

JOURNAL
of the
1992 AIAA HOUSTON SECTION
TECHNICAL DELEGATION TO CHINA



**An activity of the Houston Section,
American Institute of Aeronautics and Astronautics,
in cooperation with the Chinese Society of Astronautics**

Houston, Texas

August 1992

**JOURNAL
OF THE
AIAA HOUSTON SECTION
TECHNICAL DELEGATION TO CHINA**

May 1 - 15, 1992

**COMMEMORATING THE
INTERNATIONAL SPACE YEAR**

**Assembled and edited by
James C. McLane, Jr.
and
Louis E. Livingston**

First printing August 1992

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Foreword

The 1992 Houston Section AIAA Delegation to China was conceived as one of several Section activities to commemorate the International Space Year. Earlier, in September 1987, a "Sister Section" relationship was proclaimed by the Shanghai Astronautical Society (SAS) and the Houston Section. Since then, the two organizations have undertaken a variety of activities aimed at "fostering goodwill and understanding between their members." In keeping with that theme, the first visit to Chinese space facilities by a Houston delegation took place in September 1988. That activity was patterned closely after People-To-People International Citizens Ambassador technical delegations, except that the project was authorized as a self-supporting non-profit activity of the Section. As with all other activities of the Section, it benefited greatly from volunteer services provided by Houston Section members. The 1992 project built upon the experience gained in that earlier very successful undertaking.

An invitation for a Houston Section delegation to visit China again was extended through me as Sister Section Coordinator in August of 1990. The invitation came from the then Secretary General of the Chinese Society of Astronautics (CSA), Mr. Zou Ze-Qing. The CSA is the parent organization of the SAS. All of this was duly reported to the International Space Activities Committee, and to the Executive Council of the Houston Section. It was decided to postpone any specific action until there were clear indications of sufficient interest from potential delegates to warrant the considerable effort to organize the project. By the fourth quarter of 1991 the number of inquiries on hand suggested that this point had been reached. In October, the CSA Beijing Office that had made all arrangements in China for the 1988 project was requested to prepare a proposal for a visit in May of 1992. Their positive response included introductory cards to be used in requesting special assistance from the PRC airlines (China Air and China Eastern). With this information I was able to get firm schedules and cost estimates for every element of the project. A comprehensive plan and written proposal to go ahead with the project was presented to the Houston Section Council at their monthly meeting on December 5, 1991. The proposal was adopted.

The project was publicized in several issues of the Houston Section monthly newsletter, *Horizons*, and the weekly newsletter of the Johnson Space Center, *Space News Roundup*. Flyers announcing the project were placed on organization bulletin boards both on- and off-site JSC. Announcements were made at each monthly AIAA dinner meeting, and an advertising poster was displayed at those meetings as well. By March 13, 1992, which was the deadline established for applications, 18 people had applied to participate. Circumstances forced one of them to cancel, leaving a total of 17. Of these, twelve were technical delegates and five were non-technical accompanying spouses.

On March 26 a dinner for participants and other interested AIAA members was held at a local Chinese restaurant to provide final information and to answer questions from the participants. Clips from home video sequences by Lou Livingston, Jim McCoy and Jim McLane introduced the participants to some of the SAS and CSA people we would contact, and some of the places we would visit. Other material intended to help the travelers was distributed.

A number of people deserve special recognition for their work in support of this project. Mr. Chen Rong Ying, Head of the CSA Office and his Deputy, Mrs. Li Furong, indubitably contributed the most. Their effort began with the original planning for the project, and extended into all the detailed arrangements in China. Lou Livingston composed and printed the inserts for the unique custom name tags and bag tags distributed to the delegates. He has also shared the editorial responsibilities for this journal. English/Chinese name translations for the name and bag tags, and for the business cards bought by most delegates, were performed by Tai Ling Lee and Tuyen Hua. Business card printing was arranged by Tai Ling Lee. Jerry Goodman was instrumental in obtaining certificates from JSC to present to the CSA and the SAS. He and Andrew Petro performed a great service to me by carrying these heavy framed items to China. The Houston Section Treasurer, Chris Burmeister, did an excellent job in managing the cash flow for the project. And lastly, I want to give special thanks to the Houston Section Chairman, Dr. Zafar Taqvi, and to the (then) Chairman-Elect, Mr. Steve Zobel, for their unflagging support of the project from beginning to end.

