controlled by a digital device. Beam current of about 10^{-9} ampere, spot size 0.5–1.0 microns. Purpose is mask making for integrated circuits, now being used to prepare masks for transistors to be used at 4 GHz frequency. Line width less than one micron. Machine is a vector scan machine with magnetic deflection. The field of "good resolution is 1x1 millimeter." They have a steady magnet focus (presumably no dynamic focus). The stage is moved mechanically by micrometers within the vacuum chamber. There are no facilities for registration or monitoring during exposure. Use a "KPR" made in China on a glass substrate. Mr. Lou said that the digital equipment for E–beam exposure was made in 1968 by a "three–in–one team." It is a general purpose computer in addition to providing E–beam control. It has 8K store of 18 bit words, no drum (consists of two frames). Has about one failure per week.

The I.C.'s are in manufacture "as a functional prototype" Time for exposure of one square millimeter "according to complexity" say 0.5–1.0 minute. Sixteen microseconds per point. Maximum exposure pattern is 10x10 millimeters. Wafer diameter is 25 to 30 millimeters. The mechanical motion of the mount is computer–controlled on an XY stage. The whole mask exposure time about one–half hour.

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RLG told them of IBM's use of PMMA and mentioned some of its advantages and promised, to send the issue of Research Reports dealing with this.

Ion implantation: use PH_3 or B_2H_6 in ion source. Beam is magnetically analyzed and focused. Discharge uses about 360 watts and has a transverse 100 to 200 gauss field. The silicon is annealed after implantation. Use is for MOS devices. They have in the research stage a 64–bit storage chip.

Discussion on way to Zhiadin. Two hundred persons there and about 800 in Shanghai. In Zhiadin they work on superconductivity, magnetics, low-temperature techniques, also have a small workshop there. Why in Zhiadin? Initially planned to move the whole Institute there, but electronics had to stay in the city to be close to its customers. Also liquid hydrogen is dangerous, and that has to be in the suburbs, so that is why they have two. At Zhiadin I met Mr. Chang who showed me various examples of superconducting wire and tape made there and in the factory according to their prescriptions. One tape was made with Nb–1% Zr base coated with molten tin and then diffused. It had a critical current density of $6x10^5$ ampere per square centimeter at 39 kilogauss normal to the tape. They had also Nb–Ti and Nb–Zr wires. They showed me a solenoid which should produce 100 kilogauss and which had produced 70 kilogauss.

I told them of my two schemes for making synthetic hard superconductors—1) drawing down lead in AgCl to diameters below 100A; and 2) impregnating Vycor with lead under very high pressure either in complete coil or in fine strands to form a flexible high–field, high–current–density material.** Send NATO superconducting workshop report and also some data on commercially available closed–cycle helium refrigerators**. They showed me home–made helium liquefier producing 5 liters per hour. It is a piston–expansion machine using liquid nitrogen and was built during the GPCR by the college, factory, and institute. This was carrying out Chairman Mao's line regarding self–reliance and hard work. It took less than one year. Helium liquefiers were blockaded at that time, so they had to make their own. It is the first one in Shanghai, and there are two more now. The cylinder is stainless steel, and the piston is coated with an anti–abrasive material—MoS_2 plus lead and copper powder. They have a 12–liter–per–hour Joule–Thompson nitrogen liquefier and also a Philips–type nitrogen liquefier producing 4 liters per hour and made in Hang Zhou. I asked them whether they had a license from Philips (forgetting that the patent was probably more than 17 years old). They said that China has a policy of self–reliance and they don't use licenses. The liquefier has been working since 1967. What are the uses for superconducting wire? Only to make solenoids to magnetize permanent–magnet material! They use an iron–nickel type permanent magnet with a BH–product of $9x10^6$. Saturation magnetization on the order of 11,000 gauss.

How do they manufacture their superconductors? They prefer the Nb–Ti alloy to the compound–type superconductor. They use a surface preparation on Nb–Ti to make a good bond to copper (acid pickle only). The wire is hexagonal before drawing so it is easier to get it close packed for further drawing when they draw many strands together in a copper jacket. "Where holes are present they can be filled with copper." They work in vacuum to prevent oxidation, then they seal the wire in the copper jacket also in the vacuum. Heat to 600 to 700°s C before extrusion. A 60 to 70 millimeter diameter bar is extruded to a 20 millimeter diameter after jacketing in pure copper. After extrusion, then they draw and anneal etc., different annealing for different properties. So far, they have jacketed only once, but they will now try the multi–jacket operation. So far the largest wire has more than 500 wires in the jacket.

I mentioned to them the suprising use of 60–100 kilogauss magnetic field (plus stainless steel wool) in water purification. Continuing my views of the early application of superconductivity, I said that it was particularly important, especially for China, to provide inexpensive, reliable, closed–cycle refrigerators using a sealed system. I also commented that IBM was working on Josephson junctions for computer uses and mentioned some of their advantages.

What was Professor Wang's view of applications of superconductivity? 1) to magnetize permanent magnets, 2) NMR 3) cancer cure by blocking arteries with ferrite powder 4) superconducting motors, 5) Josephson junctions for high–sensitivity instruments to measure voltage, 6) magnetometer for surveying, 7) microwave receiver.

The Institute would like to raise the transition temperature, and apparently had not caught up with the recent debunking of TTF–TCNQ. They would also like to work to reduce AC losses, carry out Josephson junction work.

They seem to work below 4° only by pumping on a large dewar, and I showed them a sketch of the dewar–refrigerator which we have sometimes used, whereby we pump on a small vacuum–jacketed working chamber which is inserted into the storage dewar and which receives its helium from a porous stainless–steel capillary.

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3/27/74 p.m.—Visit to a shipyard in Shanghai. The cast is Mr. Liao, Engineer of the Shipyard (there 20 years), Miss Shien, responsible member of administrative office of the factory. "The factory is is many respects backwards." Its main purpose is to repair wrecked vessels, but also to manufacture some. About 7,000 workers including 1,400 women. It began to manufacture vessels recently, the main purpose is overhaul. In 1958 built a 3,000–ton ship. Nothing more until after GPCR when they built 10,000–ton ships. They are now building a 13,000–ton ship on a 3,000–ton slipway. Only began in 1969 and have already built six–13,000 ton ships. They have built six 13,000–ton ocean vessels, Yangtze River passenger vessels, harbor tugs. They are trying to improve tools and capability with a 20,000–ton slipway under construction. Also 10,000– and 20,000–horsepower diesel workshops. So we shall see three items: 1) 3,000–ton slipway, 2) diesel engine machine shop, 3) 13,000–ton ship.

So how use 3,000–ton slipway to carry 13 KT? The 3–KT slipway can carry 1,200 tons of steel, while the 13–KT ship is 4.2 KT of steel. How do they distribute the load? More keel blocks to distribute the load within the capacity of the earth. Extend 140–meter slipway to 161 meters using old steel. During launch,the ship must slip on the rails, with only 5 meters between them—need more. Added auxiliary slipways on either side. Peak load on tip over, so reinforced these. They have used a 40–ton crane with a radius of 30 meters. They are building a 100–ton crane with a radius of 38 meters. The 13 KT ship was built in 150 sections. Fewer sections will be required with the larger crane. They use steel "45" (which is 45 kilogram per square millimeter.) They use automatic welding and manual welding. Plates cut with an optical curve tracer.

Diesel Workshop. Saw 10,000–horsepower diesel engines with 6 cylinders of 760–millimeter diameter and 1,600–millimeter stroke. Dual–supercharged 115 rpm. Have been using the general purpose machine shop in the interim while the new workshop (not visited) is under construction.

The river passenger ship used two 2,000–horsepower diesel engines with a 12–cylinder V design, cylinders 300–millimeter bore by 550–millimeter stroke.

Thirteen KT ship is 161 meters long by 20.4 meters wide by 12 meter depth. Draft fully loaded 9.5 meters, speed 17.5 knots, steel weight fully outfitted 5,300 tons. Cargo 13 KT. Five holds with a 60 ton heavy derrick, its ordinary derricks have five to ten tons. Eleven months from receipt of order to delivery. Forty–five days to two months on the slipway; three–to–four months for outfitting after launch; sea trial, one month.

Ship has both single–bed and two–bed rooms and accommodates 46 officers and men. Living quarters are air–conditioned. Diesel generators. Engine room is very spacious. CO2 plumbing for fire extinguishers.

Ship design is approved by the Chinese Registry head in Peking, with a branch in every port.

In answer to a question, Mr. Liao said that Chinese are doing a lot of thinking about selling their ships in foreign trade. (How will anti–dumping etc., rules apply to China trade?)

In Shanghai harbor saw six two–canister missile launching ships. (No pictures of course.)

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3/28/74a.m. Shanghai Science and Technology Center for two speeches by RLG on gravity waves and on computers. The cast was Mr. Nim, Professor Hsieh Hsi–teh and Mr. Hsun. Mr. Nim welcomed me and said that China was still a developing country but that it had been especially backward before the liberation and now was making much progress. China must learn from foreign countries and from guests and is especially interested in exchanging ideas and experiences with foreign scientists. In some fields must catch up with advanced technical levels in our work. RLG had much experience in gravity waves and computers and has visited a Shanghai computer factory and some other things and can understand the level in Shanghai. The leaders of Shanghai pay a lot of attention to exchange of experience, so we have a center here to help do this job. Many foreign scientists have spoken here on different topics, especially Severo Ornstein, Cheatham, Yang, David Pines, etc. Here we also exchange experience among our own scientists, workers, and teachers. Today, teachers and researchers will listen to your lectures and will discuss them. We are glad to have you here and are interested in what you have to say.

Professor Hsieh (a woman) was a student of Weisskopf and did undergraduate work at MIT.

I gave my lecture on gravity waves, then some of my views on near–term developments in computers in the United States (including a description of my understanding of computer usage and some facts about the transition from one computer generation to another at Yorktown).

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3/28/74 p.m. Futan University. The cast is Mr. Chang, responsible member of the administrative office of the Revolutionary Committee at the University, Professor Hsieh Hsi–teh (as noted above), Professor Lu (Second Department of Physics), Mr. Sun, teacher of physics, Mr. Ching, teacher of math, Mr. Dai, staff of the educational revolutionary group, Mr. Chien, teacher in department of Math, Mr. Tu, teacher of physics, and some (un–noted) member of the administrative office of the Revolutionary Committee.

Program: 1) Workshop in components (physics) 2) Computer and the Math Department, 3) Discussion.

Futan is a comprehensive university of both liberal and sciences with 13 departments, six of science—arts, physics, nuclear physics, chemistry, optics, math, and biology, seven in liberal arts—Chinese, history, journalism, international politics, economics, foreign languages, philosophy. They have also some research offices in foreign languages and historical geography. There is a mathematical research institute and a biological research institute. The university community is 3,500, including workers, staff, and teachers. There are 1,810 lecturers, 152 of them of professor or associate professor rank. Three hundred fifty others are "assistants." Seventeen hundred are workers and staff, and there are in addition 2,500 students. They also hold some short–term classes and have from 4,000 to 5,000 graduates from short–term classes; e.g., foreign–language department broadcasts.

Futan was founded in 1905 as Aurora public school. Founded by French missionaries. At that time the university was in the power of French imperialism—student and teachers had to use French in their classes. In the struggle with the imperialists, they separated to form Futan University. Preliberation, under Guo Min Dang reactionary control, there only a few [classrooms??]. Postliberation everything has changed—e.g., three times the number of square feet; five times the area for [?]. Preliberation 80,000 books in the library, now 1.6 million. Also students—before liberation 6,000 students.

Postliberation progress but the Liu Shao–chi revisionist line impeded their work; Chairman Mao's line could not get through. The teachers and students have many struggles with Liu Shao–chi line, e.g., in 1958 during the Great Leap Forward they broke through and went to school in society. Students from physics, chemistry, etc., held class in the factories. Foreign–language students held class in the countryside. It was a big blow to the Liu Shao–chi line. Liu Shao–chi and his followers had authority, so Chairman Mao in 1965 called for reduction in time for education; education should be revolutionized; he called for bourgeois influence in our society to be ended. So the revolutionary students and teachers in the university united to struggle with the Liu Shao–chi line. In August 1968 Chairman Mao called for the proletarians to lead all of China; so the workers' propaganda team entered the University.

In June 1970, students entering the University before GPCR had graduated; and in November 1970 they selected a new set of students from the workers, peasants, and soldiers for the first new enrollment after the cultural revolution. The same in 1972 and 1973. They now have a three year course. The students have had a very rich experience now because of their background, and the University therefore carried out reforms—first in the means of selecting students (before, even with ten years of study, a student could not teach workers to work; or peasants to plant in the field). The education was entirely "book learning". They have now changed the way of selecting the students: 1) The applications are prepared by those qualified. 2) They receive the recommendations of the masses. 3) They receive the recommendations of local authority. 4) They are approved by the University.

Each student receives 19.5 yuan per month, and tuition is free. This money is for food and transportation, etc. In addition the student receives 15 yuan per year for books. The students have a very rich experience and a clear purpose in studying technology and culture and also Marxism, Leninism, and Mao Tse–tung thought.

They organized workshops in the University, for instance, to study Chairman Mao's teaching: "Education must serve politics." The University has "close relations with 100 factories" so it can help the students learn and they changed the separation of theory from practice.

Students from liberal arts have the whole society to use as a classroom (Chairman Mao: "Liberal arts should take whole society as their factory.").

There are three centers of learning—books, classroom teaching, and practice in the society. Also there are reforms in teaching. They tried to give up the forced–feeding for a heuristic method. They try to arouse enthusiasim for learning in the students. Also they reformed the examination system. Before students only followed the teachers, and they tried to memorize exactly. The exam only verified this, and afterward a student forgot everything.

Now they have two kinds of exams: 1) Open book exams; and 2) Discussions—i.e., grading of the response to a question raised by the teacher.

They have just begun to do the work of educational revolution and remain in the experimental state—plus make a lot of effort to sum up the experience and do better.

What fraction complete the course? The students have the rich experience of practice and the level of class consciousness is very high—to be able to overcome all difficulties. In three years have not found an example of difficulty—of course, there are differences between students, so comrades and classmates help, and teachers may pay more attention to somebody who is having some problem.

Now as for the workshops: materials, components (integrated circuits), and systems. They incorporate the principle of three–in–one—teaching, research, production. This is in accord with the principle of self–reliance. Teachers, workers, and students work together. In the IC workshop students learn how to make IC's and also their different principles of design. Forty to fifty students per year pass through this workshop. They are majors in microelectronics but also in semiconductor materials.

I saw furnaces for SiO_2 growth, and also for antimony diffusion to form the buried layer. Sources for $POCl_3$. The photolithographic material was "No. 206".

Wafers are 30 millimeters in diameter and the IC being produced with the logic circuit "was several gates."

Photoresist is applied by spinning, and exposure made by UV.

How many students graduated under the new system and what kind of jobs did they take? They go according to the needs of our country. Also we give short courses, and the ones who take these courses go back to the factory whence they came.

What mechanism is there for summing up experience and sharing it with universities in other parts of the country? We do it quite regularly. Orally or by newsletter? By discussions here or in other universities. Also Futan sends staff to other universities. How about Progress Report? "We are still in the experimental state, and we don't write things down very much. We pay more attention to learning from society."

Here and several other times I tried to make the point that it is particularly in the experimental state that wants to share experience, but this concept is hard to get across.

Which kind of resist? Exposure *hardens* They asked me whether I saw much use for a "negative inductance" circuit component. I said I didn't think it was nearly so important as negative resistance, although one could use it to simplify filters and things.

Computer Visit. Saw the 719 computer. What language? They are trying to set up their own, but at present they use ALGOL 60. Their compiler is not yet complete. Does one have to write in machine language? Partly. There is no teletype and no output punch. The computer is "still in the experimental stage," and they are trying to have tape output "eventually."

Systems Workshop Visit. Saw people working on oscilloscopes and other things—voltage regulators, medically–used electronics.

These three workshops are for *instructional* purposes. Today is the commencement day of the first class, more than 800 students are graduating.

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3/29/74 Nanking (Jiangsu Province). Met by Mr. Lu (2'nd tone) from the China Association for Science and Technology, Mr. Liu, Professor Lu (4th tone) from the Electronics Department, Mr. Tsui, an interpreter.

Mr. Liu gave an introduction to the history and status of Nanking. Its temperature is –4° C to + 40° C, with an alltime high in 1934 of 43° C. It has scenic areas (Sun Yat–sen's tomb, built in 1926–1929, with 80,000 square meters and 392 steps, also a pagoda and the famous lake in the park, then the Yangtze River bridge built from 1958–1968 with a railway on the bottom and road on top. Railroad bridge 6700 meters, road 4500 meters, bridge proper 1500 meters. Built the bridge according to Chairman Mao teaching on independence and self–reliance. Good to develop industry in Nanking, for instance, car factory.

Technical Program: 3/29/74 p.m. Visit Professor Lu's Nanking Engineering Institute electronic components workshop. Nanking Engineering Institute is a polytechnic university and has for instance, civil engineering.

Mrs. Fang Fei, Minister of Education for Jiangsu Province will attend the dinner party this evening and will meet with us at 8 p.m. (at my request).

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3/29/74 a.m. Visit to Yangtze River bridge. Mr. Yang Director of the Bridge. Formerly took two hours for the train ferry, now two minutes. Miss Chu gives introduction via a model of 1:300 ratio. Railway is 14 meters width, 6,700 meters long. Highway 19 meters wide. There are nine pillars 160 meters separation on the 1,500 meter wide river. From the river to the top of the roadway is 120 meters?? Bridge was built with independence and self–reliance—learn from the experience of foreign countries and ourselves. Bridge built 1960–1968 (railway section complete October 1, 1968, roadway complete January 1, 1969). Seven thousand workers, plus spare–time workers, staffs and PLA.

There were several difficulties—e.g., underwater construction of pillars began in 1960, but the Soviet Union refused to supply the steel and tried to stop our building the bridge. The workers in An Shan supplied the steel without interfering with their contributions to national plan. Workers made a great contribution to building the bridge and also to the fabrication of special steel.

After Krushchev took over, he tried to destroy Socialist construction in China. China had a contract with the Soviet Union to help on more than 100 projects—this was one.

They have four types of pillars, those with pilings have pilings 6 meters in diameter. Two trains can cross the bridge simultaneously (even in the same direction). One–hundred–thousand tons of steel were used ("low-alloy steel"). In 1972 "Antonioni visited and photographed the bridge from very bad angles to make the bridge appear crude." Bridge used one million tons of concrete and cost $280 million yuan. Three lives were lost in building the bridge, although the government and the socialist society are very careful about human life.

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3/29/74p.m. Visit to Nanking Engineering Institute. Professor Lu, Electronics, Professor Yang—Vice–President to greet us. NEI has more than 2,000 staff and 1,600 students. They have Departments of Architecture, Mechanical, Power, Radio, Civil Engineering; Electronics Components; Fundamental Course (Physics, Theory, Chemistry). Preliberation our Institute used to be [central?] university of reaction; reorganized after 1950 into the Polytechnic University with seven departments. There are 1,100 teachers and staff, including 47 professors and associate professors. Post–GPCR, in 1972 began selection of new students. There are now 1,600 students and 1,200 workers and staff. Post–GPCR, the teaching methods have been changed: *Mr. Wang* Teaching has undergone reform and improvement, but some of the innovations are still experimental. All students are now workers, poor or lower middle peasants, or PLA. All have at least two years of experience in practical work and production. There are four steps to enter the University: 1) submit application, 2) be elected by comrades in local units, 3) get permission from the leaders, 4) be approved by the Institute.

After three years of education, students return to the organization from which they came. The old teaching separated teaching from workers and peasants and soldiers—now we combine theoretical work with practical work and with the working class. Now operate the NEI in a open way and go out to society to learn. We have a close relation with 60 factories, and as a *whole* we teach these students.

We accept tasks from factories for teaching, modernizing the machines, production. *All* students take part in these three types of work and thus learn theoretical knowledge. We also organize labs and workshops. Students use labs and workshops here to do production and research—and thus learn their theory.

For instance, 1) motors and generators are manufactured by students in the workshop and they thereby learn the theory. 2) they study semiconducting circuits and make semiconducting receivers themselves. They also study basic theory courses. Students are very active in their studies and study hard. Under the old method, students only *followed* teachers. Now teachers can give a lot of help. While students study, students now learn also from practical work. For example, under the old method—the teacher would only tell the student—"the injection method." The student does not get the capability to think and analyze. The new method allows the student to develop capabilities to think, analyze, and settle problems himself. Experience shows that the student is conscious of studying for the socialist revolution and is very active in studying (with the help of teachers). We think it is very good. The new method is experimental and needs more improvement. We must "sum up experience."

Regarding examinations: Formerly the examinations caused excessive attention to good marks. Three steps deserve more attention: 1) Teach students with a high level of consciousness (study for the revolution). 2) Teach students to have a good capability to organize knowledge, 3) Good health.

So we don't need the old method of exam. We must not look at the "student as our enemy" and give very difficult exam topics. We are trying now: 1) Give students a topic 2) He can find a book in which to study, 3) *Then* he can answer. The purpose is to let student review knowledge of his previous study and also try to make a step forward. This also raises the capability of the student. How long does the student have to reply? We are still doing experiments. and the period is not as yet fixed. Sometimes two to four days. Sometimes a week. It depends on the course.

Regarding foreign language: Generally English, and mainly to read it and not to speak it.

What are the admission statistics? What fraction of the students are rejected at each step? The Institute is only in charge of the last step so they don't have the figures.

How about the sharing of the new teaching materials? Yes, there are new textbooks and they *do* exchange experience; conditions in other universities and institutes are different, so each writes its own textbooks.

Mr. *Yang*: The Institute has evolved a lot since its founding in 1952. It has about 20 labs now and at the beginning just a few. It has about two to three times as many classrooms. This whole area is for classrooms, labs and workshops—dorms are in another area. Now for the visit.

Saw architectural models, projects, and now for the workshop.

Vacuum tube lab —Mr. Hwa, Mr. Fan. Saw vacuum tube manufactured FU483F;—25KV class C. Also ID2P saturated diodes for stabilized power supply. Also scale–of–ten neon counter tube with three electrode pins per count.

The gas for the torches in the tube lab is locally produced (at the Institute) by cracking oil.

Semiconductor Workshop (also mainly for instruction) manufactures some single or dual–gate integrated circuits. According to Chairman Mao's injunction, "Spend less, do more." About forty students populate the workshop and this year's batch was due to arrive the day after we were there. They use chrome masks and have a large camera for 50:1 or 10:1 reductions.

They have a 1970 step–and–repeat camera with a JSS–1–control unit. They use chemical-mechanical polishing of the wafers, using CrO3 in sulfuric acid. I saw furnaces for antimony diffusion and for oxide growth. They handle seven to eight wafers at a time in a furnace. I saw also evaporators for aluminum and chromium. This is a bipolar IC shop only. The furnaces for phosphorous diffusion had manual temperature controls via a Leeds and Northrop (I didn't check to see if it was really an L and N) potentiometer). They use thermocompression bonding of leads. Forty students will come, and their involvement in the workshop will differ according to their grade. The first class of students mostly come to participate in manual labor. The second class students will first visit the whole workshop and then will stay to learn how to operate it. After graduation, some will go to factories. The students will remain for one month and then will come for so many hours per week. The permanent staff of the workshop is one responsible member plus 26 workers.

(TV–tube manufacturing workshop. Also for instructional purposes. Mr Liu in charge, different Mr. Liu). "Education must serve proletarian politics." Combined education was practiced. The workers are from the factory in Nanking. There are two to three students here at a time (forty workers!). TV–tube manufacturing is a young industry in China (post-GPCR). To form the workshop, they used old waste material. Twenty to 30 students will come and give one week of labor to help run the workshop I saw sealing of the envelope and sealing of the gun into the stem.

[In this workshop as in most every other, every door way had a sill to trip one and there were pipes and tubes on the floor (and cable runs) with no concern about that aspect of safety.]

At the evacuation station, the worker used a Tesla coil to test the glass system for leak. I saw aluminum evaporating on to the phosphor and saw face plates in green, brown, and clear glass. They would prefer the clear (hardest glass) and the others had different softening temperatures, but they adjust the process for each one.

This seems to be a rather big investment for the narrow benefit obtained.

Radio Department Workshop. Mr. Wan, responsible member. These are passive microwave integrated circuits. Saw a power divider 500 to 10,000 MHz, also a 10 dB directional coupler. The workshop is only six–months old and they have no active devices. About 20 students.

They make film masters on a scribing machine. I saw substrate grinding and polishing (alumina substrates). They use micrometers to measure the thickness of the substrates in various places and then regrind. They evaporate gold on to the substrates and also use argon sputtering of tantalum for resistors, which they trim by anodizing. They evaporate aluminum, gold, chromium, and tantalum. They drill the substrates with an ultrasonic cutter, and they gold plate chemically.

Visited "Electronics Lab": Saw every student in the lab assembling "Heath–Kit"–like seven–transistor receiver. The teacher was preparing the next year's work, which may involve circuits of a TV receiver. Other staff were working on digitally–controlled swept–frequency sawtooth and sine wave generator. They also produce components.

Discussion. Do these organizations which send students to the University have sufficient technical jobs for them on their return? "There must be some changes—dependent on the needs of the state." Are many communes building factories to supplement agriculture? "Yes, most People's Communes have their own factories." Is an organization more likely to send students to study in a speciality of use to the work group or commune, and therefore the Institute is unlikely to find students studying electronics coming from a commune? "If a student is found to make a special contribution, then we will change his job." Students *are* recommended to study at a specific institution and in a specific speciality.

Will those students who study TV tube manufacture go to work in a TV factory? Yes. I regard the benefit obtained from that as very narrow, and the investment substantial; what is your view? "Depending on the need, we establish different specialties—some provide knowledge which is very narrow, some very wide—we prefer the wide."

There is no graduate study at NEI. Many students enter at the *Junior* middle school level, and so six months of remedial work is provided before the three year course.

And they have not decided how they will move ahead to advanced training, or whether it is compatible with socialist goals.

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Discussion with Mrs. Fang Fei, Minister of Education of Jiangsu Province, at dinner and afterwards. 1) She thanks Professor John Lewis of Stanford for the material and textbooks he sent, also Donald Munro, of the University of Michigan Center for Chinese Studies, Lane Hall, Ann Arbor, Michigan 48104, for his letter of 12/21/73.

The children in Nanking are taught Pinyin at seven years (when they enter school), but they have two years of preschool education. "To write the Chinese characters (Han Ze) is very difficult. It is not easy for them to learn to write Chinese characters, and so Pinyin can help."

First, a general introduction. The population of Jiang Su Province is 47 million, and they have 25 universities and colleges. (The Ministry of Education is in charge of the universities and colleges.) There are 5,000 secondary schools, 50,000 elementary schools. Total is 8.8 million in primary schools, 2.2 million in secondary schools. There are 20,000 college students because they have just enrolled first and second class of college students after GPCR. A few words regarding education pre–1949. Only 15 universities and colleges in the province—all very small, totaling less than 10,000. Eighty percent of the population was illiterate. Three hundred secondary schools, 18,000 elementary schools. Total secondary education student body 90,000, primary 1.4 million. In the past 24 years, the total number of secondary school students grew from 90,000 to 2.2 million.

What is the literacy rate for people of 25? We do our best. Every child can receive universal primary school education (four to five years). During the fourth five–year plan in the future, universal secondary education can be achieved. In the cities (especially Nanking) we've already achieved universal secondary school education (10 years). Regarding Mrs. Garwin's visit to a primary school. They are not all so large. Tomorrow Mr. and Mrs. RLG will visit Lu Hsun Secondary School. That is also a big secondary school in our province.

Total teaching staff in 1949 was 50,000—now 400,000.

Who makes the educational *plan*? This unified plan made by the Central Government Planning Commission. Every year our province makes our own plan and reports to the central authority. The Central Planning Commission collects plans of different provinces and autonomous regions and makes a unified plan for the whole country and then hands *us* a specific plan. Educational finance is also awarded by the state. Regarding Mrs. Garwin's telling of 13–year schooling, here we try to achieve the 10–year schooling in the fourth five–year plan. Then we have two years of physical labor, then we continue the education in some cases.

What is the size of secondary schools in the People's Communes of, say, 50,000 population? Two thousand students? In the countryside, every two production teams may share one small primary school. Every People's Commune has its own secondary schools. But, there are also some very small schools for children of the peasants, and some students can only attend either morning or afternoon ("because they may have younger sisters or brothers and no grandpa or grandma at home"). Only a few production teams have their own nurseries or kindergartens.

Mrs. Fang Fei's authority covers primary school through university. The nurseries and kindergartens are under the Women's Federation and the Neighborhood Committee.

Does the Ministry of Education set the *standards* for nurseries and kindergartens even if they don't have authority? Yes, many nurseries and kindergartens are affiliated with a primary school. Also the Ministry has the responsibility for training teachers.

Do the teachers have authority or does the neighborhood revolutionary committee? Of course, the school is under the leadership of the neighborhood revolutionary committee, but each nursery or kindergarten has its own.

Every university or college and most factories has its own nursery and kindergarten. "The neighborhood committee has the responsibility for training teachers."

In secondary schools, what are the required math courses? There is a great difference between the U.S. and China. Secondary school graduates here must take part in labor for two years, and only then are freshmen for higher education selected. So the emphasis is on basic theory and skills and not on preparation for higher education.

What are the courses in senior middle school? Chinese, foreign language, math (geometry, algebra, analytical and solid geometry), physics, chemistry, general industrial knowledge, general agriculture knowledge, politics, physical training. For students of the junior middle school the same subjects, plus history, geography, and fine arts (also in senior school).

I have read the text books on physics, chemistry, and math which Professor Munro sent me. I think the scholastic level is about the same, but we have more practical material in our textbooks than in those he sent me. There are fewer "sets"!!! For the students of secondary school in the rural area, it is important to know the structure of water pumps, motors, diesel engines, chemical fertilizers and insecticides. But all these are *required* courses for all of our secondary school students.

Besides secondary schools, we have other (vocational) schools.

I discussed with Mrs. Fang my work on the Man Made World, and she would very much like to see it**" Send the Man Made World and details about its preparation to Madam Fang Fei, Jiangsu Province Bureau of Education, Nanking, People's Republic of China**. We plan to combine physics, chemistry, biology for secondary school students. The theme of the course might be "from big things to little things" and would include proteins, artificial satellites, astronomy, nuclei, etc. We have already made some outlines to compile such kinds of textbooks—like "some common knowledge of the natural world."

Who does this work? A group under our bureau includes teachers of institutions of higher learning, secondary school teachers, primary school teachers (about 100 teachers).

RLG: On the Man Made World, we worked as a thee–in–one team—people from industry, researchers, and school teachers.

"Most text books seem to be signed "Professor–Doctor So and So." (She thinks that school teachers can do a better job in most cases.) She asked "In Britain, there is an organization SMP..." (perhaps this is a "school mathematics project" which might be in the US? RLG).

LEG: "In primary school we use games for *education*, and in the school I visited I saw them playing games for *relaxation* which could easily have been given an educational flavor." A. In some cases, we have put such games into our teaching time—e.g., a mathematics "shop." Some students pretend to need assistance and others pretend to be clerks. Your suggestion is a good idea.

LEG: "Emphasis on *speaking* English is a good idea—especially the international phonetic alphabet is very important." A. This is a very common method in our schools. LEG: "But the children repeat in *chorus*—when does the teacher listen to them individually?" This is also a problem for us to solve—the classrooms are always a little bit crowded and the teacher cannot always hear what children say; but in colleges and universities the classes are smaller—15 or 20, and they also have better equipment (and cubicles). Sometimes the teacher also invites the students individually to recite." But "Right now we have a shortage of foreign language teachers."

RLG: (In sum, I think that Mrs. Fang is a very open and effective educational leader.)

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3/30/74 a.m. Visit to Lu Hsun Secondary School in Nanking. Cast: Mr. Ch'u, Director of the Revolutionary Committee of the School; Mr. Wu, Vice Chairman of the Revolutionary Committee of the School; Mr. Hu, representative of the teachers; Miss Chien, representative of the workers; Mr. Ming introducer. "Chairman Mao said that Lu Hsun struggled firmly with reactionaries during his life."

Mr. Wu: I welcome you myself and on behalf of the teachers and workers of the "Nanking Lu Hsun Secondary School." From 1899 to 1902 Lu Hsun himself was a student at this school. Preliberation it was also a secondary school and belonged to the Guo Min Dang Central University. Then only 600 students and 70 teachers and workers and also very simple equipment. Postliberation, under the leadership of the government and of Chairman Mao, the school was much changed and improved. Added a new teaching building and new lab, also new swimming poll and playing ground. Bought some new instruments for teaching.

Postliberation, name changed to "Nanking Teacher's College," post–GPCR changed to present name; now 36 different classes, 1,980 students, 136 teachers and staff.

During GPCR, teachers and students criticized Liu Shao–chi and Lin Piao revisionist educational line. After that, the school has changed a lot and deeply. Under the influence of Chaiman Mao's thought, teachers and students are carrying out educational revolution and reform. Since GPCR six main changes:

1) Reform old school system. Before that, six years of study—now four years (Chairman Mao: "School system must be shortened.") Some others were shortened to five years. We prefer five years and will change to five years (have made some comparisons).

2) Educational policy change. Chairman Mao has charted revolutionary line in education, and we have achieved some success in our work; but due to interference of Liu Shao–chi's revisionist line on education, Chairman Mao's line on education was not implemented very well in the past. Under the evil influence of Liu Shao–chi and his followers, teachers encouraged the students to put intellectual learning first and to study for their own gain. During the cultural revolution, the masses of teachers and students repudiated and criticized the Liu Shao–chi line, and we are now doing our best. Our purpose is to develop the student *morally*, intellectually, and physically to become a worker with socialist consciousness and culture.

   Take the students' ideology, as an example. After class they have organized many political study groups to study Marxism, Leninism, and Mao Tsetung thought. They also learn from heroes and modern persons to do some good deeds for people. Here is a very interesting story: Once a student picked up a wrist watch on the way home from school. He immediately reported to the school authorities, and asked help to find the owner.

   We have done some work in combining the mental and physical work of the students—the health level is greatly raised. For example, precultural revolution 45 percent of the students suffered from nearsightedness—now it is less than 5 percent! In addition to the combination of mental and physical work, we also give education to the workers on protection of the eyes and sense of sight. Also eye exercise every morning after the third period. [!!!!!]

3) Running of school. The pre–GPCR school ran in a closed–door way—divorced from a) proletarian revolution b) from reality, c) from practice. Post–GPCR we have tried our best to implement Chairman Mao's May 7th (1966) instruction and to have an open–door way to run the school. Students not only study intellectual knowledge, but also industry, agriculture, military affairs.

We integrate teaching with production: a) We have close links with some factories and people's communes, b) School runs some small workshops and has vegetable fields inside the school.

4) Reform of educational policy and teaching method. We have criticized and repudiated the older method of teaching (divorced from politics, production, and practice). Have concentrated on combining education with political and social practice. Have abolished the method of spoon feeding. We try our best according to Chairman Mao; by elicitation, enlightenment, to encourage the student to study vividly and actively. But also encourage democratic teaching method.

5) Teaching material. Old material contained many idealist things, but we have now discarded that and added materialist and historical material. Also have discarded some outdated and unnecessary materials and added some on new scientific achievements—e.g., in physics have added some things on artificial satellites, also lasers.

6) Relation between teachers and students. Previously there were not close relations. Most students were afraid of teachers. We are striving to establish new relations between students and teachers so that students and teachers are concerned with each other. Thus teachers can perfect their teaching, and students can study well. Although we have made some achievements, still we have some defects and new problems.

Reform is still in the stage of experiment. We still lack a rich experience and have a lot of room to improve.

One problem: Education in our country has developed rapidly, but in our school there are shortages of teaching equipment and teachers. We lack the rich experience in how to integrate our teaching with social practice and production.

The quality of some subjects does not reach the requirements. But teachers and students are determined to sum up our experience and to make revolution in practice in a deep–going way.

Now, a visit to some classes, among them math (grade l Junior) 13 year olds (Junior is the first two grades and Senior is the next two grades).

Chinese language (grade 2 Junior) teaching from an article of Chairman Mao as an example of combining theory with practice.

Math (Grade l Senior) about 15 years old. Here they are studying trigonometry, and they are only two children with spectacles in the whole room.

English—Here they are listening to a voice in good English reading a "speech." They listen to the tape and then the teacher asks, "who will try to recite the speech?" A boy volunteers and recites—from memory! I ask why it is necessary for the students to recite the speech from memory; wouldn't it be more productive of language education with less energy (according to Chairman Mao, "spend less, achieve more") to have the students recite while *reading* from the foreign text? Answer, "In learning a foreign language, memory is very important." The speech of the student was also recorded, and then the students could listen to their own speech. In general, we were much impressed with this, except for the necessity for the students to memorize the speech before they were allowed to practice their English. How many tape recorders? Four sets in the school.

Class in Electricity (Grade 2 Junior). Here each pair of students was wiring a fluorescent light. They wired directly from the 220 volt outlet at the desk via some wires to the tube pins, using ballasts and starters. There were fluorescent lamps going on and off all over the room, but there were also wires which could easily short one another or contact the students. I asked about this, and the instructor pointed out the individual fuses! Regarding the danger of shock (220 volts), he said that he lectured the students and that they had a worker lecture to them about appropriate caution around electricity.

Biology, a very impressive class with 50 microscopes. The students were sitting down while they did their experiments on staining leaves, etc.

Chemistry (Grade 1 Senior). Here too the students were sitting while doing Chemistry experiments. Every two students had a small desk equipped with sink and faucet.

Physics demonstration equipment—one large room was filled with cabinets for demonstration of optics and mechanics. Another large room was filled with equipment for demonstration of electricity.

Bio Lab demonstration equipment had number of animal models.

Outside we saw that the school had a total of eight basketball courts—these were concrete courts made by students and their teachers in their spare time. A swimming pool was also made by students and teachers, by using local method.

Saw a "sewing workshop" where the students do some manual labor in sewing up the materials which come to the school precut. In response to a direct question, they admitted that a girl could sew her own clothes in her own time if she wanted too, but that it didn't seem to happen.

In a year, a student spends eight and one half months on book knowledge and one month on industrial production; one month on agriculture production; one and half months for summer plus winter vacations. They "often use their holidays to study military affairs."

The products of the sewing workshops vary according to the needs—sometimes gloves, sometimes bags for holding grain—quite simple. The materials are precut and are semi-finished. Can a girl make her own clothes on the sewing machine? "In the past few, but yes of course."

There were fish in the pond as part of the agricultural effort.

The students exercise every morning, and after the second period in the afternoon they have sports.

About 70 percent of the children wore red arm bands meaning they are members of the Red Guards. The rest of the others have likely applied but have not yet been accepted because it takes time and the recommendation of their fellows. To become a Red Guard the individual applies, the organization decides, and the school must approve.

The school is about 50:50 girls and boys, and its population is determined on a neighborhood basis.

When the new class enters varies in the cities and in different parts of China. At this school they have enrolled new freshmen after the winter vacation. They are now changing to enroll after summer.

Discussion.

The textbooks are standard throughout Jiangsu Province, not throughout all of China. This is a period for reform of teaching material.

About details of eye exercises? For five minutes after third period in the morning. Is once a day enough or do they do it at home? Once a day is enough (they later took us back to a classroom to watch the eye exercises in progress). (I have a poster detailing the eye exercises—it says they should be done twice a day—see Attachment I.)

Do they bring in local workers to lecture? Very often. Regularly invite workers to lecture the students, e.g., on safety in use of electricity they invited electricians to give lectures. Also students go outside for a visit—e.g., when we study about transformers, students visit a transformer station.

Do you walk or ride a bus on a visit? According to the distance. Are there special buses, borrowed buses, or regularly scheduled buses? The school *has* one bus which they use for trips.

Is there a physics lab in addition to the physics demonstration? Yes, besides the demonstration, "we often organize students into very small groups (two students) with a set of equipment each. How do you teach the teachers to teach the new material? Two methods—1) Teachers often regularly go outside for further study in colleges and technical schools; 2) Teachers also organize themselves to learn from workers; we often have adopted the three–in–one technique to discuss teaching methods.

When a teacher teaches a lesson on electric motors, the teacher often goes to the factory to discuss.

LEG: Regarding the English class we are very pleased to see the use of a tape recorder and so much emphasis on the speaking and reading of English. And the teacher carefully instructed the students to follow the text as they listened to the voice on the tape recorder, a very important device for correlating the eye and the ear. All of the children followed very carefully, and did what she told them to. A very few (four to six) also pronounced the words quietly to themselves. Normally we teach children to read silently without moving their lips because it slows them down. But in learning a foreign language, it is very helpful to pronounce the words. So the teacher might suggest that all students do as these few do.

RLG: It seems to me that it would be wise to separate the memorization of speech from the reading of text. The requirement to memorize slows the learning of reading and speaking, and is not in accord with Chairman Mao's injunction to spend less and achieve more. And it is certainly good to have the students listen not only to the exemplary reading but also to the recording of the student's voice.

The students can choose *either* English or Russian.

LEG: Is there any other possible choice in the curriculum?

Other subjects are *required* except drawing and music which are taught only in Junior middle school. These subjects are arranged according to needs and practice. Every student takes physics, biology, etc. In Nanking we have realized universal *Junior* middle school education, are trying our best to realize universal Senior middle schools. Now over 70 percent of the Junior middle school graduates enter Senior middle school (in Nanking). [This does not agree with my understanding of Fang Fei's discussion.]

How about examinations? How often? Teacher–prepared or standard? According to Chairman Mao's teaching on the reform of the exam system, have also made some improvement in the examinations. In the past we used examinations to stimulate the students. Now we give exams to students as a method to improve their ability to analyze themselves and their problems. At the same time we regard examinations as an important link for the teacher to improve his teaching method. With this guiding thought, we have combined oral examinations with written examinations, and have combined exams on theory with examinations on practice. An example—our students had a lesson in electricity, then they were organized into several groups to check up the lighting system and electric system in the school and neighborhood. After that, they made a report and gave their opinions how to improve the portions which were substandard. Each semester there are two exams for each student.

How long does an oral exam take? According to different materials the oral exam is different. It might take longer in, say, English. The questions may be put by the teachers or by the combined efforts of teachers and students themselves. Sometimes also questions are used which arise from the practical work.

Are there marks on exams, on courses? Yes, on both. If a student does not learn enough? Yes, some students fail exams. In dealing with this there are two methods: 1) special coaching by teachers and a make–up exam, 2) organize student help for the students.

We have a few cases when students have to repeat courses the next year, not as a punishment but in carrying out our responsibility to help the students. We do this with the parents' consent.

How often do the parents normally come to school? Each semester, two parent meetings are held. The teachers very often use their holidays and spare time to visit the students' families.

We then return to see eye exercises which are done in a regular class for "five" minutes to the accompaniment of some rhythmic instruction from a tape recorder. The eye exercises are not at all what I expected—they do not involve movement of the eyes. In fact they are done with the eyes closed and are a light massage by the fingers in four places. There are four movements: 1) small circular movements with the thumbs in the inner upper corner of the eye sockets, 2) slow sliding movement up and down between finger and thumb on the bridge of the nose; 3) circular movements on the cheek bones with the forefinger of each hand; whether it is significant or not, the direction of the movement is up next to the nose and down on the outside of the face; 4) slow bidirectional movements over the lower portion of the forehead and across the face below the eyes to the bottom of the nose and then back again. **I have asked for some more detailed printed material on eye exercises and have found a poster in the Xinhua Shudian.** (Attachment 1.)

We were then asked about education in our country, and I explained by *state* I mean what you would call the *province*; New York State has about 20 million people, and our town has 20,000 persons—the high school has 2,000 students and we have universal secondary education.

Their questions: Q—; our answers:—A; Q. Would you tell us something about your secondary school system? Q. Something about your examination method?

A. Our goal is the same as yours—to motivate the students, to promote friendship between students and teachers. Formerly (and maybe still) some teachers may have used exams as punishment, but they are now a tool for the teacher and a help to the student to know whether his study methods have been effective.

A. In many classes, there is a self–paced exam. However, mostly we still have a class exam, either open book or closed book. We also have a small computer in our high school.

Mr. Ming: Q. Our educational goal is to train the student to become an ordinary worker with high socialist consciousness. We must teach practical education so that he will be ready for his job. Now our school is concentrating its effort to focus the student's efforts for the success of the revolution. We believe the future of humanity depends on the younger generation. Due to differences of social systems, education also varies. So today we were very pleased to hear from you some views on education in your country.

Ch'u: We are sure that mutual understanding will be further promoted by your visit. The people of China and of the U. S. are always friendly, and normalization of relations between our countries is the hope of the people of our two countries. We send our best regards to the American people, teachers, and children on your return.

(There is eye exercise in the primary school as well.)

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3/31/74 Mr. Liu (1) says they are now building 2.5–ton trucks in Nanking and build 10,000 trucks per year and 15,000 engines. The manufacture began in 1958 and there are about 8,000 to 9,000 workers and staff.

**Some questions for RLG for the future: 1) In the USA what *should* be the social interest rate under a ZPG state—e.g., should we build in stone vs. steel or aluminum? 2) if we use solar energy via concentrators, what will be the influence of contrails and high cloud produced by aircraft in the upper troposphere? Now, what is the cost or the opportunity cost of such operations?

There are famous "three stoves of the Yangtse"—Nanking, Chunking, Wuhan.

Sunyatsen's People's Principles were: nationalism, democracy, people's livelihood.

In Nanking we saw a gas pipe being laid about 10 inches in diameter—adjoining sections were concrete, cast iron, and welded steel simply because they didn't have enough of any one material for the total line.

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3/31/74 p.m. arrived in Peking. Met by Lo P'ei–lin, Yen P'ei–lin, Pan Chuan, and Liu Tsu–de, all officials of the China Electronic Society. We had a brief chat at the airport while waiting for the baggage, during which Mr. Lo made it clear that Mr. Chang, our traveling companion was in charge of the plan for Peking, but that they would try to accommodate all of our wishes.

Mr. Lo warmly welcomes us to Peking. He notes that we have visited four cities in the south and now we are in the north. Peking is the capital and the first city in the north that we have visited. We will visit four in the north—Peking, Tachai, XiAn, YenAn. Thus we are halfway through our visit both in time and in number of places. So let's discuss the Peking visit and the latter part of our trip. We are trying to arrange as follows: one week in Peking, four, five, or seven days in the other three places.

First they will give us the proposal and then hear our opinions.

So this is the proposal made to me by Mr. Chang after dinner the first night in Peking 3/31/74. He said that some of the times were delayed because we went to Guilin rather than Hangzhou. Some times will have to be resettled. We will try to do our best to arrange meeting with technical/economic planners. Otherwise the plan is as follows:

4/1/74 a.m. Sightseeing about Peking. Also visit some department stores. p.m. The Peking exhibition of Chinese handicrafts.

4/2/74 a.m. Physics Research Institute of the Academy of Science—meet with leading members of the Institute, also scientist researchers.

4/2/74 p.m. Discussion there regarding superconductivity and low temperatures.

4/3/74 a.m. Some scientists would like to hear lecture and participate in discussion on gravity waves. (LEG will try to visit two factories—carpet and handicraft, making flowers.)

4/3/74 p.m. Palace museum (forbidden city) and relics. 4/3/74 evening Mr. Lo, Mr. Yen, Mr. Pan, would like us to have dinner with them at *the* Peking Duck Restarant.

4/4/74 a.m. Atomic Energy Research Institute of the Chinese Academy of Sciences.

4/4/74 p.m. Discussion of low–temperature technique and superconductivity at the Physics Research Institute. LEG p.m. Also a handicraft factory—the glassware factory Mrs. Nixon visited.

4/5/74 a.m. Lecture by RLG on computers. Scientists in Peking would like to listen to lecture and then another smaller group will have a discussion. The lecture should be my views on the development of computers in the near future, also the experience with computers at Yorktown, also my views on important aspects of computer development in China.

For LEG some places of historical interest—The Temple of Prayer for a Good Harvest.

4/5/74 p.m. Computing Research Institute of the CAS (Mr. Yen P'ei–lin).

4/6/74 a.m. Discussion on Computers—Purpose is to provide opportunity for our scientists to ask questions and make comments. For LEG—Children's Hospital.

4/6/74 p.m.—Summer Palace

4/7/74 a.m.—Textile Factory.

4/7/74 p.m.—uncommitted so far.

4/7/74 evening—leave Peking.

4/13/74 evening—return to Peking.

4/14/74—visit to the Great Wall, Ming Tombs, and underground palace.

4/15/74—leave Peking—will discuss later.

About the evenings, will tell later on. Start in the mornings at 8:30 and in the afternoon at 2 or 2:30. Before leaving Peking there are six evenings—four are arranged with two standby. There will be some performances and dinner parties. *Think* we'll leave 4/16/74 by air to Canton in the afternoon. The people at Zhongshan University would like to hear me talk on detection of gravity waves. Also there is possibility to visit the Canton Trade Fair if I want to.

At this point I compared the plan in Peking with the requests I had made of Mr. Chang when we first discussed the overall plan in Guangzhou the night of March 18. I had told him as follows, having read from a paper which I had prepared in order not to miss anything in our discussion 3/18/74. That paper follows in sketch form.

Topics of mutual interest. Order of listing does not convey order of importance. Not negotiating nor carrying messages for the U.S. government. Not *negotiating* for IBM.

1. Experimental Physics—low temperature experiments in superconductivity; liquid and solid helium (He^3 and He^4); my recent work showing that gravitational radiation has *not* been

detected (I would be pleased to see and comment on anything I am shown, but my purpose is *not* to review all experimental physics in China.)

2. Management of Science and Technology at the State and Local level. How is it decided which aspects of research and development are most urgent? How does one avoid having the *urgent* displace the *important* but of longer term? *Who* decides? Once having decided, how is it determined where the work is done? Are there consultants/advisors (PSAC?) How enable political leaders to have a realistic view of what can be done (as contrasted with what *is* being done)? How insure the doing of new and useful work rather the redoing of work already completed? For these reasons, I want to visit Peking, Shanghai, and Shenyang.

3. Computer Development and Computer Use. Peking, Shanghai, Shenyang, Hangzhou (radio plant). Who is responsible for translating the needs and the requirements of *present* computer users and *potential* computer users into the design or selection of a computer type or into a specific computer installation? Examples: a) scientific computation of the Academy of Sciences, b) Bank of China. What value is placed on standardization in the domestic computers? If not standard, what programming problems and costs are anticipated? How transplant "application programs" from one place *and computer* to a different place? What rate of growth of computer use is regarded as desirable? What reliance on higher level languages to ease the transition from one computer system to another and to enable training of programmers and users without knowing or constraining where they will be used?

   Can I respond to questions regarding China–IBM relations—not as a negotiator, but as a reasonably well–informed and sympathetic viewer? But from the point of view of the ultimate user as well as of an agent.

   What are the goals of Chinese computer development? Plans? Learning vs. doing? Is China interested in exporting computers?

4. Strategic and Defense Questions—my personal curiosity; long involvement; no messages from U.S. government. Chinese views on measures to reduce chances of nuclear accident?: a) nuclear safety (PAL Permissive Action Link) vs. accident or unauthorized use—transfer of information? b) views on benefits to China of ABM treaty of 5/26/72. c) background of unilateral U.S. declaration re BW and later international treaty). d) views re U.S. defense commitment to Japan (as contrasted with Japan becoming a nuclear power). e) views re recent developments in U.S. strategic statements—can I interpret? f) views on the oil problem and long–range energy picture (from the point of view of decades and millenia). g) scenario for the use of the Chinese air raid shelters?

5. Technical and Public Service Education, and preparation for it. Nanking—Mrs. Fang Fei, Minister of Education. Peking—Xinhua University and Peking University.

6. History and beauty and organization of China—Guilin; Shenyang; Hangzhou; Nanking; Xian; Loyang; Tachai.

Since the plan had very little to do with many of these desires, I decided to restate them in terms of people and said that the plan was good insofar as it went, but that it did not meet the needs which I expressed March 18. In particular, I wanted to see the following *people*, and it was best to check whether the plan as proposed included visiting these people, as that is a way to cross check whether everything had been done: 1)Chang Wen–yu, 2) Chien Wei–chang, 3) Chou P'ei–yuan, 4) Bai Chieh–fu, 5) Hsu Pin, and 6) Ch'eng Chi–hsien. Mr. Chang said the first four were famous in China, and so he has heard of them and will contact them. He said that he didn't know the last two. I explained that I wanted to see Chang Wen–yu to discuss some aspects of high energy physics with him and especially to convey some messages from Dr. Panofsky of Stanford

University and Dr. Agnew of the Los Alamos Laboratory. I said that I wanted to see Chien Wei–chang, in order to continue some discussions of strategic questions which he had when he visited New York in November 1972. I wanted to see Chou P'ei–yuan in order to discuss with him questions of the planning for science and technology and the use of science and technology in national planning, and I wanted to see Bai Chieh–fu in order to learn how the Peking municipality managed science and took into account the potential of science and technology. Mr. Hsu or Mr. Ch'eng I wanted to see because they were at the machinery import–export corporation in the fourth department—the branch dealing with the possible import of IBM machines, and I wanted to talk to them about the status of this negotiation.

I also said that I thought that I wanted to visit Xinhua University instead of or as well as Peking University.

Mr. Chang said he would see what he could do.

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4/2/74 a.m. Physics Research Institute of the CAS. Met by Professor Shih Ju–wei, who served as our guide all day. Also by Miss Wang who had studied in England and whose English was excellent, as was her grasp of the technical aspects.

Professor Shih: "I'll say a few words—welcome and then a brief introduction: In the past twenty years the Physics Research Institute has developed under the leadership of our government and party to include the following departments: 1) high–temperature plasma laboratory—designed and built some small–scale devices for diagnostic investigation: a) plasma–focus device, b) theta pinch, c) laser–heated devices. 2) Magnetism Lab—thin magnetic films and alloys and ferrites—uses in computers and in microwave devices. 3) Laser Lab—primarily design of and improving the lifetime of argon lasers—also visible light at room temperature from semiconductor lasers; also laser information processing. 4) Crystallography: a) growing of crystals— YAG; LiIO3 lithium iodate (used in lasers and in conjunction with lasers); b) crystal structure analysis—e.g., insulin protein 1967–1973 resolution improved from 4.0 A to 2.5 A to 1.8 A. This work done in conjunction with the Institute for Biochemistry in Shanghai, Institute for Biophysics in Peking, Peking University. Now they are proposing to study the relationship of biological structure to function, but the members of the group are off to attend a conference today, and I can't tell you more. 5) Cryogenics and low–temperature physics lab in 1965 designed and built a helium liquefier—piston–expansion type with liquid–nitrogen precooling. After completion, found it very similar to the Collins machine. Preparation and characteristics of superconducting materials—also AC–losses in superconductors, and Josephson effect. 6) High-Pressure Lab—build some small presses for 35 to 100 kilobars. Study compressibility and change in crystal properties with pressure of various materials. Also synthetic diamonds by static and by dynamic method (in collaboration with a factory outside the Institute). 7) Acoustics-"ma) linguistic accoustics (frequency characteristics of ordinary Chinese speech), b) ultrasonics and microwave accoustics, c) city noise and noise pollution. 8) Also small theory group—elementary particles, general relativity, gravity waves. Also solid–state physics—statistical mechanics, phase change, critical phenomena.

Pre–cultural revolution, the theoreticians (especially the solid state theorists) were in a separate department of their own. But this was broken up and the theorists attached to the individual groups in order to try to make theory more relevant to practice. But which way is better is a matter for experiment. Last year, another American delegation, including Professor Robert Sachs, noted that there are two schools of thought in the U.S. also.

RLG: "Those with administrative experience will probably prefer theorists dispersed; those with theory–background–only would prefer them concentrated."

Under the leadership of the party, we have achieved a certain success but must strive hard for greater progress and contribute to the party and the people. This is a brief introduction. Are there any questions before we visit?

Visit Magnetism Lab—saw YIG spheres; variable–frequency microwave filter; orienting of spheres by magnetic effects to choose the orientation which is very stable against temperature. In response to a question about distributed microwave limiting they said they had previously had such an apparatus.

Kerr apparatus—magnetic domains in thin films of permalloy. Pulsed field effects. Two layers of permalloy are compared with and without a separating layer of gold. 800 A total thickness; characteristics are greatly improved by inclusion of a 20 A separating–layer of gold. Pulse duration 200 nanoseconds; rise time of 20 nanoseconds. The application would be to computer memory, but the purpose is instructional. "The purpose of adding gold is to obtain high immunity to disturbing fields."

I noted that IBM may have done such work in preparation for its flat film memory which we fielded in the Model 95 and asked about a mechanism to exchange progress reports, but did not get any response.

Saw EMI ocilloscope type WM16 with wide band amplifiers type 7ll. I asked whether they had made any multilayer films to enhance the Kerr effect, and they said had tried a layer of zinc sulfide, but they were not using it at the moment.

At the morning break there was much ping–pong playing in the halls.

Saw a study of the magnetic properties of GdCo as a function of the percent of gadolinium. The films are prepared by sputtering *or* by vacuum evaporation. When they use evaporation, they have two sources. They use a GdCo alloy as a target for sputtering. They are now experimenting with a tungsten filament and alloy source. They find unexplained difference between the sputtered and the evaporated films, in that the Faraday rotation increases with wave length with one type of film and decreases with wave length with the other.

Laser Lab—Saw laser–optical processing of electrical signals. "A subject of great interest now." The electrical signal is converted to an optical signal and is then processed to reproduce the original signal. This system uses a pulsed xenon laser with the one–microsecond pulse passing through a traveling–wave acoustic modulator. There is a reference beam and one produces a hologram. The propagation medium for the acoustic modulator is a quartz crystal operating at "10's of MHz". The hologram is then reconstructed with a helium–neon laser, and one can observe the original (four–pulse) train. Where is this to be applied? "It is still in the experimental stage."

Saw the helium liquefier of 15 liters per hour capacity designed and built here. It began operation in 1965 and has a piston expander. The liquefier has a hollow piston of epoxy resin covering a stainless–steel–tubing core. It has a stainless steel cylinder. There is also a smaller 8 liter per hour liquefier. For superconducting material they use a niobium- zirconium (1%) base, and then a layer of tin plus 60% copper. Copper increases the diffusion rate in the formation of $NbSn_3$ very much, and produces a tape which will carry 400 amperes at 40 kilogauss. The more copper which is added, the better the results—up to 95% copper so far!

For wire, they use niobium–1% zirconium, 55 filaments, and then react it with 10% tin and 90% copper (99% copper is even better!). They showed me electron micrographs and electron–probe micrographs. They also have NbTi wires with 200 filaments which carry 150 amps at 60 kilogauss and 90 amps at 76 kilogauss. The wire is 0.5 millimeter diameter and the filaments, 20 microns diameter. The tape is already in production in the factory and can be made by CVD using $SnCl_4$ reduced by H_2. They showed me a 100 kilogauss coil. They showed me a Josephson effect magnotometer, using point–contact junctions and more recently bridge junctions. The period is 10 $^{-4}$ gauss, the sensitivity 10 $^{-6}$ gauss. They have used a 2 micron bridge of niobium, or screw contacts for a point–contact junction. "We haven't solved this stability problem with either of them." They use tens of microamperes in the bridge junction. I said that we had had good results with Josephson tunnel junctions made on a lead substrate and suggested that they might want to use tunnel junctions. They asked why we didn't use niobium for our Josephson junctions, and I later responded that I believed we couldn't grow a proper oxide insulator on the niobium.

Plasma Lab—Saw the plasma–focus device. High-anvoltage power supply consisting of a condenser bank, vacuum switch, vacuum spark, coaxial guns. It has 36 microfarads at 20 kilovolts and produces neutron signals (for instance) at a deuterium pressure of 2.2 Torr. The coaxial gun has a tungsten nose, and produces 10^8 neutrons per discharge. They showed also some X–ray pinhole photos; they get more neutrons and better focus with the inner electrode positive. They measure the plasma temperature by soft X–ray absorption, and they have made a magnetic probe measurement of current in the gun. They have been working on this since 1970 and obtained electron temperatures of 500 to 1,000 EV. What are their plans? They are debating their plans. And want to get a larger vacuum system.

The theta pinch uses three condenser banks with spark gaps. The main bank is at 50 kilovolts and has 100 kilojoules total. They worked at about 90 milli–Torr of deuterium at a maximum field of some 60 kilogauss, starting with a static reverse field of about 3.4 kilogauss. The one–quarter cycle time is 3.6 microseconds, and they get 10^5 neutrons per pulse. They measure electron temperatures by soft X–rays and by differential absorption between aluminum and aluminum–plus–polyethlene. They have used streak photography and a laser interferometer. With the latter they find the maximum compression at 2.8 microseconds.

They have made computer calculations of end losses, using computers at the Academy of Sciences. The power supply inductance is 27 nanohenries, the same as the coil. The coil length is 20 centimeters by 8 centimeter diameter and the tube ID is 7 centimeters, made of aluminum oxide. The condenser bank is triple having a preliminary field producer of 150 microfarads at 5 kilovolts, an ionizer of 0.022 microfarad at 60 kilovolts, and a driver of 72 microfarad at 50 kilovolts. Plans? Increase length of the coil to reduce the losses. They note that most people still use a toroid.

Laser–produced–Plasma Lab—They use a glass laser of the oscillator–amplifier type. It is a Q-switched glass rod laser, using a laser–triggered spark gap. There are six amplifiers, and some Faraday isolators. The laser pulse is five nanoseconds by 10 gigawatts and they can pulse every few minutes. They have pulsed some hundreds of times, and the capacitors seem to be standing up all right. They have a single output beam about 4 centimeters diameter (I think) and they focus it with an aspheric final lens of ordinary (K–9) optical glass. They use LiD pellets of some cubic millimeters in volume and they measure the temperature by soft X–ray absorption of the emitted X–rays. There are two amplifiers after the Faraday isolator, and additional isolation is obtained by the use of saturable dye cells using a material whose Chinese name I have. Plans? are to go to disk amplifiers and to shorter pulses. Regarding multidirectional illumination, "We are considering it." Have considered the use of ultraviolet short–pulse diagnostics to detect acoustic oscillations, mechanisms of absorption, etc? "Very good for the absorption, but we don't have any good–quality ultraviolet lasers yet—we have used frequency–doubled ruby laser." Are there any theorists associated with this work? A few. The laser was first operated in 1973.

I saw lithium iodate, LiIO3, growth for frequency doubling and parametric oscillation. There had been observed a 5–to–1 difference in growth rate between the positive and negative end of the crystal. They believed that the positive end should be faster, and it is. (reprint attached) The negative end grows slowly and forms parasitic or twin crystals (electrical twins) Also, beta phase is formed from an aqueous solution and they have measured the phase diagram. The growth is at a constant temperature of 70° plus–or–minus 0.1° C by evaporation from the warm solution. Although the difference in growth rate had been discovered previously, the explanation is due to this Institute.

Discussion: The Institute has about 600 people, but it varies as people are sent elsewhere to learn or to help out, and as others are sent here. They have no students of their own, but "some university students in their final year are sent here to work."

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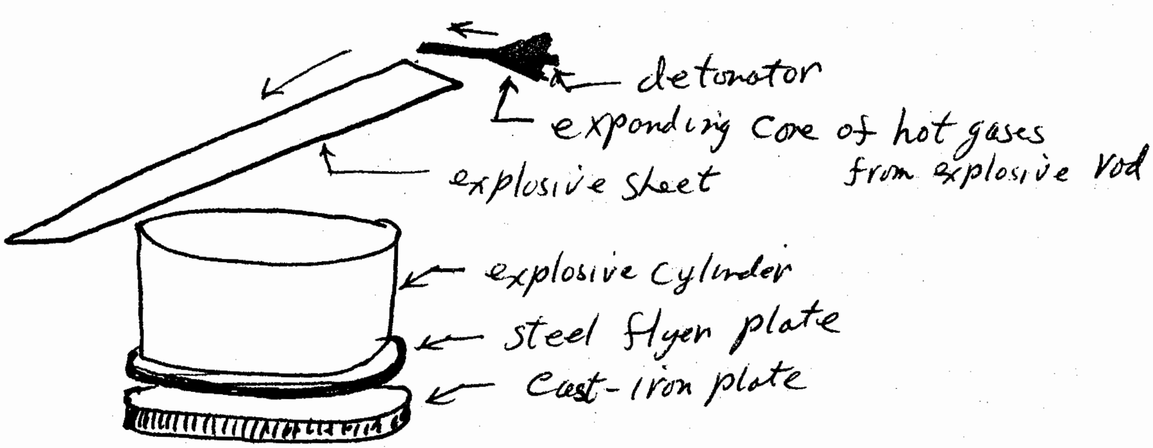
4/2/74 p.m.—I spoke at the Physics Research Institute on "cryogenics and superconducting technology." The talk was translated by Mr. Chang Hsiu–ch'i of the Electronic Society. Some of the remarks and comments are of this nature: 1) Is it true that I think applications in motors and generators are unlikely in the near future? 2) What is my overall speculation on future applications of superconductors? 3) What are macroscopic applications of superconductivity? 4) Regarding liquid helium, we have only small machines for research use, no large factory liquefying helium. 5) Why does IBM work on computers which might not be manufactured? 6) What do I think of superconductivity for energy storage for power lines? 7) What is the relative cost of superconducting water purification and more common techniques? ** I promised to send excerpts from the NATO Fall Workshop, if it is available and also some material on closed cycle refrigerators which can be purchased commercially in the United States. **

I had asked for more information on the "dynamic method of diamond production," and at the end of my talk and discussion, about fifteen people came into the room to discuss this with me. Their dynamic method of diamond production is to use explosives to shock cast iron. They convert about 10% of the graphite in cast iron to diamond and less in pure graphite. They have used ordinary graphite and not pyrolytic graphite.



At this point in the report I shall attach a sketch expanded from page 15 from my No. 4 notebook. I also promised to look for some pyrolytic graphite in my lab to send it to them to see whether its higher density might not improve the results.

Some interesting aspects of their technique: They use a point–to–line–to–plane detonation converter which then detonates a 26–centimeter–diameter by 15–centimeter–long cylinder of high explosive, which projects a 4–millimeter thick steel flyer plate across a 38 millimeter space to impact on a 20–millimeter–thick cast iron block. The block is recovered "whole but cracked." I asked them why they didn't detonate a cylinder on either side of the cast iron block, and they said that there were problems detonating the two explosives simultaneously! They asked me whether I was familiar with such work in the United States, and I said that I was interested in explosive techniques, but that I was not familiar with the manufacture of diamonds by explosive methods. They told me that they thought DuPont made diamonds by explosive methods. They told me also that GE had made clear diamonds 5 to 6 millimeters in size, while the Chinese diamonds are much smaller. Strong of GE is a man they quoted. At the Institute they have *sintered* diamond and the strength of their sintered diamonds is as high as the strength of natural black diamond (itself a poly–crysta1).

I told them I thought that there must be people in China who could detonate their two explosive plates simultaneously.

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4/3/74 a.m.—Physics Research Institute again with Mr. Wa, head of their theoretical group. Mr. Chang again translated my talk on detection of gravity waves. Mr. Wa said that there are two kinds of theory at the Institute— general relativity (15 people), solid–state physics (8 people including statistical mechanics), and elementary particles (8 people). Also there some theorists distributed to the various groups. Management and organization is "still in the testing period." They have two different kinds of system.

When experimenters and theorists work together, they sometimes find things which are quite interesting, and that is good. Sometimes the theorist may find it very urgent to go to the laboratory to verify his ideas. *Some* actually participate in the experimental work. The purpose of the general relativity work is to try to solve Einstein's field equations in different situations, and some of the theorists work on a different kind of gauge field. Also some of them work on fiber bundles (mathematica1) to try to link with physics. This is related to differential geometry.

The solid state theorists concentrate on statistical mechanics—e.g., phase transformations and critical phenomena. Do they have a computer? Yes, they do have a small computer in the Institute and use others of the Academy of Sciences. Questions after the gravity–wave speech: 1) What are the prospects for improved sensitivity? 2) Comrade Chien has come here from Guangzhou because his interest was aroused when you spoke with him in Guangzhou!!

About 15 people stayed to discuss for an hour or so more precise and concrete questions about the detection of gravity waves.

Some of the comments follow. 1) Regarding the work of Moss and Forward, was their laser 75 milliwatts or the few watts that I said? I promised to send more information on this. I think it's likely that he is right. 2) What would be involved in a laser experiment? 3) Are there coincidences between Weber and Douglass? (My answer was that Weber sees them but Douglass doesn't.) 4) "By using prompt coincidences, how can you get coincidences at 20 seconds delay?"

Left the Physics Institute at 11:30 and arrived at the U.S.A. Liason Office in Peking at 12 o'clock. The telephone number is 52.20.33. I first saw John Holdridge, one of the two Deputy Chiefs of Mission (DCM)—the other is Jenkins. I did not ask to see Ambassador Bruce. After introducing myself and having a 20–minute conversation on general aspects of China/US relations, I asked to see Bill Rope, who is the second man in the liason office economic branch. My purpose in visiting the office was 1) to make contact for the future, 2) to speak with the commercial affairs officials regarding my curiosity about how to do business in China. I told Bill Rope that I believed the Chinese were very frank in showing copies of machines (as I had seen a copy of the Philips nitrogen liquefier), and he recounted the story of a textile machine manufacturer being taken to a factory where he saw his machine working away, together with six others of identical manufacture and even made in the same color! The Chinese "attended as observers the 'World Intellectual Property Organization, WIPO' " and they may be considering joining the International Patent Conventions. ** Confidential paper available in the Commerce Department or in State **

Although there are a few joint stock–shipping companies (15 Polish citizens in Shanghai), there appears to be no possibility of manufacturing in China. Regarding off–shore oil development on which they want to make progress for both domestic consumption and for its value in foreign exchange, they have imported some rigs from Romania, and they have talked with a very large number of US oil firms. They bought off–shore shallow water rigs, and they are talking with western firms probably because the cost and difficulty of deep water drilling is so high.

One reason for the regionalization is that one "can't plan the whole country—it's too big." Another possibility is that in order to hold the country together politically, each region must see benefits for itself, not simply "more steel development in the northeast." In Taiwan also there is substantial dispersion of government operation for similar reasons, but the country is much smaller and they have not dispersed manufacturing to any large extent.

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4/3/74 evening—dinner party with Mr. Lo P'ei–lin, etc. We discussed engineering education, particularly electronics. ** I promised to send the "Man–Made World" text and materials in which he expressed interest. Also a selection of publications which they might have but which I thought might be of particular interest to them. ** They emphasized the concept of three–in–one (workers, technicians, leading cadres), also can be construed as production, scientific research, and users.

There was considerable interest in mechanical translation of Chinese to English (raised by them!). I gave the current status of the question as determined by a review about two years ago, and I promised to send them the papers of the National Academy of Sciences on this subject from approximately 1972 and 1962. ** Send these papers on mechanical translation. **

They raised the question of computer recognition of Chinese characters (Han ze). I hinted that our computers speak Han ze very well for output (in some cases), but I asked why they wanted to recognize Han ze; for input via handwritten characters? And this turned out to be the case. I then explained the progression of difficulty in existing character–recognition machines for alpha–numeric characters: 1) stylized font, like OCR A and B, made primarily for recognition by machine and only secondarily for reading by humans, 2) specialization of the reader to a single font, 3) multifont recognition, but confined to printed material, 4) handwritten character and alpha–numeric recognition.

I noted that in general, programming input to computers was a very restricted language, and I doubted that it would be either feasible or desirable to have a computer try to recognize handwritten Han ze for this purpose. Since everybody in China is learning Pinyin anyhow, I thought that Pinyin would be far better for programming. Furthermore, I pointed out that any work on character recognition of Han ze done in the United States would have been directed toward the recognition of printed characters, since our interest would have been in translating technical literature. End of dinner party.

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4/4/74 a.m. —Peking University—Met by Chou P'ei–yuan, Vice–Chairman of the Revolutionary Committee of Peking University; Mr. Pan, computing technology student; Mr. Chang, computing technology student; Mr Jiao, staff of the administrative office; and Miss Li, same. Chou proposed to give us a history of the University and of the educational revolution. Then we would visit the Physics department and the drug factory belonging to the University.

Educational revolution is perhaps similar to that of other universities. Peking University was built 1898 and is 70 years old. It is a comprehensive university with 20 departments and 70 specialties in arts, sciences, and foreign languages. It has 2,300 teachers. We like to recall that in 1918 and 1920, Chairman Mao studied Marxism, Leninism here. Peking University was also the location of the May 4 (1919) movement against imperialism and feudalism (the beginning of the revolution and of democracy).

Postliberation there has been much development. The area of buildings is now three times, and the number of teachers, ten times preliberation. The number of students graduated is also much greater.

Since GPCR, there have been important changes. Chairman Mao has a lot of instructions to change the old school system. In 1957 he taught us "Education must serve proletarian politics and must be combined with productive labor." But Liu Shao–chi desperately preserved the old educational system. So Liu Shao–chi supported the revisionist line of education in the University. Because of the influence of the Liu Shao–chi revisionist line we could not carry out very well Chairman Mao's educational line. The revisionist line is to educate the students to be an intellectual elite rather than to serve the masses.

During GPCR, workers, peasants, PLA men formed a team to run the University, and so began the change. In 1969 an all–round educational reform was begun. According to Chairman Mao's educational principles, we have been carrying out educational reform, changing the procedure for selecting students, also the educational system and the teaching method. We have also shortened the period of education.

In the fall of 1970 we resumed admission of students. We have enrolled a total of 5,600 students in the period 1970–1973 inclusive. All the students enrolled in the last two years have a certain level of socialist consciousness, culture, and practical experience.

This last spring, the first of the new type of students have graduated from the University. The facts prove that workers, peasants, soldier students are better in political consciousness and have great capability to solve problems. Students in the science department received an all–around training before graduation. Of the entering students, there are more with junior middle school than with senior middle school graduation experience. So the University has prepared a complementary course of about one half year, (but its length depends on the preparation of the student) in order to prepare them for the University work.

Since GPCR we have carried out more than 400 items of scientific research work according to needs of the country, of which more than one hundred have reached an advanced level in our country, and many have been adopted in the construction of our country.

For example, students of chemistry before graduation participated in improving the catalytic production of polymeric fabric from petroleum waste. In order to transform waste into polymers, there was a need for a catalytic agent to promote the reaction, and this element has been manufactured by this group. They maintained a "continuous vigil" for life tests. Eventually they wrote a report, which was published at a meeting of the fuel–and–chemistry industry organization.

Another example—some of the departments of science have already built "school–managed factories," including a pharmaceutical and radio–and–electronic instrument factory. In collaboration with other factories, the electronic instrument factory has already made a computer with about one million operations per second. Students of computer technology specialty have also participated, using theoretical knowledge gained at the University, in the development, final testing, and alignment of the system. In this practical work, they got a lot of opportunities to increase their knowledge in practice and theory.

Some prepared very good proposals to improve the computer during the testing and alignment work.

In contrast to this good result, the students before GPCR, although studying for six years in theoretical aspects of science, seldom had contact with the practical side. These two circumstances lead to different outcomes. The examples are from the scientific departments of the University.

For the literary departments, we use "whole society" as our factory (or our class). It is necessary to study not only from books, but also from society. We must make research and investigation work in society—we must do research and practical work for three years.

During three years, the students have been to more than 160 communes, factories, stores, etc., to carry out their study.

Q—How many stores, etc., does each student visit? It depends on the concrete circumstances—each has enough opportunities to go to communes, factories, department stores, and the like, to complete his studies.

Q—Since the study of population growth is so important to China, do some of the students go out into the field to see what the actual population growth is, to see whether urging of the party and of the government is in fact being followed? We have not this kind of specialty. The state places great emphasis on planned birth, and it is "strictly enforced."

Another example—students of economics if engaged in studying socialist economics can go to some factories, if agriculture can go to the countryside.

The time he goes will be determined by the concrete needs of his studies—a short or long time. Because of the emphasis of studies of literary science departments is theory and practice of Chinese Revolution, there is a particular need to study practice. During the great movement to critize Lin Piao and Confucius, 1,600 teachers and students have gone to the countryside and factories to participate with workers and peasants.

Before graduation of the first batch of worker–peasant–soldier students, we gave a comprehensive training. They wrote more than 1,700 papers in several months, several hundred have been published in addition to twenty–five books. One is a book "Critical Notes on Lun U (the Confucian analect)." Confucius was a philosopher, a servant of the slave owners. The work mentioned above is a collection of his works and deeds. Throughout history, the reactionaries took Lun U as the bible is taken by Christianity. Throughout the history of our country, people only expanded the Lun U, and none made any criticism.

During this great struggle, the students of the Philosophy Department determined to make critical notes on Lun U to let people know more clearly the nature of Confucius. In less than one month, the students gathered materials. (Lun U is a collection of 500 items, totaling 15,000 words). The students wrote a 200,000 word manuscript of explanation and criticism. After producing a draft, they printed it by handwriting and distributed it to the broad masses of worker and peasants, and corrected their criticism.

An old professor, Fun Yu–lam, has been studying Chinese philosophy for many years. He is 79 years old. After reading these critical notes by the students, he said he regarded this as "a great achievement for students who had not read much Chinese ancient literature, and in such a short time was without precedent."

We consider that using this method—intimate combination of the theory and practice—allows students to increase their ability to participate in class struggle, struggle for production, and scientific experiment.

So immediately after graduation the student can go directly into the revolutionary work.

In general the students study now for three years, but in some particular specialties, considering the theoretical nature of the work, we have a four–year program.

Before GPCR, literary science took five years, physical science took six years, and the present system is clearly shorter. We have just begun the educational revolution, and are still in the stage of experiment. There must be problems and struggles ahead. The present movement to criticize Lin Piao and Confucius will definitely have a great influence on the educational revolution and will further invigorate our thinking.

Criticizing the ideas of restoration and religion would

Visit to the Radio Physics Department (building built 1960 and houses Radio Physics, and Geophysics).

This workshop makes SCR's of 200 ampere and about 1,000 volt PIV. about 10 microseconds shut–off time. A machine labeled SP–80 was doing ultrasonic bonding. There are five furnaces under automatic control, using automatic potentiometers (or perhaps indicating meters) with set points. They automatically *hold* only, and are not programmed vs. time. They diffuse phosphorous and boron, and deposit aluminum for metallurgy. The SCR seals are of two types—silicone rubber and a resin.

Visit to Physics Workshop. Here we saw manual core testing of the type seen at the "door handle factory" in Shanghai. Also a thin film experiment to measure the anisotropy of the metal film for flat film memory, using a quartz fiber balance. This is an *instructional* laboratory, as are they all, and will provide a base for integration into a permeability–tensor measurement.

Visit to laboratory producing semiconducting lasers of GaAs. The process requires three temperatures in two ranges: 1250° C, 650° C, and 1100° C. The temperatures are controlled by a home–built automatic control using optical pyrometer. The GaAs lasing threshold is 10^4 ampere per square centimeter, and they use 200 microsecond pulses of 5,000 prf ?? Saw expitaxial growth capability for GaAs.

Visited the helium liquefier producing 4 liters per hour and which first operated in 1970. The piston has a stainless steel core and fiber cloth and resin covering. Saw measurements on superconducting material—particularly Nb_3Sn. Saw two examples of the Philips type liquefier made in Hangzhou, producing 5 liters per hour each of liquid nitrogen. In addition to Nb_3Sn, they also have Nb–Ti alloy. I saw an experiment in which they were working with the Josephson effect as a voltage standard.

A visit to the *drug factory*. This combines "organic chemistry and biochemistry." The first room made two kinds of drugs—an antiparasite drug, and a drug for *raising* blood pressure (for treatment of shock). They combined the factory with the teaching of organic chemistry. They try their best to let the students combine their theory with practice.

Another room was concerned with the preparation of a fast acting anesthetic ("injectio ketamine"). Its feature is that it counters *pain* only, without disturbing other senses. They were also manufacturing an antibiotic which is used especially for treatment of large areas of burns.

Before, "teachers could use their lips and not their hands."

At the exit of the drug factory we passed a display containing the various products among which was "coenzymes complex (injection)." Also pig pancreas insulin. Professor Chou said that "all diabetic patients in Peking use this insulin made by our factory." Also cytochrome C 0.75 —emergency treatment (for lack of oxygen).

On the way back to the meeting room, Professor Chou said that they had seven factories and more than twenty workshops and derived a large amount of profit especially from the drug workshop. In fact "one–third of the University expenses are paid from the factories."

Discussion: Is there a further opportunity for training (in order to serve by deeper scientific research)? A—not yet involved in graduate studies. The main job is to carry out the revolution in the undergraduate body. We'll consider graduate students in days to come. It is quite hard work to carry out the revolution among undergraduates.

So far as scientific research is concerned, our students have already taken part in scientific research before they graduated. We have visited the drug factory today where research, instruction, production are well integrated. The purpose is to train students to have the ability to analyze and to solve problems—the main content of our scientific research has been to analyze and to solve problems.

The present graduating students now have a higher level of such ability than previously.

Before GPCR, Chinese education was copied from the Soviet Union. Formerly Chinese universities were very much influenced by Feudalism and Capitalism. In 1952 they reorganized completely and took over everything from the Soviet Union, so revisionist influence was very great. The purpose of Soviet Union education is to train scholars (Ochornyi). The intellectual elite is a basis for revisionism. In six years of study, the student had to read many books and became divorced from practice.

The educational revolution is intended to .... morally, intellectual, physically, with socialist consciousness.

At this point I made the proposal regarding more communication. I said that we would very much like to create a continuing conversation between Americans and Chinese scientists and that we would like to do this bilaterally between the two countries; that such an exchange could develop in depth over a long term, and that it would be on the American side a *national* group and not entirely a group from any locality. I said that Stanford University as a core would be very attractive, with John Lewis and Panofsky. Furthermore, Carl Djerassi would be an important participant with his work in birth control, insect hormones, pheromones, etc. Furthermore, Stanford is a center of computer technology and that could serve as the topic of one of the early conferences. The idea would be to have initially some topical conferences and we would add to the core group of scientists interested in that conference, others with peripheral interests, some of them in policy questions.

CPY's reaction to the Stanford proposal: "We have various kinds of exchanges—e.g., Chinese People's Friendship Association towards Foreign Countries; People's Institute; also Science and Technology Association for the CPR; also Academy of Sciences which can make contact with foreign countries which have already established diplomatic relations with us; also a lot of societies of sciences—e.g., China Electronics Society which is responsible for your visit; Chinese Physical Society; Chinese Chemical Society.

These societies are under the leadership of the All China Science and Technology Association of the PRC. It is sometimes possible for us to invite some foreign guests to universities.

I said that on our side we could probably get support from one of the foundations and that would probably not be a problem.

CPY went on that "There have been some concrete difficulties so far—1) our country is a developing one with insufficient material conditions—e.g., hotel problem (Peking Hotel under construction) would like to build some more. 2) Technical and Engineering personnel are busy so it takes a lot of effort to collect so many people from all over the country—it takes some time. The educational revolution has just begun; so also scientific research work has just begun.

I countered with the view that there is already much that the US can learn from China. For example, the *facts* of acupuncture anesthesia are important, because many of our scientists are concerned about the *theory* to the extent of ignoring the plain facts which are available in China. On the other hand, the Chinese could benefit from the US status in computer technology; and we don't have to wait until each of us moves out of the experimental area for the two of us to benefit from such close and continuing exchanges.

CPY continued. "We are also for the exchange in the field of science and technology. According to Chairman Mao (approximately) one should "make use of the foreign to serve the Chinese." Undoubtedly, we are for exchange. By means of exchange in the scientific field we will learn from each other. Nowadays, especially the last two or three years, the exchange between the peoples of our countries has increased a lot and will be increased much further.

At this point we went on to a conversation about the structure of the Revolutionary Committee which manages Peking University. CPY stated that the subject had several parts: Some members belong to the workers–PLA–Mao–Tsetung–thought propaganda team which entered Peking University in 1968, that is, some members are workers, etc. Of this part there is one PLA man as well as workers. The workers come from factories outside the University. Also there are representatives of the workers from the campus. Also cadres at the University level and the department level, teachers, young and old professors, also some student members, also *relatives* of cadre and teaching and staff (male and female—but this time female). The total number of members of the Revolutionary Committee is 39. So far as the composition is concerned, the same is true of the composition of the department committees (which average 20 to 30 in size) depending on the size of department. The Physics Department has more than 20 members.

The Revolutionary Committee works under the principle of collective leadership—a triple combination of aged, middle-aged, and young. The principle of three–in–one is *one* of the most important teachings of Chairman Mao, put forward during GPCR. Considering the necessity of continuation of the revolutionary course, we must nourish the young generation with the rich experience of the old. In our country, people pay great attention at all levels to *this* three–in–one principle.

In teaching there is the other three–in–one—teaching, production, scientific research. In factories, there is another three–in–one—workers, technical personnel, and cadres (this came from the An Shan Steel Works).

Of the 39 Revolutionary Committee members, how many change each year? A—according to needs. For instance, if students are near graduation, they are changed. In case of reassignment of some teachers or cadres, they are changed. Our Revolutionary Committee members are selected by the large masses. When the propaganda team came in August 1968, after a year of their leadership, candidates were first *nominated* by masses of the University. The propaganda team then discussed the nominations and sent some names back to the masses. Finally, the Revolutionary Committee was approved by the members of the Peking Municipal Revolutionary Committee. Thus, there were two–to–three weeks of discussion and consultation.

The process of the selection of the Revolutionary Committee is characteristic of the People's Democratic process. It involves centralization, then discussion, then centralization, then discussion, and then finally centralization. When a candidate was put forward, the masses could propose their opinion before the candidate is selected—if they give objections, we must change the candidate. The propaganda team broke up [presumably (RLG) into twos] and went to various levels of the masses and individuals could talk with them. It may be more convenient for people to show their opinion or objections when a member of the propaganda team has come to him. In a big meeting, a person may be reluctant to express his objection but with two people talking to two people (or maybe one–on–one), he will; and the propaganda team member has to find out whether the objection is true.

This opinion, as well as the name of the person, will be kept secret in order to protect him. Also, leadership of the Revolutionary Committee must listen to the broad masses of people—must analyze and research to determine whether opinions are right or not. Not only in our University but in all levels of government this course from discussion to centralization operates.

Of the Revolutionary Committee there is a standing committee of 13 members, which meets and deals with important affairs. It meets often to discuss University affairs. For major questions, it must hold an overall meeting of the Revolutionary Committee—like building of a new library. Not only is this discussed in the general meeting, but they have to apply to the Revolutionary Committee of Peking Municipal government. The project must be approved by the government.

RLG (when meeting was obviously drawing to an end) "I hope that we have a chance to discuss further the questions of mutual interest."

CPY: "We *will* have a chance to discuss further these questions of mutual interest." (And in fact a dinner party materialized for 4/5/74 with Dr. and Mrs. Chou P'ei–yuan as host.)

At some time during Chou's discussion of the difficulties and costs to China of organizing such a continuing conversation with Americans, I pointed out that the costs really were the same to those of us who were involved on the American side, and that in both cases it was a matter of priorities—for China it was a matter whether they would use 10 or 12 hotel spaces a couple times a year to accommodate this group or to accommodate some other people. And I suggested that if the participants had some continuity, then we would know one another better as time went on and less effort need be spent in preliminaries and in organization.

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4/4/74 p.m. Atomic Research Institute of Academy of Sciences (southwest of Peking—about one hour's drive). Met by Mr. Li I and staff, who welcomed us and asked how long we had been in Peking. The main purpose of the Institute is to do basic research in nuclear physics. It has more than 1,000 persons, 40 of them graduates of universities or colleges. One third of the staff are workers and one fourth are women. There is one reactor, a cyclotron laboratory, an accelerator laboratory, a neutron physics laboratory, a nuclear reactions laboratory, a theoretical physics laboratory, a radio isotope production laboratory, a stable isotope laboratory, electronics and detector techniques laboratory. There are auxiliary units of equipment supply and health physics and a library.

The High Energy Physics Department is not here—it is in the city, and it is theoretical high energy physics. As for experimental high energy physics, there is a cosmic ray station in Yunan Province.

Our staffs according to plan go to the May 7th School to study and to take part in manual labor and to study Marxism/Leninism and Mao Tsetung thought.

Before liberation there was no atomic energy research in China. After liberation, the party and Chairman Mao paid more attention to this kind of work. Not long after liberation, the Academy of Sciences was founded and Nuclear Research Physics Institute received its present name. Our Institute was founded in 1958. There is a heavy water research reactor in the Institute, a cyclotron and Van de Graeff accelerator. There are two electromagnetic separators for stable isotopes. All of this equipment mentioned was bought from the Soviet Union in about 1958. They were very expensive. And this was "selfless and fraternal help!" They didn't allow us to make any changes (at that time). In about 1960, the Krushchev traitor clique was very notorious and broke the existing agreements and withdrew their experts. We had temporary difficulties then, but following Chairman Mao's teaching on self–reliance and mass struggle, avoiding superstition and (trying for an) emancipated mind, we overcame these difficulties and made a series of technical improvements. For instance, the original scheme for production of radio–isotopes in the heavy water research reactor was of very bad design, and we have improved it.

Before the 1955 International Conference on Peaceful Uses of Atomic Energy, nuclear science was kept secret and there were very many difficulties for development—e.g., buying a counter tube abroad (when we already had the money). Under the guidance of Chairman Mao's teaching on self–reliance, we started from the beginning and made it ourselves.

After the Soviet revisionists withdrew their experts, we quickly mastered the techniques of nuclear science. In visiting the laboratories you can see more for yourself.

In a word, we have done a certain amount of work but are far from satisfying the needs of our party and people. And there is a certain gap between our work and the advanced level of advanced countries. So it will be good for us to have foreign guests visit and to make their comments.

Is the accelerator lab concerned with the design of new accelerators or only with the Van de Graeff? We have changed the cyclotron to a variable energy machine. But so far there is no such group to design new accelerators.

(Each of the following sections quotes a spokesman for that portion of the Institute.)

Research Reactor. The 7–megawatt design power has been raised to 10 megawatts. Improvements have been made in maintenance and shutdown, also in the training time. The fuel is 2–enrichment uranium metal in hollow cylinders of 112 millimeter length, 2–millimeter wall thickness, clad with 0.8 millimeters of aluminum (I don't have the diameter of the cylinders).

Previously the reactor used a complex helium gas circulation system in order to carry the radiolytically decomposed hydrogen and oxygen to a catalytic recombiner. The helium flow used to be 160 cubic meters per hour. Now the machine uses an ion exchange resin to purify the heavy water, and they find that they need not circulate the helium at all—the radiolytic decomposition of the water is negligible! There are 34 vertical and seven radial channels through the reactor for experimental purposes. The central flux is 1.2×10^{14} neutrons per square centimeter per second. Initially the reactor was started up manually, but now all one needs to do is to push the button, and the reactor achieves the desired power all by itself. The fuel elements are replaced twice per year and are rotated from the center toward the outside. The automatic start up takes 40 minutes, including the preparation. For emergency shut down, there is equipment to drain the heavy water.

There are six fast neutron holes and one thermal column. We can *now* put in and remove radioisotopes remotely with automatic equipment now in operation in the upper water shielding tank. According to the design, it was necessary to shut down the reactor in order to remove the radioisotopes produced.

There is a remotely–operated crane for remote replacement of fuel elements. The fuel elements are not removed from the reactor shielding—they are stored in the upper water shielding tanks.

There is a rectification column for heavy water, made by our lab. Its purpose is to reenrich the water drained from the reactor. We can start with 80 or 90 D2O and bring it to 99.8 . We use electrolysis for the 90 to 99.8 step, and the rectification column for enriching from 80 to 90 . The tower can handle 5 tons of D2O per year.

Neutron crystal spectrometer. It was built during the great leap forward in 1958 and is used for neutron cross–section measurements, for instance transmission measurements of total cross–section, also fission cross–section measurements, resonance–parameter analysis, etc. In 1960 we observed that the beam diffracted by a quartz crystal was increased remarkably in diffraction intensity (6 times) when the crystal was set into vibration. Also, the half width remained the same. We are now analyzing alpha–phase lithium iodate (LiIO3). There are three possible explanations: 1) Doppler effect, 2) aberration effects, 3) during vibration the crystal planes can produce a change in diffraction angle (strain in the crystal). The crystal is vibrated at about 360 MHz, and the diffracted intensity increases with amplitude of vibration up to levels where the crystal shatters.

Neutron spectrometer. This other spectrometer is built around an antiaircraft gun bearing and is accurate to about 6 seconds of arc. It was built in 1960 and uses a BF3 (enriched) slow neutron counter. They use a germanium filter to eliminate secondary effects and increase the intensity.

Solid state nuclear track detectors. They have made many detectors here of various materials—muscovite mica; polycarbonate films; phosphate glass; cellulose nitrate. The polycarbonate film is a threshold detector for neutrons with energy exceeding 0.3 MeV (detection by carbon and oxygen recoil).

Cyclotron lab. We imported a fixed–frequency, 1.2 meter diameter cyclotron in 1958 which could accelerate deuterons to 12 MeV and alpha particles to 24 MeV. During GPCR reconstructed the cyclotron to a sector–focussed isochronous cyclotron with variable energy. It now gives 5,9,14 MeV deuterons or 7,9,or 17 MeV protons. The rf input power is 120 kilowatts, the fractional energy spread of the beam is 2 , and the beam is brought out via an electrostatic deflector. Beam current is normally 80 microamperes.

Neutron physics experimental lab. Here fast neutron work is done using a time–of–flight spectrometer. Following Chairman Mao's teachings on self–reliance, most of the equipment is made at home by ourselves. Originally, we used the natural burst modulation of the cyclotron with a resolution of 3 to 5 nanoseconds. Now with variable energy, because the cyclotron is not stable, we are still adjusting the spectrometer. We are doing 1.7 MeV neutron inelastic–scattering spectra. At 4.7 MeV we are determining values of the excitation energy of the nuclei of Li6, Li7, C, Fe, etc. Also structure of the *secondary* neutrons in beryllium from 5.4 MeV incident neutrons. (Incident neutrons from the lithium p–T reaction). The time resolution is still 3–5 nanoseconds, and the detector is a stilbene crystal. There is no plan to use a plastic scintillator, but a liquid scintillator "will be used in the near future."

Charged–particle induced induced reactions. The beam is monitored by a Faraday cage, and work is being done on d–O, or d–C reactions. We use a gold–silicon solid state detector with time of flight analysis over 1.5 meters. We use a combination of energy in the detector *and* time of flight. The target for carbon is a carbon film and for oxygen is MoO_3 on a carbon film.

The electromagnetic isotope separators. These were brought into operation in 1965 and 1970. Thus far we have separated rubidium, strontium, chromium, tin, etc.—12 elements and 50 isotopes all told. The machines cost 5 million RMB (about 2.5 million dollars). According to the 1958 agreement, the Soviet Union was supposed to *complete* the system—"but they sent only the magnet and the vacuum tank, not the ion source and pumps, etc." So we had to make all these ourselves. The smaller separator is 62 kilowatts of magnet power, 220 tons, 6,000 gauss, and has a 350 millimeter gap. The machine is now separating Yb. Ytterbium 168 has medicinal uses. The ion trajectory radius is 1,000 millimeters, so that 1 mass difference is 10 millimeters separation.

The larger separator is 280 tons, 1,700 millimeter radius of curvature and consumes 75 kilowatts. The large diffusion pump is made in China and pumps 7,500 liters per second—it can reach a pressure of 10^{-6} torr in 40 to 50 minutes after the tank is at atmospheric pressure. The ion current is about 100 milliamperes for the ytterbium. For alkali metals, we use surface ionization.

Van de Graeff accelerator. Bought from the Soviet Union in 1959. According to the contract, the Soviet Union shall be responsible, but the Soviet Union tore up the contract, so we installed and adjusted the machine ourselves and had it running in 1963. Initially it was a machine with energy from 1 to 2.5 MeV, but through our adjustment we can now operate it from 0.2 to 2.5 MeV. Beam current of 1 to 10 microamperes has now increased to 20 to 30 microamperes (50 microamperes max.). Fractional energy spread 0.1%. The ion sources are high–frequency ion source, and the belt is rubberized cotton with life of about 500 hours. The insulating gas is a mixture of nitrogen and CO_2 at 11 atmospheres total pressure.

We study charged–particle nuclear reactions and are using a new type of charged particle spectrometer. We use a small magnet together with a semiconducting detector (in order to deflect away perhaps much more intense particle groups than the ones which are intended to be studied). We began to use the semiconductor detector in 1970—it has 20 millimeter diameter. We are studying low Q value reactions. For instance with d on C, there is only one group of protons with positive Q value. We are studying the excitation function and angular distribution. We are also studying the interference between stripping and compound nucleus reactions.

Detector display. These detectors were all made after liberation. Under the guidance of Chairman Mao's teaching of self–reliance and hard struggle, established laboratories by our own efforts and trained personnel and made all the detectors. We can satisfy the requirements of the nuclear and neutron experimenters in our laboratories.

There are four types of detectors—gas, scintillation, semiconducting, and photoelectric tube detectors. For instance, we have a hydrogen–bearing proportional tube. We have sodium iodide and cesium iodide crystals. Also stilbene crystals. Also lithium–drifted germanium; gold–silicon (mesa barrier); cadmium telluride CdTe; plastic scintillators. All these detectors were on display.

Discussion. Is the interesting question of diffraction intensity from vibrating crystals being worked on in other countries? Not in 1960, and since then we have heard of it but seen no final explanation.

4/5/74 a.m. Talk by RLG at the International Club of Peking to an audience of about 200 on three computer–related subjects: 1) My views on near term–developments of computers in the United States, 2) Experiences with successive generations of computers at the IBM Research Center at Yorktown Heights, 3) Some comments on developments in computers in China. My talk was presided by Mr. Yen P'ei-lin, and there were half–a–dozen questions afterwards, but with the promise of a discussion with a smaller group the next morning.

4/5/74 p.m. Visit to Peking Institute for Computer Technology. General introduction by Mr. Yen P'ei–Lin: The Institute is part of the Academy of Sciences and its name is "Computing Research Institute of the Academy of Sciences." Began to organize the Institute at the end of 1956. Its main tasks are 1) research and manufacture of computers (all general purpose and mainly scientific computers); 2) a lot of mathematical researchers here—we do some computing and some mathematical research of our own; also help solve problems for other departments. The computers are here for our own use and to solve problems of others.

Re computer development and computers used, we have had several generations—vacuum tubes beginning in 1959 at which time we began to research the transistorized computer. Then in the middle 60's (say 1964) we finished our first transistorized computer. Since 1968 we have had integrated circuits on the Chinese market, and we began to look at an integrated circuit computer which we put into operation in 1971.

So you will visit two computers "which we use ourselves." The transistorized computer (109C) began operation in 1967. The cultural revolution began in 1966, so our workers and researchers here worked very hard according to Chairman Mao's teachings and made that computer during the cultural revolution. Generally speaking, the speed is 115,000 operations per second. It has 32,000 words of internal storage, and you will receive detailed information from Mr. Chien.

The other integrated circuit computer (type 111) began operation in 1971. Its design and manufacture was begun during the cultural revolution (1968 to 1971). It has a floating point mode (180,000 operations per second (OPS)) and a fixed point mode (400,000 OPS). Mr. Chien, the responsible member, will give details: Mr. Chien—For outside users, if they have no computer and need one for a certain problem, they can use our computer themselves, *or* they can use our mathematical researchers here to calculate their problems, which extend over a wide range—scientific research in chemistry, physics, atomic energy, meteorology, astronomy, etc.; construction—civil engineering design, bridges, water dams, reservoirs, machines.

Mr. Chien continued: *The 109C* began operation in 1967, the second year of the cultural revolution. Therefore, our workers and staff at the Institute according to Chairman Mao's teaching grasped the revolution and worked very hard to make this computer. All components are manufactured in our country. So the operation speed is 115,000 OPS; word length 48 bits; floating point; single address; several internal storages—32,000 words of ferrite core storage with a cycle time of 6 microseconds; (this is the data store, the first type of storage).

The second type of storage is 4,096 words of 48–bit storage for instructions of 24–bit length. So 8,192 instructions can be stored. The main purpose of the instructions storage is to store instructions, but we can use it also to store data. *Cannot* use the data store to store instructions. (The purpose of these two types of storage is to increase the instruction speed.) A third store is also used—a read-only store of the inductive type, with permalloy core. This stores 6,144 words and is used for subroutines and management routines "in a higher level language."

There are *no* data registers, but there are 128 index registers of 18 bits and 2 microsecond cycle time).

Peripheral equipment: Four drums with 32,000 words per drum. The drum cylinder is on a vertical axis, and there are 276 floating heads (self–floated). There are four magnetic tapes, each of 260,000 words. Sixteen tracks across a one–inch wide tape. The data is stored using a Hamming code at a longitudinal density of 20 bits per millimeter (500 per inch). The format of tracks of storage on the tape is as follows—three tracks for synchronization; five tracks for Hamming code, eight bits of data. Therefore, six lines per word are necessary.

There is a dual photoelectric input machine for reading punched tape. For output there are four line printers with 72 positions per line and a 64–character alpha–numeric font. The characters are the digits from 0 to 9, 26 characters of "Pinyin" (the Roman alphabet) some special signs like plus, minus, less than, etc. The speed is 7.5 lines per second.

The computer works 24 hours per day.

The integrated circuit computer, type 111, has one gate per chip, 15,000 chips. Its word length is also 48 bits, and it has a memory with 2 microsecond cycle time and 32,000 words of storage (2 1/2 D organization). The storage is divided into two parts—data and instruction store, of 16,000 words each. There are 16 x 4,096 bits per core plane. We can put data into the instruction store; can also put short word instructions into the data store. We do this for a purpose of overlap, and we access data and instruction simultaneously. Also there is a 4,096 word buffer store with 6 microseconds cycle time to buffer the drum (some confusion here) "for common use with diplay equipment" (CRT). There is an index store of 256 words, 660 nanosecond cycle time and 18 bit length. The technology here is thin magnetic film. We plan to add a read–only store of 16K words and 2 microsecond cycle time.

Peripherals. One drum with 64K words. The data format on the drum is 48 bits broken up into 4 segments of 12 bits, each of which has a parity bit. We plan to add another drum.

The IC mounting technology uses a four–layer board. There are two mag tapes of 500,000 words each. The data format for the 16 tracks across a one inch tape is different from the other machine "we use two–out–of–three"—that is we store the data three times, and if two of the words agree as read we count that as the correct interpretation. Of the three identical words stored, four bits of each are stored on four tracks across the tape. Three tracks are used for sync and one bit for "area sign" (to help find the right address). Thus a single word takes 12 lines across the tape. The storage density here is also 20 per millimeter. There is no internal checking in the machine, but there is also a longitudinal check on the tape. There is also a dual paper tape input of the same type as the other machine. We *plan* to install a paper tape output. There are two line printers as before and a CRT alpha–numeric display. The display is used for a monitor. It uses a vertical wiggle to display characters in successive lines on the screen.

Software will be discussed by Mr. Tang:— There is only one programming language on the 109C. We call it "BCY," which means Compiling Language—ALGOL-like, but with some differences: There is no "own" variable; there is no "type declaration," and it is all floating point.

It has four additions to ALGOL. We can do operations on a binary stream, e.g., Boolean sum and product on a binary stream. BCY is a three–pass compiler—scan, translate, code generation. Some of its features are redundant–expression elimination and local optimization. "Parsing is done by the top–down method." Local optimization is like the "subscripted variable by Hill." Assembly language is rarely used (because it is poorly written). BCY has been in use since 1967.

What is the distribution of computer time between compiling and operation? No good answer, but 1,000 instructions of object code take "many seconds to compile." What kind of error messages are there? Many kinds, and a pre–processor handles this (before the first pass) for error recovery.

For the 111 machine there is only one assembly language finished, and BCY is in preparation. Also FORTRAN is in preparation(!), or rather a mixture of FORTRAN with some PL–1 operations. We choose a nesting structure and block structure, but we don't know when it will run. We are interested in FORTRAN because it is easier to optimize the object code; also subroutines are easier.

Does the separation of instructions and data make the computer less than a general purpose computer? Are there other machines of this type manufactured? The 109C is in large scale production, but there is only this one type 111. What kind of standard programs are there? There are elementary functions—sine, logs, etc. No good answer as to what kind of approximation methods are used "because none of the mathematics researchers were at the table." Are there other organizations doing work on FORTRAN? "Some others have just begun to do research in FORTRAN."

What is the period between unplanned maintenance occurences on the 109C? Several tens of hours—"some of the errors are very small—mostly some spare parts."

4/5/74 evening. Dinner party at Cheng Du Resturant in Peking. Dr. and Mrs. Garwin are guests of Dr. and Mrs. Chou P'ei–yuan. Other guests are Chang Wen–Yu, Lo P'ei–lin, Yen P'ei–lin, our interpreter Mr. Kao, Mr. Chang of the China Electronics Society, Mr. Liu of the China Electronics Society, Mr. Pan of the CES. A photographer is present from Hsinhua News (New China News Agency) who took pictures throughout the evening and sat with us at the table.

Chang Wen–Yu was there and was cordial. My letter to him of February 15, 1974, was "received only two weeks ago, so of course it was too late to write." This means that it took 35 days for an airmail letter from New York to Peking!

Regarding Chang Wen–yu, I had the following charge from Panofsky:

1) Give certain materials to CW–Y: namely, color photograph of the Grand Canyon, letter from Panofsky; report of 1973 summer school at SLAC, status of PEP.

2) Determine status of invitation of Panofsky to China (perhaps Weisskopf and Pief can go, or Weisskopf and John Adams, or Weisskopf and Kjel Johnson).

3) State the complete offer to the Chinese to participate in US high energy physics—especially at SLAC—but *anywhere*.

4) Kind of participation can be a conference; or the next greater involvement would be a one to two–week meeting; or the next greater would be to join a *team* for the use of one of the accelerators; or the next greater would be to propose and do experiments on a US accelerator. All these are small investments compared with that required to design and build a machine in China.

5) Finally, ask status of considerations of high energy physics involvement in China.

I delivered the materials *at* the party and there was much thanks from CW–Y. They do expect Weisskopf and Pief—I explained Pief's obligations as president of the American Physical Society and indicated that he would indeed have to come at the time which will have been arranged, and not have indefinite postponements. They will communicate with Pief. There is no decision on a high–energy accelerator, and I didn't have a chance to talk much about it.

On hearing that Lois and I were from Cleveland, Chou P'ei–yuan gave us some interesting comment about Mr. and Mrs. Cyrus Eaton, whom he met at the first two Pugwash meetings. Then he chatted with me about the status of detection of gravity waves, about singularities in general relativity, and about Brans–Dicke.

Regarding the Soviet Union, Chou initiated this subject and said that Krushchev tore up all the contracts in 1960. The Soviet Union is *not* a Socialist Country. The Director of Moscow University and the Professors make 200 times as much monthly as does a worker!! *And* their children find it easier to go to the university, thus perpetuating the power of the intelligentsia, which rules the Soviet Union (together with the bureaucrats whom he lumps with the intelligentsia).

Had I been to the Soviet Union? Yes, in 1969 to a Pugwash meeting, and later to take part in some US–USSR bilateral (non–official) talks on arms control. Chou thought perhaps I had been involved in management of the scientific and technical exchange with the Soviet Union, but I said that I had not been.

He went on to say that the Soviet Union is a *begger* begging technology from the US and Japan, begging investment, while building warships to sail the world. China on the other hand, as a Socialist country, has no interest in expansion—only in improving agriculture and industry within China. Why does not the Soviet Union use its military expenditures to solve its internal problems?—Why don't *they* depend on self–reliance?

RLG—I believe that the security of the US and of the world would be increased by *reduced* military forces—e.g., by one third as many ICBM's and other strategic weapons within the Soviet Union and within the United States (and I have been trying for 15 years to persuade the US and the USSR to this point of view).

Chou—"Has the Soviet Union caught up with the US in ICBM's?"

RLG—I don't want to overemphasize the utility of nuclear weapons, but the answer is *yes* in numbers—they have 50 percent more land–based ICBM's, but in usable military might, the US is far "ahead" (if it makes any sense to call it so). By virtue of the ten MIRV's in each submarine missile (that is in each of most of 656 submarine launched missiles) and by virtue of three MIRV's in most Minutemen, the United States can deliver against military targets with every individual Poseidon warhead an explosive power several times that of the only two bombs which were used in war time, namely those against Japan; and with each Minuteman warhead more than ten times the explosive power of the 1945 nuclear weapons. So the US has much more capability. Against cities, either side has far more than enough, and the Soviet warheads are really too big to make efficient use of the carrying power of their rockets.

Chou—In 1946, Chairman Mao called nuclear weapons a paper tiger (RLG—"He has not been calling them that lately.") In 1957 at the first Pughwash meeting, I (Chou) said that Japan would have fallen without nuclear weapons because the Chinese would have destroyed the 1.5–million–member Japanese main force (by the Chinese Eighth Route Army) and America would have destroyed the Japanese fleet. Eugene Rabinowitch took me aside and lectured me for two hours that I was wrong. RLG—Perhaps you may have seen a recent article by Mitchell Wilson (perhaps a year or so ago) on the Op–Ed page of the New York Times. Mitchell Wilson is a well–known novelist, formerly a physicist, who had gone to Japan recently with the initial feeling that the actual use of the atomic bomb against Japan had been unnecessary. Much to his suprise he found no Japanese scientist who felt that Japan would have surrendered without the use of the atomic bomb or without later suffering destruction which was far worse.

Chou—We rely on mobilizing the masses and on protection via air raid shelters. We do not fear one million Russians on the border and 300,000 more in inner Mongolia. RLG—"We would like to continue this kind of discussion and share our views and experience."

I introduced the next topic by a statement that I was speaking for myself alone and that I was certainly not carrying messages from anybody in the United States government, but that I had a long involvement with these matters and a deep interest in them and that even an ordinary citizen might help in these questions.

(At this point there was a lecture by RLG along the lines of some of my testimony to the Congress about the pernicious influence of some of our leaders who say that we must not be "second" (in order to get more money and power), but then look at the military comparison with a very partial estimator—sometimes equating military research or testing on the Soviet side with a deployed or lack of deployed capability on our side. "But in any case nuclear weapons *are* powerful, e.g., one would want to prevent their accidental or unauthorized use. I don't know whether Lin Piao had access to or control over nuclear weapons when he died, but it is certainly in the interests of both the United States and the PRC to prevent the use of nuclear weapons without authorization of the political leadership. The US has special locks and procedures in regard to its nuclear weapons, and I am sure that we would like to see China make use of similar safeguards. There is every likelihood that the United States would be delighted to share such information with the Chinese in this matter.")

Chou asked me directly "Do you know how the Russians control their nuclear weapons"? RLG—"No, but in all candor I have to tell you that if I did, my answer would be the same." At this point there was some comment that this was a very frank reply. I went on, "and my reply would also be the same regarding a question involving Chinese weapons."

I then said that there were two good things Mr. Nixon has done: 1) To go to China and to begin to normalize relations between China and the United States; and 2) to take the initiative in renouncing the use, manufacture, development, and research on biological weapons. This action first as a unilateral declaration by the United States and then as an international treaty obligation, it seemed to me, considerably improves the security of both the United States and especially of China, when one considers the possible effect of wheat rust and rice blast, especially combined with nuclear weapons against the Chinese people. I said that I had served on a committee to review the question of biological weapons before Mr. Nixon made his decision and I hope that I was of some help in helping him to arrive at that position. I went on that I had been working for many years with quite a few other scientists within the government to try to have more rational views on defense and national security matters, and that we had made some progress but that the present time was not very good in Washington compared with other periods in recent history. I was asked why, but before I had to answer I was saved by a toast.

Chou—"China has said that there is the most safety for everyone in the destruction of all nuclear weapons."

RLG—"Yes, but it would have to be safeguarded because if all nations but one destroyed their weapons and that one had quite a few left, then it would have a much stronger position." For instance, the official policy of the United States is for complete and general disarmament, but that is not realistic either for the near future.

Chou—China has a no–first–use declaration regarding nuclear weapons and we were glad to see that the Federation of American Scientists agrees with us.

RLG—"It seems to me that a *limited* US no–first–use declaration is attractive—e.g., against non–nuclear states and perhaps China. What do you think of the possibility of a bilateral no–first–use agreement—after all, the Chinese respect the Latin American nuclear–free zone?

At this point the dinner party came to its usual abrupt close at the hour of 8:40 or so. I said that I thought there was much mutual benefit to our two nations and to our two peoples in continuing such conversations and that we had barely scratched the surface. I felt that Chou in no way rejected the discussion or such a proposal, but the next move is clearly up to them.

(I had an agenda for discussion with *someone* on strategic and security questions as follows:

1) No messages from anyone, but

2) Long experience and interest. Even an ordinary citizen may help.

3) Socratic method—examples,

   1) Perhaps I can clarify (give my personal view) "new US targeting policy."

   2) BW/CW limits. First real progress was the *US* declaration on BW.

   3) PAL (Permissive Action Links), etc.,—accidental or *unauthorized* use. US no doubt would be pleased to provide procedures and hardware.

   4) US defense commitment to Japan (as an alternative to a Japanese nuclear force).

   4') Desirability of IAEA safeguards for Taiwan even though Taiwan is out of the IAEA.

   5) ABM SALT Treaty, whereby we rejected an anti–Chinese ABM.

   6) End to atmospheric tests.

   7) Attitude toward Latin America Nuclear Free Zone.

   8) Korea/NFZ/NFU/Renounce Force?

   9) *Bilateral* NFU? Link to NPT, LTB? Conditions?

   10) Attitude toward nonproliferation? India, Japan.

   11) Attitude toward Israel.

   12) Who are the arms control experts in China or at least those who evaluate the meaning of nuclear war for China?

   13) Clarify the manner of technical input to US policy—e.g., BW and NPT agreements.

   14) Note that the US Atomic Energy Act *requires* government–to–government agreements, assurances of peaceful use (JCAE, AEC)—bilateral safeguards are in agreements with the French (even though the French are a nuclear power).

   15) Launch on warning.

   16) Scenario for the use of civil defense—e.g., US spending 80 million dollars this year and has 108 million spaces stocked for eight days.

   17) Brookings book on US–China relations in strategic sphere (Doak Barnett, et al.).

   18) Step–by–Step approaches—how big should be the steps?

   19) Scholarly community? Birth control? Arms control?

   20) China weather forecasting; WMO typhoon group; earthquake forecasting; (seismic sharing).

4/6/74 a.m. Discussion at the International Club on the subject of my talk the previous day, Mr. Hsu presiding (of the Computer Research Institute—He had visited IBM with the computer group last fall). Twenty–two people present.

Mr. Hsu—Yesterday when I (RLG) mentioned standardization of a language "in the middle of the range," what did I mean? I said I meant the range between problem–statement language on the one hand in various application fields, and machine language on the other. I thought to standardize machine language would be to constrain the future development of machines, while standardizing problem–statement language was impossible, since the number of fields was enormous. But some place in the middle a language like FORTRAN or APL or PL/1 (or several of them) should be adopted as standards.

Hsu—Do I think machines produced by IBM are in agreement with this philosophy? Yes, since we have a FORTRAN compiler for almost every machine. Furthermore, our 360 and 370 series machines form a system which is very largely machine–language compatible as well.

Re standardization in the middle of the range, should one standardize on basic FORTRAN or on extended FORTRAN? A. My own view is that the standard should be the larger language, for instance extended FORTRAN. I want to emphasize that I am not saying *which* language China should standardize on, but the language should not be too small so that programs would have to be written outside the language.

Does a standard language constrain word length, instruction set, etc.? A. No it simply means that the individual machine type plus a compiler must run the standard language. One might have a machine without a hardware divider, and in that case a problem which used many divisions might run quite inefficiently on the machine, but a problem written in the standard language would in fact run.

Q. Is standardization dependent on an operating system, etc.? A. I don't think so.

Q. As we know, standardization of languages has been talked about very much in the United States. As Dr. Cheatham said when he visited here, with the exception of "common" statements, standardization has not yet been reached. "Would I comment on this?" A. My own view is that there is a standard COBOL which was mandated by the US government for contract reporting. Furthermore, I think that there is such a thing as an American Standard FORTRAN, even though other FORTRAN's are used as well. The purpose of having a number of standard languages is to avoid having each computer have its own special language. For instance: If there are N computers of one generation and M computers of another generation and the problem is to run the application programs of the first computers on the second computers, then there will be N times M different types of translations required. Even if no standard language was used for programming, it would be more efficient to have even a standard archival language for the first set, call it S1, and a standard archival language, S2, for the second generation of computers. In this case N translation programs would be required from the first set of computers S1 and M from the second language S2 to the M computers; and a single translation language would be required from S1 to S2. Thus in this case only N+M+1 translations would be necessary.

Q. So far, American scientists have failed to achieve this target of common language (e.g., UNCLE??). At this time we are not sure whether we should devise *another* language. So far as I know, in the field of standardization, COBOL is the "best one." How would China go about standardizing? A. COBOL may be the most standard, but it is not the best language, of course. I could not suggest how China should go about standardizing—perhaps a working group of the All China Association for Science and Technology, but I don't know enough about your organization to advocate the mechanisms.

Would you contrast the philosophy of Illiac and CDC and IBM machines? A. Illiac–4 is a highly-parallel system which executes a single instruction at a time with multiple operands. CDC and IBM machines do not seem to differ much in organizational philosophy, but in general IBM has a very large research and development program on components, while CDC does not. Furthermore, IBM has machine language compatibility over a very large range of performance. Finally, IBM provides with its machines a very large and capable operating system which reduces the effort required to put a problem on the machine and which allows the machine to be used efficiently in both commercial and scientific applications.

Q. Insofar as operating systems are concerned, the large–scale operating system wastes more time, while the small one uses the machine more efficiently. Could I comment on this? A. In general, a small operating system will probably allow the machine to run more efficiently when it is actually computing the problem. However, the operating system can do many other things for the user. It can accommodate different machine configurations; it can ease the difficulty of putting the problem on the machine in the first place; it can maintain peak performance of the hardware by allowing multiprogramming of problems with different requirements on CPU and peripheral equipment. Thus, while the machine might run less efficiently on one job, on a whole set of jobs or on several simultaneous cases of a single job, it can be more efficient than a machine with a simpler operating system.

Q. Looking at the problem from this angle, to use multiprocessors rather than a single one would seem to be more beneficial for scientific and engineering problems. But it does not seem that IBM has gone in this way? A. Not so, we have had a large number of multiprocessing installations, usually of the type of an associated support processor—e.g., Model 75 and a Model 91. Furthermore, I believe (although I am not sure) that there have been some dual Model 67 installations in which two Model 67's can share the common main store.

Q. So far as we know, the IBM machines are not of this type? A. IBM has delivered about 20 or 30 Model 9020's (three Model 50's clustered together in a multiprocessing installation) to the Federal Aviation Agency for air traffic control, and there is of course a kind of multiprocessing inherent in the several arithmetic units of large pipelined machines.

Q. Regarding multicomputational elements, could you comment on the efficiency of a system with a vector processor? A. I agree that for problem workloads with a very large component of vector processing, an attachment such as a vector processor can be very valuable. In fact, IBM has such a feature, and I believe most of our users are in the petroleum exploration business. Such a processor can also be used to very good effect for high–efficiency calculation of the fast Fourier transform.

Note: In my speech the previous day I had said that there were at least three kinds of multiprocessing—the highly–parallel multiprocessor illustrated by Illiac 4; the highly–pipelined machine illustrated by the Model 91; and finally and to my mind most importantly the kind of multiprocessing one gets by using several or very many modest–sized but efficient machines on the same or different problems at the same time. For almost all cases, the purpose of multiprocessing is to obtain higher performance than can be obtained by a single machine. But in very few cases is it necessary or preferable to use a small fraction of the time of a very large machine on a particular problem. In the case of weather forecasting, it *is* very different to have the next week's weather predicted the next day, rather than a year from now; and in that case there is no alternative than to have some type of multiprocessing in order to get all this computer power to bear on a single case of the large problem simultaneously. However, in many other situations such as reactor design, etc., the designer wants to study many cases, and he can obtain effective multiprocessing by running several cases simultaneously on independent machines. The break point, to me, seems to come with a calculation elapsed time on the order of a few hours, and except for real time applications such as weather prediction or ballistic–missile–defense systems, multiprocessing by means of independent processors seems to me at least as attractive a route.

Q. Could you please comment on future development of language–oriented machines (the questioner meant computers built to execute a particular higher–level language). I noted that there was considerable attractiveness in building machines which could execute interpretive languages directly, and among such machines a very attractive one would be an APL machine. It was my own view that introducing APL into the microcode might improve the machine performance by a factor of 10, but that an APL machine with the same amount of hardware might be a factor 100 faster than a machine which has to interpret via a standard microcode into the ordinary machine language. For languages which are normally compiled, it was not clear to me that one could execute them interpretively with high efficiency, and there was not great benefit (I thought) if a compiler were to be used anyhow. I apologized for being unable to make a more definitive judgement, but this was far from my own field.

Q. Some questions on components: The 360 had already adopted a microprogram design using capacitive read–only memory (sic); we hope that it is feasible to use semiconductor ROM as well; but in IBM people seem not to have very extensively used semiconductor ROM; why? A. I noted that some of the 360's also had a transformer read–only store (TROS) and what was used was dependent upon the technology available in a reliable manner at the time. I noted that the CROS could be changed in the field, but I believed that the TROS could not; and that there are both advantages and disadvantages to a field–changeable ROS. I said that I knew that there was active consideration of integrated circuit ROS, and that we would use whatever technology appeared the best to us.

Q. How will the development of physical science contribute to the computing field? A. In some cases improvements and greater knowledge in physical science will lead to greater density, greater yield, higher quantity of existing components. In some cases, they will lead to other manufacturing techniques for the existing type of components. Another example is that of the Josephson junction, which provides the mechanism for building a whole new type of computer technology, which could lead to computer speeds of 10^8 or 10^9 OPS in a single box. Another example is magnetic bubbles which provide a complete alternative to semiconductor storage, but whether bubbles or semiconductors will be used depends, to my mind, entirely on cost after we have developed a reliable technology.

Q. What are the limits of MOS storage as regards to density and speed? A. As regards technology, I referred people to various published articles, like that by G. Feth in the (I believe) January, 1974, Spectrum. I did note that if one extended the historical trend, one would soon see the capability to produce 200,000 storage bits on a single chip. I then discussed the scaling of MOS technology by changing line width and oxide thickness.

Q. What are the applications of E–beam exposure? A. Mask making and wafer exposure. I pointed out the advantage of the undercutting of the electron beam resist (PMMA) for the fabrication of thick lines of metallurgy. **I promised Mr. Hsu the IBM Research Publication which deals with this matter.**

Q. What are my views on the future of MNOS and floating gate ROS? A. These are both very interesting technologies, but before they are widely used we have to make sure that they are completely reliable and that we understand the failure modes so that we can devise an accelerated life test. For this reason, sometimes it was not desirable to bring such new technologies to complete maturity, even if they offered marginal improvements over existing technology, and I did not know what the future might bring. I did know that we had some enthusiasts for these technologies.

Q. Could you go into more detail on the comparison between the single–user machine as opposed to the machine with multiple terminals? A. I had discussed this in considerable detail in the previous day's talk.

Q. Could I comment on the uses of molecular beam epitaxy? A. I probably have no clear idea of the possible applications, as contrasted with the possible new physics one might see. I thought that it was more important to look at amorphous materials for computer applications, as we have successfully done in the case of magnetic bubble film.

Could I clarify the concept of virtual machine? A. I tried to do so for the questioner.

The above gives the flavor of the discussion and is a more complete rendering of the questions than of the answers.

4/7/74 a.m. Peking Cotton Textile Mill No. 3. Cast: Miss Hu, Mr. Nan Bei–ho (administrator), Mr. Shi (staff). The mill was built in 1954 to 1957 and has a total area of 420,000 square meters. The living area is across the road (for the workers and staffs). Number of spindles is 87,000 and number of automatic looms is 3,200. All the machines are made in China. Of 6,400 workers, 70 percent are women. There are three shifts of eight hours.

When the factory began, we used only natural cotton. Since then we have made technical reforms in the machines and we now use synthetics as well. In all departments and rooms, we make use of the three–in–one team for technical reform (workers, cadres, and leaders). This is all in accord with Chairman Mao's teaching. For instance, when the cotton arrived from the outside, we used to comb it by hand; in the spinning department, if the spindle was full of yarn, we used to remove it by hand—we now have an automatic machine; the workers used to *stand* for eight hours to operate the machine—now we have an automatic moving seat to carry the worker along the machine.

Besides raising the production, the party also pays attention to the worker's life—we have built 40 big buildings for dormitories of workers at the same time as we built the factory. Also we have clinics, kindergartens, nurseries, barbers, green ground, and a primary school. We supply gas to the workers' homes (waste gas from factories nearby). Also there are radiators for heating in the winter time.

The workers are *free* to see doctors—if the doctor prescribes rest at home or in the hospital, the worker still gets paid. The worker's family pays half price for medical care. The leaders of the mill decided that male workers can retire at 60, women at age 50 (at 70 percent of salary). Is retirement mandatory? The workers can continue to work according to health—the factory may change *the* job, but the worker is paid the same wages as before. The leaders also pay a lot of attention to the welfare of women workers. After seven months of pregnancy, a women can reduce her work in the mill from eight hours to seven hours. As for postnatal care, a women gets 56 days off for rest (at 100 percent salary). In addition, for each baby, a women receives four yuan "for consolation"? If there are no grandparents, the family can send the baby to the factory's nurseries. The mother can take time off twice per shift to feed the baby. The fee for houses is very low—e.g., one room of 16 square meters costs 1.5 yuan per month. Running water, radiator, gas, electricity, etc., are about three yuan per month (Y.50 per month per person for gas, Y.10 per month per person for running water, one 40 watt bulb Y.40 per month). Even for a large family, the maximum rate is set 2.5 yuan per month.

Since the mill has been operating since 1957, it has overfullfilled its task each month per year. However, compared with advanced factories in your country and abroad, we must learn from others—must also improve management—there is a lot of noise; also cotton dust. The machines run 22.5 hours per day, and the factory has Monday off. The factory makes 320,000 meters per day of cloth.

The factory is air–conditioned in the summer and winter. There are 200 machines making (loose) cotton rope for feeding the spinning machines. One worker tends 18 cotton rope machines.

We saw the input to the whole process, a vacuum eater of bales. Fifty–fifty cotton synthetic is made by having the eater eat a bale of cotton and then a bale of synthetic fiber. We saw roving, spinning machines, and then the machine which prepares the warp by winding 400 threads in parallel onto a large drum. In one of the large weaving rooms, we saw signs proclaiming three model workers. The temperature is held at about 20°s C. and the humidity between 50 and 60 percent. Initially there were 5,000 workers, working two shifts. Additional workers were added gradually. Also there is a subsidiary factory in the suburbs of Peking, with 300 to 400 workers, which does similar work.

Discussion. We discussed the noise level in the weaving rooms. We saw one woman wearing ear plugs, and suggested it would be a good idea for more people to wear ear protection. The leadership said that they were doing research on reducing noise level—we countered that until the research bore fruit, ear protection would be useful. Each loom weaves 5 meters per hour, and each worker tends 32 looms. I pointed out that expressing production in terms of looms per worker or meters of cloth per loom tender was obviously somewhat inadequate for management purposes, since 3,200 looms would require 100 workers (300 for all three shifts), which is only about 5 percent of the total work force. Thus labor could be saved and production increased only if attention were paid to the *other* workers in the plant.

What would happen if the efficiency of each worker could be doubled, without increasing plant size—what would happen to the displaced workers? A. If we could reduce manpower, the workers would be transferred to other plants or to different factories. The workers would then change their place of living. Some could bring their families. Also there could be a bus from their present homes to the new job. **I promised to send OSHA data on noise control to the Physics Research Institute and to the Textile plant in parallel. I also made some suggestions re inexpensive means of reducing noise by treating the room, while working on quieting the machines themselves. **

4/7/74 p.m. Sent Chou P'ei–yuan some of my writings on strategic subjects. Here is a list:

1968, Scientific American, Bethe–Garwin article on ABM systems.

1971, U. of Chicago: Superpower Postures—An American View.

1972, RLG testimony regarding the SALT treaty of May 1972.

1968, International Science and Technology magazine, "Defense Research–and–Development."

1974, MIT–Press book, "Survivability of the Sea–Based Deterrent."

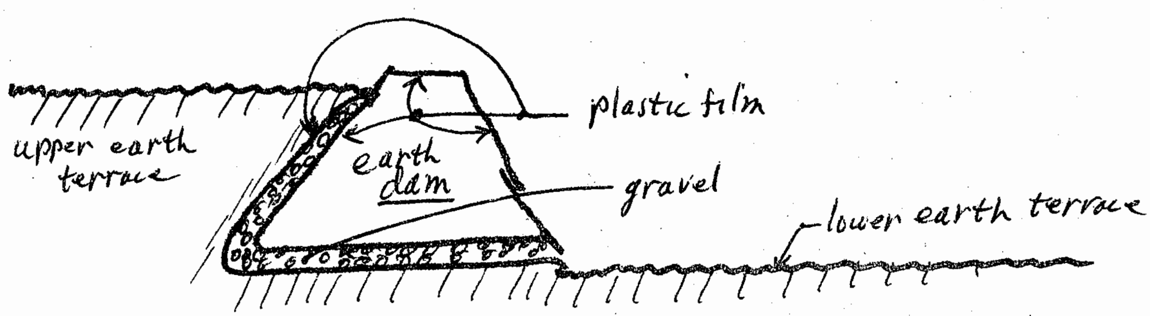
I invited him to look through these and to talk about them with me some other time.

4/8/74 Tachai (leading agricultural commune and production brigade in China). At 6:10 a.m. we were met at Yangshuen by Mr. Jiao, who would take us 45 kilometers to Tachai. Mr. Jiao is one of the assistant leaders of the production brigade, which has 440 members. We stayed and ate in a guest house which was built and staffed by the *country* (not by the brigade). In addition to their crops, the brigade has sideline products—pigs and Chinese noodles. These are bought by the county–operated cooperative or by the department store. We have a fine breakfast with Mr. Jiao in the guest house. Later we will go to the mountain to see the Tachai Production Brigade—to visit fields, also the forest fields run by the brigade, see animal husbandry, see the homes of the families of the people's commune, and the home of the family of Chen Yung–Kwei, the famous leader of the Tachai Production Brigade.

All of the brigade members live in houses which are newly built. In the summer of 1963, it rained for seven days and seven nights, causing a large flood which swept away 97 percent of the houses and damaged or destroyed 80 percent of the fields. Following Chairman Mao's teaching of self–reliance, we worked hard to build new houses and to repair the farm fields. After seeing the terraced fields then we will visit the exhibition in the county, then lunch and rest before going to the train.

In Tachai there are 21 brigades. The Tachai Brigade has two trucks and five tractors. The exhibition was built to carry out Chairman Mao's injunction of 1964, "In agriculture, learn from Tachai." More than 2,000 people per day visit the exhibition. It was built in 1971.

(The history and accomplishments of the Tachai Production Brigade are well documented, and I have literature on them.) I suggested to Mr. Jiao that the work of building the terraced fields (they are on their third generation of rock retaining walls) could be eased if one considered the alternative of small earth dams terminating these fields. The earth dams could be protected against water by facing them on their uphill side with a thin layer of gravel or crushed stone, covered by a plastic film imbedded between the earth dam and the earth of the terraced field. In this way, even small faults in the plastic film could be accommodated because the water would be drained harmlessly down the front face of the earth dam and under it without washing away the earth.



Discussion. While waiting for the train at Yangshuen: Some of the young people have now been sent to the universities—one at Tsinghua University in water conversation and construction; one at Taiyuen in medical studies; another at Taiyuen in the Engineering Institute; one at Tientsin studying electronics and computers; one at Cheng–du City in Szechuan Province at the military medical school.

The Tachai Production Brigade does not have any lower or upper middle school graduates doing their manual labor. The building of the large reservoir was under the technical direction of the Tachai Production Brigade—the PLA did the manual labor. All brigades in the Tachai Commune can use the water. Five communes organized to build the canal.

What is the agreement on water rights to the reservoir? A. The county leaders made a plan according to the needs. Q. What is the management of the Tachai schools? A. It is under the leadership of the Revolutionary Committee of the *Brigade* (not a separate revolutionary committee for the school). One member of the Brigade Revolutionary Committee is assigned to be in charge of the school.

4/9/74 a.m. Arrived at Xi An 0840, met by Mr. Tsao, Vice–chairman of the Province Branch of the All China Asssociation of Science and Technology; also by Professor Zhou in physical metallurgy and by Mr. Yang. Mr. Zhou regarding Xi An: It is in a central part of China, and the south part of Shan Xi Province, of which it is the capital and cultural center. It was liberated May 20, 1949, by the PLA. Before liberation, Xi An was a consuming city, not a producing city; but after liberation it became a producing city. Preliberation, there was a small power station, a cotton textile mill, and a match factory. Now it is an industrial city with more than 1,400 enterprises, small and big. There has been a forty–fold increase in workers; sixty–fold increase in electric power. Now there are two match factories; machine–building factories; metals; chemical factories; electronics.

Preliberation the population was 380,000, now 1.5 million. Xi An is an ancient city, and from the western Zhou it was the capital of 11 dynasties. A lot of relics have been found which are made by the Chinese laboring people. There is the Big Goose pagoda from the seventh century, the Small Goose pagoda from the eighth century.

There is also the bell tower and the drum tower of fourteenth century. Also the "Forest of Tablets" dating from the eleventh century. We will also see the Provincial Museum. Also the relics of a village which was found when they were digging the site of a factory. It is a village of 6,000 years ago which has now become a museum. It was discovered in 1953 and became a museum in 1958.

Also we will visit some scenic spots—the Waching Hot Springs, which is also a place of historical interest. It was a summer palace, and Chiang kai chek was captured there.

Program for Xi An: 4/9/74 a.m. Visit to Pan P'o Village, 6,000 years old.

p.m. Two programs—Big Goose Pagoda and the porcelain (enamel) factory.

4/10/74 a.m. Secondary school in a village some 30 kilometers from Xi An.

p.m. Waching scenic spot.

evening. Dinner party.

4/11/74 a.m. The province museum (three parts): 1) unearthed objects discovered during the cultural revolution; 2) stone carvings; 3) Forest of Tablets, which contains more than 1,000 tablets.

4/9/74 p.m. Visit to porcelain enamel factory (i.e., enameled steel). Cast: Mr. Ma, Vice–chairman of Revolutionary Committee of the factory; Mr. Ch'ang. The factory was built in 1951 to 1952. Preliberation, under the Guo Min Dang, industry in northwest China was very backward. Postliberation, we found ways to build this product to serve our people. In 1951, with the help of ten PLA and thirty Shanghai workers we began to build while producing. At that time we spent 200,000 yuan to build the factory. How? Follow Chairman Mao's prescription to "save money and increase production"? By working the land and getting money from the sale of agricultural products. We borrowed an old textile workshop. At that time, the production area was 5,000 square meters, and the building was very simple—when it rained very heavily outside, it rained inside. The living conditions were also rather poor. The workers and staff slept on the floor (on mats); we could see the stars in the sky through holes in the roof. We built a single hut for the dining room. You can imagine the machines we used then. They were rather simple and hand operated. We had ten machines and 100 people, making ten types of products.

In the 25 years since liberation, the workers and staff here worked very hard (especially since 1958) following Chairman Mao's line of "self–reliance" to change the living conditions. Now there are 1,100 workers and staff (eight times the original). We have 36,000 square meters of production area. *Most* of the equipment used was manufactured by our own workers here, but we also bought some machines from other factories. The value of the production increased 17 fold. We are also working to do some scientific research work to improve the management of the factory and the quality of the product. The number of product types has increased. We have manufactured more than 400 types of products since the beginning and more than 4,000 designs.

We began to export since 1957, and we export to more than 70 places and regions, including foreign countries.

At the beginning there was only one technique to make patterns—spraying it on. Now we also print the patterns. Also we use a Chinese brush for gold decorations. Also we have copied some old time traditional designs—for instance the large bowl at the Hall of the People.

The lacquer technique in Fukien Province is very famous, so we have copied that and we produce lacquer–like tea sets.

Since the cultural revolution, the leadership of the factory pays more attention to the political education of the workers, to socialist thought and to improved products. In the last three years, we have had 80 technical reforms and have bought 200 new machines, replacing about 50 percent of the old machines. We have built an automatic production line. Before that, we had only one piece per die push, but now we have a whole automatic line.

Regarding furnaces, our old one burned coal, but we now have electric furnaces and have increased the production of the furnaces three to four times. We built our own new electric furnaces in 28 days. Before the cultural revolution, building a new furnace took three months. These were made by a three–in–one team in the factory. Most recently, we built a furnace in two weeks.

So revolution can promote production. In 1973, our production was 68 percent above 1965 (in money terms). The productivity of the workers has increased 77 percent (according to the income of the factory)?? Last year, we fulfilled our task 65 days ahead of plan. Of course there has been some improvement, but there are still some weak points, and we cannot meet the needs of our country. Also there are some gaps between our factory here and those in advanced foreign countries.

People like more and different colors, and we can't meet the needs of the masses. Still have some hand processes, still some weak points in factory management—so must work hard to improve.

Do you make bath tubs? Before, not now. We had a special work shop for manufacturing that product, and after the cultural revolution, it became independent.

We make three main kinds of products: 1) Basins, 2) Enamel cups, 3) Small numbers of large variety of things (e.g., plates, medical instruments, etc.)? Do you manufacture to special order for other factories or research institutes? Our management is like this: The task of the factory is only production, and we give the production to commercial departments in China. So for special orders, customers contact the commercial departments, and the factory will receive the order. Q. How is the factory price of the product determined? Does it reflect the cost of manufacturing? A.

There are three aspects of cost—the cost of materials, the wages of the workers, and the cost of management. Anyhow, the market price is decided by a specialized agency. How about the *factory* price to the commercial agency? A. Also decided by the specialized pricing agency.

Some patterns are applied by *decal*, then fused. A technician and two workers worked for three years and failed 1,000 times in perfecting this process, then succeeded.

We had a very good tour of the factory, from the input where they make the frit into porous clumps, through the grinding with porcelain balls and water, through the pumping by air pressure. We then saw the largest part of the factory, which is devoted to punching blanks from coils of steel strip, forming by punching or spinning, welding, etc., etc. Some of the machinery has been manufactured or improved by the workers, and a typical machine used a rubber suction cup to lift successive blanks into the machine. I suggested also the use of magnetic lifters at times.

We saw a lot of young students around. They spend "four hours per day for one half month in the factory." They earn 0.2 yuan for four hours (not salary, but for food and bus).

The factory manufactured many beautiful things.

4/10/74 a.m. Visit to the Wei–Chu Secondary School in a village about 30 kilometers from Xi An. Cast: Mr. Li—Vice Director of the Revolutionary Committee of the school, Mr. Kao—physics teacher, Mr. Liang—Chinese teacher. Mr. Li on behalf of himself and of teachers and staff warmly welcomes American friends to visit. First, a general introduction. Our school is a *comprehensive* secondary school. There are fourteen teaching classes—seven in senior, seven in the junior school. Seven hundred sixty–three students, 44 percent girls. There is a small library of 54,000 books. There are three labs for physics, chemistry, biology. Also a (large) instrument room storing more than 725 kinds of instruments. The total number of individual instruments is more than 3,000.

Before the great proletarian cultural revolution, because of the influence of the Liu Shao–chi revisionist line, we could not carry out Chairman Mao's revolutionary educational line, so the students had education segregated from proletarian politics. Since GPCR, we are also deep in the movement to criticize Lin Piao and Confucius. We have tried to thoroughly carry out Chairman Mao's educational line.

Students learn theory, industrial production, agricultural production, and military affairs. We also try to carry out Chairman Mao's line in teaching. The main task of the student is to study, but also to learn from other knowledge. In a term, there are 31 weeks to study theory, political knowledge, socialist construction knowledge; eight weeks to learn industrial production, agricultural production, military affairs. We pay more attention to raising the level of socialist consciousness of the students. We lead the students to learn the good ideas of the workers and poor and lower middle peasants. Also of the working staff. Also to go with them in the future.

Besides having close relations with one factory outside, and the production brigades, the school also runs one workshop within the school and an agricultural field.

In the school workshop, there are seven different processes. There are six departments in this factory, so a student learns to combine theory in school with practice to serve *agriculture*. Have already overhauled small models of equipment used in the production brigades nearby. Have also fabricated 1,200 small tools for production brigades nearby. Also made 3,000 pieces of machines—by casting iron into molds. Also manufacture animal food grinding machines at a rate of 250 per year. Also produce a noodle–making machine at a rate of about 300 per year. Also have made two water pumps (only for experience).

Also there are 37 mu for farm fields to grow wheat, corn, and different kinds of vegetables.

During the last few years, we have sent more 10,000 jin of seeds of corn and wheat to the production brigades. The revolutionary education also remains in experimental stage. The movement to criticize Lin Piao and Confucius is going on in the school. Deepening this movement, we are convinced, will deepen the revolutionary development of our school.

Regarding military affairs we ask the students to learn principles from the PLA—three principles or rules. Ask the students to live a certain period outside the school—just like the PLA marching in the field. Also physical exercises like the PLA.

We visit some classes: *Chinese* (first year of senior middle school). Here they learn Pinyin and characters; math (first year senior) analytical geometry; library (no modern English books in view—"Uncle Tom's Cabin"). We visit also a chemistry lab and see large storerooms of physics demonstration equipment. Also biological lab equipment.

We visited a physics class (held three times per week) and see a factory worker teaching about water pumps (first year junior middle school).

We see an apple orchard on the school grounds. It is surrounded by barbed wire. Are there so many animals to keep out? A. 1) The fence serves to keep out animals, 2) There is also a lot of class struggle in society, and it helps to keep out the class enemies who might damage the trees; 3) It also keeps people away from the pesticides which might harm them.

We see the playing grounds for the school.

We see several students at workbenches learning from a workman how to repair modern electrical motors used in agriculture. We see a backyard retort fed by pig iron, tipped by students which pours into a ladle which is carried by workers to the casting room floor. Here they make all parts of the noodle machines and the food grinding machines. The cast iron pieces are then taken to the workshop, where the students machine them with lathes, shapers, gear cutters, power hack saws, etc.

The school puts on a performance for us—folk dances; folk songs; "Clementine" rendered in Chinese (Clem ti yi); violin performance from the White Haired Girl (very good). A dance with songs about a medical team; monologue criticizing Confucius; and Shan Xi–type opera regarding a school meeting.

Is the eight weeks per year (of manual labor) divided *equally* between industry and agriculture? According to Chairman Mao's teaching to combine theoretical teaching with reality (e.g., production) the eight weeks total is divided into two parts—four weeks per term. So in each term, we concentrate two weeks so that they can take part in labor and agricultural work. So each student has two weeks each term during which he does not go to classes? About the concentrated two weeks—this is spaced over four weeks (half time in class). But not the *same* four weeks for all students? For the concentrated four weeks, we send two classes to take part in the work. So two classes of the 14 in the school take part in the concentrated work at that one time. Besides the concentrated two weeks, every class takes part in such labor four hours per week. While laboring in the fields, students can use the knowledge from the classroom in their agricultural work—e.g., in repairing electrical motors for the brigade.

Of 100 primary school graduates, 100 enter middle school; only 30 go on into senior middle school. The policy of the country is to popularize (expand) secondary education in our country.

Discussion. LEG. Most of the orchestra was students—do they own their own musical instruments or do the instruments belong to the school? A. Part one way, part the other. The school team uses its spare time to learn to play. We have a music teacher.

LEG—Almost all the students in the workshop had new work clothes—does the school provide them? The work clothes are bought by the school. Q. What does the school do with the money from fixing motors and selling machines? The school gets an income from selling machines and spends it this way: 1) Enlarge production—buy new tools and machines. 2) Student welfare—tickets to cinema, opera, etc. 3) Order some newspapers for every class. 4) Buy instruments and materials for spare time activities. 5) Pay the student fee so the student can study free in the school. 6) Also if the student's home life is very difficult, he can get some money from the school.

Before, when the students entered school, each paid 2.5 yuan per term in the junior school and 3 yuan per term in the senior school. Also there is a system set up by the country so that those with difficulty in living can study free and get some money too.

LEG—I notice there are no red arm bands—are those wearing red buttons "Red Guards"? Yes. LEG—We also saw Russian and English books in the library; does the school teach foreign languages? Yes, Russian and English. LEG—When was the school established? 1941 (preliberation). The school was backward and simple. It used 30 houses for classrooms. Now the equivalent of 370 houses for classrooms, small library, and labs. You can see how Chairman Mao and the party pay more attention to the educational cause.

Q. Is there individual choice between Russian and English? A. We have a rule that every student must study a foreign language, so we divide according to the class. (All students in one class study the same language.) They study a foreign language three times a week.

Each class group is in a fixed classroom, only the teacher changes for different subject (except for labs and complicated demonstrations).

Physics curriculum for the first year of the junior middle school—basic knowledge of mechanics; second year—basics of heat; first year senior school—optics; second year senior school—deeper study of mechanics and heat; also electricity and magnetism.

For all four years, they have physics three times per week; chemistry twice per week; Chinese six times per week; foreign language three times per week; biology once per week for the first two years (no biology in first year of senior middle school); twice per week in second year of senior middle school.

Math six times per week for four years; politics in junior middle school twice per week; three times per week in senior. Geography first year of school only— twice per week.

History twice per week only in second year of junior and the first year of senior middle school. (Physical training twice per week for four years.)

Music, drawing pictures, one class per week each for first year only; personal health twice per week for first year only.

Of the 70 percent who do not go on to senior middle school, is that their decision or the schools? It is the school's—there are two conditions for entrance—the will of the students, and the judgement of their moral, intellectual, and physical aspects.

Most of the students want to continue their study, but our country is a developing country and the capability in senior school cannot meet the needs. So the entrance is decided by the leaders of the school and also by the poor and lower middle peasants. (Would–be) students older than 17 years can take part in the work of the brigade. (Would–be) students below 17 remain with their family and study at home and can have a chance the following year to enter senior middle school. They can also help the family by doing manual labor.

While developing agriculture and industry, we have a plan to develop education as well. The percentage has increased. For instance in 1971, only 30 percent of the students could enter senior school to study; last year it was 36 percent.

Mr. Gao—We've just begun to do this kind of work. We think the educational development in our country is very fast, but there is still a gap between advanced countries and our own. Just a few years ago, only a few primary school graduates could enter *junior* middle school; now they all do.

Q. Is the price of the noodle–making machine the same as that made by factories? Yes, the price of the noodle machine is 310 yuan (set by our country).

Mr. Gao—Sometimes we contact universities to see whether the education we are providing is adequate also for more advanced training. We often attend some reporting meeting run by the universities and technological colleges—we learn a lot of new knowledge to bring to the students here—also we read magazines circulated by our country to bring in knowledge here. For instance, previously our textbooks contained information only about electronic tubes; now also we have basic knowledge about semiconductors and integrated circuits. Also we can buy some books from the foreign book stores regarding new developments in technology, and we can learn from foreign scientists.

The junior middle school students live nearby at home; 95 percent of the seniors live in the school. Q. How are the students transported to the school? The class begins at 8 a.m., so the junior school students have time to walk to school. Q. Why do more seniors not walk to school also? The students in the senior middle school come from a much larger area. The school enrolls *junior* students only from this people's commune; but senior students come from other people's communes. The students can live at the school according to their will. If they live close by, they may want to live at home; otherwise they will live here.

One quarter of the senior middle school students are from *this* commune. If the student wants to live here, he pays only for food—12 yuan per month.

RLG—Perhaps the staff would like to ask us questions about education in the United States? Mr. Li—What is the case in the United States about students having the opportunity to enter senior middle school? A. In New York and in most other States, students *must* attend school until they graduate senior school or until they are 16 years old. Mr. Li—We are a secondary school in the countryside. Do students in the US live in secondary schools? Mr. Gao—How about physics experience in US high schools? RLG—When we were in Jiangsu Province, we talked with Mrs. Fang Fei, Minister of Education, who said they were preparing a course to *combine* physics, chemistry, biology. Are there any such efforts in this province? Mr. Li, Mr. Gao—Our educational revolution remains in the experimental state. Our province is also carrying on such work but the Wei chu secondary school does not take part.

4/11/74 p.m. Arrived Yan an. Met by Mr. Ch'ang, responsible member of the local branch of the Science and Technology Association, also by Mr. Xien, who knows some English.

Chairman Mao arrived in Yan an 1937 and left in 1948.

Program for Yan an: 1) Visit the exhibition regarding Chairman Mao's activities while he was here. 2) Visit places where Chairman Mao lived—Phoenix Mountain, Langjiao Ridge; Date Garden, Wangjiaoping. 3) Visit the May 7th Cadre School for Xian City.

There is also a university in Yan an with 200 students. The educational revolution is being carried on. There are more than ten special secondary schools for agriculture, teacher training, medical training, and machinery.

4/11/74 p.m. Saw Chairman Mao's home at the "foot of Phoenix Hill", also Yangchialing where Chairman Mao in August 1946 called the Atomic Bomb a Paper Tiger." At dinner Mr. Ch'ang said that there were ten altogether in the All China Association of Science and Technology Office in Yan an, because there are two research institutes there—one agriculture, the other agricultural machinery. The guidance comes from the Chinese Academy of Sciences, but the funds and administration from the Science and Technology Association. It was the same *before* the Cultural Revolution.

Mr. Xien studied Spanish in the university; English in the lower middle school and by radio.

4/11/74 evening—Saw a film "Mine Warfare" produced in 1962 by the PLA and shown recently in Egypt. We saw mother–son mines; delayed mines; heaven mines; mines with hair firing lines; remote–fired mines; stone mines. [This film should be seen by US Defense Department and Congress.]

4/12/74 a.m. Visited the Mao exhibition which appeared not to mention the actions of the United States in fighting the Japanese during World War II, but did mention atrocities by U.S. troops in 1946. Exhibition very interesting, nevertheless.

4/13/74 a.m. 0908 Arrived "Nanniwan May 7th Cadre School of Xi An City". Received by Mr. Liu, Director of the Revolutionary Committee of the School, Mrs. Chang (teacher from middle school in Xian); Mr. Hsu—Engineer and Director of Research Office of a design factory—supervising 120 people); Mr. Wang—laboratory director of a research group working on micromotors (20 people); Mr. Jia, staff of the Nanniwan School.

The school has "140 staff and teachers, of whom 93 help teach." The school was founded in November 1968. Since founding, 4,000 students altogether have attended the school, of them 3,500 graduated (the rest being in the present class). This is the eighth term of the school. There are 581 students studying now in school. The task is training term–by–term the cadres of the revolutionary committees in every level in the city—i.e., Xian City, district, counties. Also receive students from the level of vice–director and up of people's communes. Of course, cadres from different parts—e.g., agriculture, transportation, culture, health. Besides leaders at different levels, also students from all departments of technical personnel, doctors, actors, etc. The term is six months, and the students then return to their own work. The student gets the same wages as usual when he is attending the school—paid by the home organization to his family. The May 7th Schools were created during the GPCR. They are built on the base of criticizing the Liu Shao–chi and Lin Piao revisionist line. A feature of the school is combining theoretical study of Marxism and Leninism with productive labor and living in the countryside to learn from the poor and lower middle peasants. The purpose is to raise the level of socialist consciousness of the students.

We are trying to change the ways of Liu Shao–chi and Lin Piao, who wanted to close the cadres in rooms to study Marxism and Leninism separated from society. So our students graduate with a high level of consciousness of class and line struggle. They can be officials *and* common people in society with good relations with the masses.

The party pays more attention to educating and training cadres. In the past, in the period of the democratic revolution, the principle of selection of cadres was according to ???, good health, ability to work; so the tradition of Chairman Mao (for instance, at the National Institute of the Peasant Movement) is also the tradition of the May 7th Cadre School. *Then* we used the national Institute of the Peasants' Movement to train a lot of cadre to carry out Chairman Mao's line and to guarantee we would win the victory in the *democratic* revolution. In the *socialist* revolution, Chairman Mao said we must reeducate the cadres. Early in the GPCR, Chairman Mao also summed up the revolutionary experience in China and also of other countries. He pointed out that we must go the route of the May 7th School. According to the teaching of Chairman Mao, our school asks students to study while taking part in agricultural production, while criticizing bourgeois ideas, and doing ideological work on the masses. So we use our revolutionary traditional methods in a new way in our society. There are several methods—study Marxism and Leninism; take the examples of class struggles among society now—raise the students' consciousness of socialism and change their bourgeois outlook.

The movement to criticize Lin Piao and Confucius is going on, so our school has selected some material to study. Have also selected some books by Lenin, and also Chairman Mao's "Lecture on the Propaganda Teams." So we are combining the movement to criticize Lin Piao and Confucius with the study of Chairman Mao's works. In criticizing the doctrine of Confucius, "restrain oneself and return to the rites" we educate the students to insist on revolution and to go the road of socialism vs. capitalism. Through criticizing, the students understand better the reactionary features of Lin Piao, and we have also swept out the influence of the reactionary ideas of Lin Piao and Confucius.

While teaching students, we pay attention to three points:

I.

1. Study the works himself.
2. Study the original works of Marx, Lenin and Chairman Mao.
3. Study the main points of Marx, Lenin, Engels, and Chairman Mao. The main way is for the student to study himself.
4. Have small group discussions—this helps the student understand what he is studying.
5. Big meetings to criticize Lin Piao and Confucius.
6. The teachers give the students some help.

II. Combine learning with productive labor—ask the student to go to the brigades and production teams to live and work with the peasants and to change their world outlook. No matter what rank before, each person is a common student. Every student is given one job—in charge of planting in the field; or electric power; or cooking; building houses; making bricks, etc.

Through labor we can feel the feelings of our laboring people, and thus students change their original feelings. Before, under the influence of Confucius, cadres might have some bad ideas—e.g., dislike peasants and manual labor—but we can change it. This is most important in the period of socialist revolution. So we can guarantee that our country remains of the same color—i.e., not change from socialism to capitalism. There are two ways to take part in labor— a) Our school; b) Live with the brigade of poor and lower middle peasants to eat, work, study, criticize with them. Also receive reeducation. The students only spend one month with the brigade. This is the only *class* for the students in the school, and we think it's most important, especially for cadres and research personnel who have only lived in the cities.

III. Educate the students to follow the revolutionary tradition of Chairman Mao. Accept the principle of self–reliance and hard struggle. This is a good place for the task—it is part of Nanniwan, a sacred place of the Chinese Revolution. So the first class as soon as it entered paid a visit to Yan an City.

Also visit some peasants who worked with Chairman Mao and took part in the agricultural reconstruction movement, and members of the 359th Brigade lectured here.

Also visited nearby revolutionary spots.

So all cadres have a rich experience in the past. They can all recite the old time activity and carry out the revolution. For the youth, activities emphasize that what we have now was not easy to get—so must learn from the old men and carry out the revolution.

So a student who graduates takes the Yan an spirit with him to Xian. Besides the education of cadres, we can produce some things for the country—e.g., grain and goods for the country. Since the founding, we have produced 740,000 jin of different crops; also 800,000 jin of vegetables. Have also developed some forests and orchards nearby. Also sheep and pigs.

We use our own hands—also developed some mills to make bricks and repair agricultural machines. We process our own agricultural grains and have repaired and built 150 caves (or cave–style buildings).

Our total building area is 9,000 square meters. Through the hard work of the students, we now have electricity, running water, telephones—before we had none of those. Of course we have made a lot of progress and achievements, but we still have some weak points and must make a great effort to achieve.

For instance, we try to help the students study politics but cannot meet the needs of the students in the way of books and materials. We have bought some but cannot meet the needs. We have a small library here, just a small one—3,000 books. Our main task is to learn politics, but we have only one set of Lenin for ten students. Within two or three years we plan to have one set for each student. In agricultural production we can only supply ourselves with vegetables and meat, but not corn, wheat, or grain.

So according to the agricultural development plan of our country, every year we should grow 400 jin per mu and have fulfilled the task, but that is not enough to feed ourselves. We are convinced we must manage our school well and adopt the new words? of the Tenth Party Congress.

The school has 700 mu of land.

Q. Who are those who are selected to come to the school? Are they selected from those in special need of reeducation? A. According to Chairman Mao, *every* cadre must take part in manual labor, so all those who are not too old, too weak, or too sick are candidates for our school. There is a quota assigned to the individual organization in Xian, and the organizations choose their candidates. How long will it take to educate this whole pool at a rate of 1,000 per year? There are 50,000 cadre total, 40,000 in the category who must attend. (So 40 years!) Now 42 out of the 581 students come from ranks above that of the county. Twenty percent of the students are leaders.

We plan to enlarge the school. In May of this year we will enroll 100 students again from cultural organizations.

Q. Do all students enroll at the same time? Yes. Simultaneous enrollment.

Q. Do you worry about modernization—about the experience at Nanniwan getting closer to that of living in the city? A. The conditions in the city and the school are different—e.g., the living conditions here are much simpler than the city. So most of the students used to be leading cadre and live in a single house or have a room to himself. Here we have four persons in one cave. Here the food is not so good as in the cities. Also, most important, in the city the cadre has authority—here he is only a common laborer and is ordered about by the teachers here.

Q. How many teachers? We have 42 staff (not teachers). The cadres as students must depend on their own hands—e.g., grow the food he plants himself. For cooking, he gathers the wood from the mountains. Also a lot of cadre in the city who used to go places by car—here they walk on two legs. Among the 42, *three* hold posts as teachers. The teaching group is seven out of the 42. [Confusion in the original.]

We also run the school according to the principle of Chairman Mao—"rely on the masses." The officer can teach the soldier—also the soldier can teach the officer—and the soldier can teach the soldier.

Visit to the clinic—Dr. Jiao, who is a student in the school (normally he is the head doctor in the number one hospital in Xian). The clinic is in three parts in three adjacent caves. 1) out–patient department, 2) next cave is the operating room, 3) next is a medical storeroom. The clinic is manned by nine persons, among them one specialist in internal medicine, one surgeon, one pediatrician (for the children of the people's brigade). The doctors all come from different hospitals in Xian. Dr. Liu—People's Hospital Number 8; Dr. ? Head of Nursing from People's Hospital Number 4. All small operations are done in this out–patient department; large operations, next door. Also acupuncture treatment. Also take care not only of students but the poor and middle peasants and the overall populations out to 20 li. Each brigade has its own barefoot doctor who can send patients here whom he or she can't handle.

What is the area served? Four brigades nearby, also two barefoot doctors here. Also there is a hospital run by the People's Commune. The major operating room was last used in August 1973 for an appendectomy.

We visit various other parts of the school—the generator room, the processing room for agricultural grains, where the transport system was designed and built by the students; the brick kiln—2 cents per brick for the coal (vs. 4 cents per brick purchased); saw a house built by the 359th brigade in the old times. The brick kiln makes 12,000 bricks per eight hours.

There is a 100–ton cistern for running water for the school and also for one brigade. There 130 pigs.

They have films on Saturday. The dorm was built in six months by the students. Among the students there are 92 women and 500 men. The students do not go home to visit during the six months term, nor are they visited by their families.

Mr. Liu has been at the May 7th School since the beginning in 1968 and sees no need to have May 7th Schools for the reeducation of the leaders of May 7th Schools.

Eighty–five percent of the students are Communist party members.

The age distribution of the students is according to the "three–in–one principle"—old, middle–aged, young. They are now increasing the fraction of younger students. Previously there were only 20 percent young—now 42 percent young. The young group is 18 to 35 years; middle 35 to 55 years; old, 55 and up.

Where do Mr. Hsu and Mr. Wang work in Xian? Who are minding their jobs? In general there are several directors in charge of the work of an office. Mr. Hsu is one of five directors; Mr. Wang, one of two directors.

In order to fulfill the task of reeducation, will this school be expanded, or will they create a new one? The school will be *enlarged* gradually—this term we are building an auditorium and a bath house; next term another 30 caves (120 persons more). We are trying gradually to change conditions. Originally we had 420 persons, 10 per cave. In the beginning there were no chairs or tables—each term a student does some construction for the school.

Q. Does every student live with a production brigade or only some students? Term by term it changes. Thirty students per group (this term we will send four groups of fifty students to the production brigades). Students on return tell of their experience. Expanding this number gradually, because there is still a lot of work to do in the school. The cadres in the city beleive this (the May 7th School) is the most important thing in their life and they all come to the school in high spirits. For instance, the auditorium foundations were planned to require two days to build; but only one day was needed for a building of 990 square meters.

Mr. Wang "was very glad to have a chance to study in the school." A bit earlier we had a battle in agricultural production. Now only 90 days to create 33 mu of land in the mountain area, moving 21,000 cubic meters of earth.

(Nice lunch was served to us at the school.) Are the students having the same lunch? They only have one meat dish except on holidays when they have three or four. The student's meat quota for the month is three pounds.

The school is directed by the Revolutionary Committee of the City of Xian, and this is the only May 7th School for Xian. Do larger cities have more than one? Shan Xi Province has 82 schools. Do directors of schools ever meet to sum up their experience? Yes, and five persons are living here right now from Inner Mongolia to exchange experience.

4/13/74 evening. Airplane to Peking was delayed until the next day because of high wind. Saw three parts of a "short" showing workers and PLA criticizing Lin Piao and Confucius. Also saw "Tunnel Warfare" dated 1965—an account of the anti–Japanese campaign of the village of 1942. [Also very interesting for US audiences.]

4/15/74 All Day. Visited Great Wall and Ming Tombs. on return to Peking hotel Mr. Chang gave me the following messages: 1) Mr. Chou P'ei–yuan *repeatedly* asked Mr. Chang to send his best regards to me and Mrs. G. He will write, but not in these few days, as he is very busy with meetings. 2) Mr. Bai Chieh–fu's office says he is out of Peking. 3) Mr. Ch'ien Wei–chang is also out of Peking. 4) Mr. Chang himself sends his best wishes to American scientists and people. Also Mr. Kao sends his best wishes to Dr. and Mrs. Herbert Simon and Dr. Ornstein et al.

4/15/74 p.m. Met with Mr. Hsu Pin of the China National Machinery Import and Export Corporation. This meeting is reported in detail elsewhere.

4/16/74 a.m. Visited Tsinghua University. Received by Mr. Chang Wei, Vice Chairman of

Revolutionary Committee, Mr. Lin, Director of the Revolutionary Committee of the Department of Electronics (graduated Tsinghua University 1952), Miss Xien—teacher in mathematics and computing Mr. Suen—staff in charge of reception, Mr. Da, staff in charge of reception.

General Introduction—Many things are similar to other universities and are not mentioned. Tsinghua is a polytechnic (science and technology) university. There are eleven departments and 51 specialties. For instance, electronics, automation, precision instruments, radio, civil engineering, hydraulic engineering, etc. There are 4,000 students and there will be 10,000 in a couple of years. After summer vacation, we will begin to enroll 2,000 students. In March 1974 we graduated our first students after the cultural revolution, after a three and one half year course.

Pre–liberation, our university was a typical example reflecting the semi–colonial nature of old China. Since liberation, we did some educational reform according to Chairman Mao's teaching, but there was some interference from Liu Shao–chi's revisionist line so we could not carry out Chairman Mao's line thoroughly. After and during the cultural revolution, the students, workers, and staff (teachers) with the help of Chairman Mao's thoughts and the propaganda team of workers and PLA criticized Liu Shao–chi's educational line and so have made some educational reforms in the institute—e.g., 1) What kind of students should be enrolled? What kind of person is to be educated or trained in the University was the *main* contradiction between Chairman Mao's line and Liu Shao–chi's line. To educate a person to follow Chairman Mao to be a supporter of the proletarian socialist revolution, or Liu Shao–chi's line to be a bourgeois aristocrat? 2) What kind of teachers should be demanded in the university? 3) In what way should one teach or educate students in the university?

These are the three points of educational reform in our university. Maybe they are rather similar to those in other universites. Q. RLG—I know about point one and I expect I know point three but in regard to point two, what changes were made in the teaching staff? A. Before the cultural revolution, the result of the revisionist educational line was to divorce students from politics, from the masses of workers and peasants, and from practice (or reality). These "divorces" have something to do with teachers. In trying to meet our new educational goal, we had to do some reform work among the teachers. So after the cultural revolution, we gave the teachers a chance to work in factories and people's communes. Tsinghua University also runs a small farm. So we reeducated teachers in factories, communes, and they learn from the masses. Also could learn professional techniques. We did not change the personnel, but we changed their outlook toward socialism. "The first important question is whom we are going to serve."

Chang, Lin, Xien had a chance to go to the farm and factories for more than two years. They had a rule for every teacher to go to the countryside or to the factory term by term. E.g., to go to the factories *with* students or alone. Of course, besides this, the teachers pay more attention to the works of Marx, Lenin, and Mao to raise their level of socialist consciousness.

(Some of the buildings of the the University are really very nice.) The new buildings were finished in 1966 and were designed by the teachers and students together.

A visit to electronics. There are 400 staff and workers, plus 200 in 2 workshops and 500 students—making about 1,000 altogether. I saw the assembly of cores into a core plane for a minicomputer. This is a 2 1/2 D memory. The first–year students in electronics come here for one month to learn soldering. Later they learn design. Some of the products of this workshop are on display—time–frequency counters; a ZFJ–1–2 step–and–repeat control unit. Ten students from September to February (senior thesis project) before graduation produced a seven–color, 64–character computer terminal which I saw in operation.

I visited the most sophisticated integrated circuits production line I had seen in China. They are making circuits with 150 circuits per chip. Their yield, for medium–scale integration, is about

40 percent. On the line they use the step-and-repeat camera employing the ZFJ–1–2 control unit. It is a screw driven, laser–interferometer–controlled step–and–repeat table with one micron accuracy. The University produces about 15 control units per year—the complete camera (control unit plus camera) is sold for 60,000 yuan.

The IC line uses chrome masks on glass and 30–millimeter diameter wafers. They can process 30 wafers per day and have about 400 chips per wafer of 1.2 millimeters square.

What is the turn–around time? Four months for medium–scale integration; ten months for large scale–integration. They use no computers in the design or for checking but have a plan for computer–aided design.

Visited the machine–tool workshop, where we were received by Mr. Song. The workshop makes 800 universal milling heads per year. These are made by the students. The students were using lathes which themselves were made by students in 1958. All freshmen in the University spend 4 weeks here, and those who specialize in this kind of work spend six weeks of each year and five to six months before their graduation. All of the students except one were wearing safety glasses. I pointed this out to Chang Wei and to Mr. Song, commenting that this was the first time I had seen any safety glasses in China and that I thought that was very desirable. They stopped to talk to the student, who was not in the least intimidated; I think that he will wear his safety glasses in the future, though.

All students and most of the staff live at the University. They have sport teams. The girls' dormitories have four to five girls per room.

The oldest building of the University was built in 1911, the library in 1919 and enlarged in 1930. The University began as a prep school for people who would leave China to go to other countries, especially to the US to be educated. Tsinghua became a university in 1925. The library has 1.3 million volumes, one–third in foreign languages. They receive 2,000 periodicals; one–third from the USA. There are three reading rooms—politics, technical literature, periodicals. The reading rooms are open shelf. The periodical reading room was under reconstruction and could not be visited.

They had just received a gift of 10,000 books from the Japanese, in partial compensation for the destruction caused by the Japanese during the war. There are 10^6 books in storage. A student can borrow five books for a month, longer if necessary. There are no fines if the student keeps the book overdue.

Relatively few students and teachers were around during our visit, because "this is the week this year for digging our air raid shelters at Tsinghua University." They spend one to two weeks per year following Chairman Mao's request to dig more and deeper air raid shelters and grain storage sites.

We passed bath houses, dining rooms, etc. They have two hours per week of physical training and five or six one–hour periods for recreations (sports, athletics, other activities).

Examinations? Before the cultural revolution, exams were used to attack the students. So made the students nervous. Now they are used to checking the quality of teaching and of study. Through the exam we can find out the weak points of teaching and studying. Before we examined only what the teachers have already taught the students and what the students have already learned in the classrooms—that is, book knowledge.

We have now adopted open–book examinations. Sometimes the examination papers are given out before hand. And the student can discuss the examinations with classmates and with the teacher. Who grades the exams? Several teachers discuss the exams, and the student can take part in the discussion and give his opinion.

Also, during the term of study, every several weeks we can have a check of knowledge and of studying. So every few weeks, the teacher will sit down with the student and discuss the studying and the teaching.

How is the teacher's time divided among classroom teaching, preparation, discussion with students, practical work? Some courses need a short period of time—e.g., courses in the factory; teachers will have discussions with workers and students in the factory.

How many courses does a teacher teach in one term? One course—four "hours" per week. (An academic hour is 45 minutes.) The teacher will also help students in their graduation projects. He will also help students in their work. Besides the classroom teaching, the teacher also discusses the material with the student.

How manage the transition from 4,000 to 10,000 students? Will you use longer teaching hours, larger classes, or more staff? All of these.

We will pay more attention to the student's capability to study for himself. Our main aim is for the student to have the ability to analyze and to solve problems himself.

Miss Xien, what courses do you teach? She helps students with their graduation projects. They use ALGOL–60, with some changes to meet local needs. We have a computer Model 112, built by the students in 1965.

Do all the students graduate knowing how to use the computer? All the students have a short course in programming—it is very easy to learn. Is the Model 112 computer used by the department of architecture and the other departments? The computer is rather small and cannot meet the needs. Therefore we also go elsewhere—e.g., to the Computing Research Institute of the Chinese Academy of Sciences.

Have you discussed the installation of a computing terminal here in order to make it more convenient to use the computers at the Computing Research Institute? Not yet, but plan to do so.

Chang Wei asked me "Is there a plan to connect all computers in the United States? How is it coming?" I answered by discussing computer netting and services. I said that there were more than fifty universities with IBM 370/145's. These computing centers each have many terminals attached, both interactive and remote job entry (RJE). Most of these computers are connected with their own terminals, and some of these terminals have high–capacity (RJE) capabilities. However, the main importance of netting, in my opinion, is that the computers share a common language and common programs, and this was in my opinion far more important than the connection of these independent computer centers in order that they should be able to exchange information electrically.

4/16/74 Met at Peking Airport by our hosts from the China Electronic Society. Mr. Pan says that Lee Tsung–dao sent one of his sons to participate in manual labor last year and will come soon and bring his other son.

Mr. Lo and Mr. Pan have been to the May 7th School for one year. Mr. Lo learned to plant rice.

Our airplane stops in Shanghai for 40 minutes, and we leave the airplane and find to our surprise our whole group from Shanghai (lacking Professor Wang, who was travelling elsewhere).

Mr. Hu explains that he is one of four responsible members of the Science and Technology Group of the Shanghai Municipality Revolutionary Committee; one of three responsible members of the Shanghai Branch of the All China Association for Science and Technology. I ask how much autonomy Shanghai has in science and technology. He replies that Shanghai can decide most things themselves—a small fraction of the tasks come from Peking. For instance, Mr. Du's Institute is entirely decided by Shanghai; Professor Wang's Institute (which is under the China Academy of Sciences) is managed differently—there are first discussions with the Shanghai group, and then these latter work out the plan with the Academy of Sciences in Peking.

Our plane takes us to Canton, where we are met by our Canton crowd. After dinner I give an evening lecture at Zhong Shan University, to the Departments of Physics and Mathematics on the subjects of gravity waves *and* computers. Mr. Chien, who had gone to Peking to hear me talk about gravity waves, is back and takes an active part in the discussion. After two and a half hours, "You must be very tired." and I say goodby and return to the guest house.

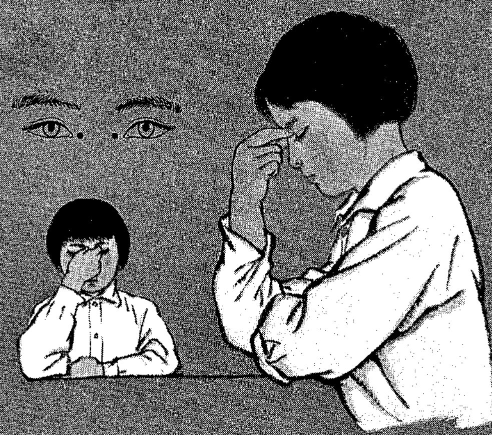
眼保健操图解

注　意　事　项

1.操练时要闭着眼睛做，跟着唱片的速度进行。2.经常剪短指甲，并保持两手的清洁。3.按揉时穴位要准确，手法要轻缓，以各穴位产生酸的感觉为止，不要过分用力，防止压迫眼球。4.一般每天可做两次，上、下午各一次，要坚持经常操练。5.做眼保健操的同时还要注意用眼卫生。

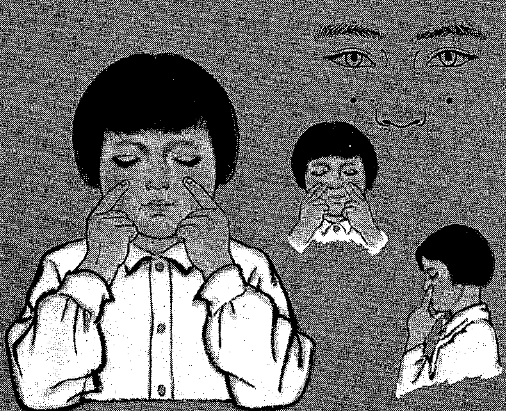
第一节　揉天应穴(攒竹下三分)

闭目静坐，以左右大拇指罗纹面按左右眉头下上眶角处，其他四指散开弯曲如弓状，支持在前额上，按揉面不要大。节拍8×8



第二节　挤按睛明穴

以左手或右手大拇指与食指挤按鼻根，先向下按，然后向上挤，一按一挤共一拍。节拍8×8



第三节　揉四白穴

先以左右食指与中指并拢，放在紧靠鼻翼两侧，大拇指支撑在下颚骨凹陷处，然后放下中指，在面颊中央部按揉。节拍8×8

第四节　按太阳穴轮刮眼眶(太阳、攒竹、鱼腰、丝竹空、瞳子髎、承泣等穴)

拳起四指，以左右大拇指罗纹面按太阳穴，以左右食指第二节内侧面轮刮眼眶上下一圈，先上后下，轮刮上下一圈计四拍。节拍8×8

[Note to the non-Chinese-reading audience: The individual sections of this page are literal translations of the corresponding text on the illustrated chart - R. L. Garwin]

ILLUSTRATIONS HOW TO TAKE CARE OF YOUR EYES

Articles To Heed And Follow

1. While doing the exercise you should close your eyes and follow the tempo of the record.
2. Always cut your finger nails and keep both hands clean.
3. Massaging the right positions gently and slowly, you should stop when you start feeling sour of the parts massaged. Keep from hard pressing, lest the eyeballs might get hurt.
4. As a rule you need do the exercise twice a day, one in the morning and one afternoon. You should do it persistently.
5. While practicing the eye-care exercise, you also need to pay attention to eye hygiene.

I. Close your eyes, sit quiet.
Use both thumbs (with the finger-printed part toward your face) to massage both ends of the eyebrows and eyes.
Let the rest of the four fingers be bent just as the illustration. The parts covered need not be extensive.
(Tempo 8 x 8)

II. Press the parts as illustrated.
Lift both thumbs and index fingers to press the upper part (the ridge, called the root of the nose) of the nose.
First downward then upward.
(One tempo 8 x 8)

III. Press the part as illustrated.
First keep the index finger and middle finger of both hands together, then have them put near both sides of the nose with thumbs pitching up the chin (as illustrated).
Then take away the middle finger using it to go all over the central part of the face (most likely the cheeks).
(Tempo 8 x 8)

IV. Massage the temple and scratch all around the eyes (parts have technical names).
Bending the rest of four fingers leave both thumbs to go over your temple.
Use the second joint of the index finger to scratch both the upper and lower parts of the eyes and massage around.
All these (circling around and upper and lower scratch) takes about four tempo (8 x 8).