James C. McLane, Jr.
Delegation Leader
July, 1992

Delegation Members

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DELEGATION LEADER
Self-employed Consulting Engineer
Houston, Texas

MR. LOUIS E. LIVINGSTON
ALTERNATE DELEGATION LEADER
Self-employed Consultant
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NASA Johnson Space Center
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MR. CHARLES A. JACOBSON
President
GB TECH, Inc.
Houston, Texas

MR. ANDREW J. PETRO
Engineer
NASA Johnson Space Center
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MR. DONALD M. ROBINSON
Aerospace Engineer (retired)
Houston, Texas

MRS. EMYRÉ B. ROBINSON
Director, Public Relations
Barrios Technology, Inc.
Houston, Texas

DR. KWEI TU, Ph.D.
Senior Advanced Systems Specialist
Lockheed Engineering and Sciences Co.
Houston, Texas

The following professional and non-professional members of the delegation accompanied the technical delegates:

MRS. JOAN L. GEISSLER
Volunteer, accompanying Mr. William H. Geissler

MRS. EDETTE C. LIVINGSTON
Homemaker, accompanying Mr. Louis E. Livingston

MRS. MARJORIE H. JACOBSON
Volunteer, accompanying Mr. Charles A. Jacobson

MRS. DOROTHY D. MCLANE
Homemaker, accompanying Mr. James C. McLane, Jr.

MRS. JANE-DEE TU
Housewife, accompanying Dr. Kwei Tu

Group Photograph



Front row: Grace Hua, Dr. Kwei Tu, Jane-Dee Tu, Marjorie Jacobson, Emyré Robinson

Middle row: Tuyen Hua, Edette Livingston, Joan Geissler, Dorothy McLane, Charles Jacobson, Dr. Betty Goldsberry, Jerry Goodman

Back row: Louis Livingston, William Geissler, James McLane, Jr., Andrew Petro, Donald Robinson



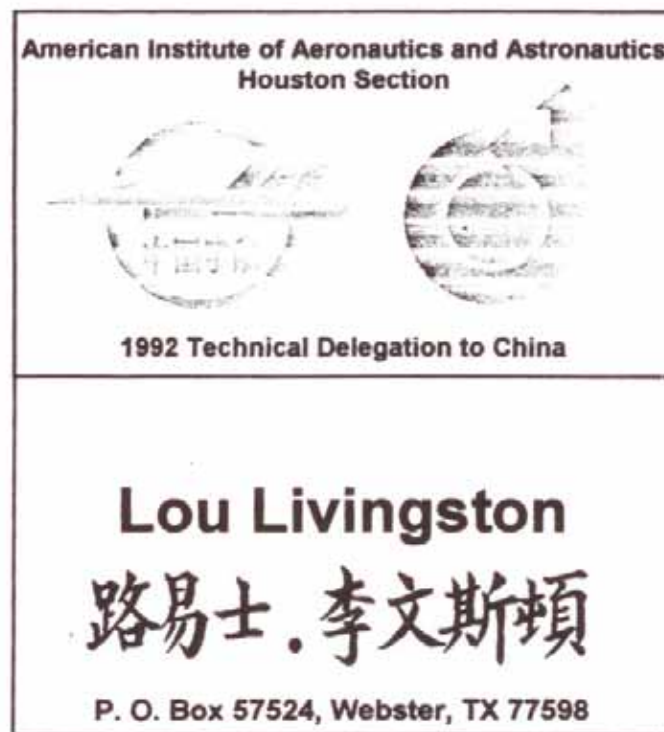
Travel Route



Badges and Baggage Tags



Sample Badge



Sample Baggage Tag (front and back)

JOURNAL OF PROFESSIONAL ACTIVITIES

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May 1-2-3, 1992
Friday-Saturday-Sunday

Reporters: Mrs. Dot McLane
Mr. J. McLane

Houston to Beijing, China

Travel

The delegation gathered at Houston Intercontinental Airport on Friday morning, May 1, 1992, and checked in on Continental flight number CO147, an Airbus, for the flight to Los Angeles. Delays in the scheduled 9:45 AM departure were announced at approximately 30 minute intervals, until finally at about 2:00 PM the flight was canceled. The delays and cancellation were due to FAA restrictions on air traffic in the Los Angeles area resulting from the ongoing civil crisis there. Several phone calls to the China Eastern Airline office in Los Angeles revealed the information that their flight number MU984, on which we were scheduled to fly to Shanghai, also made an intermediate scheduled stop at Seattle. A series of frantic rescheduling activities resulted in China Eastern being given authority to hold the flight about 1½ hours, to permit our group to board there (with a 10 minute connection time). Unknown to us, China Eastern in Los Angeles was almost immediately overruled on their decision to hold the flight by their dispatcher in Shanghai. They notified Continental in Houston, but the information failed to be passed on to us, or to the Continental agent who arranged for us to go on to Seattle in three separate groups. Thus we converged on Seattle at about 8:30 PM, only to find that our flight had arrived and left on schedule without us. After much discussion with the China Eastern and Continental Airlines agents, including conversations with Continental personnel at Houston, Continental provided complimentary lodging for the group at the Holiday Inn, Renton, Washington. The delegation caucused to discuss the available options for proceeding. These were: 1) calling the whole thing off, and recovering such funds from our payments as we could, 2) staying at Seattle until the next scheduled China Eastern flight to Shanghai departed (Tuesday, May 6), or 3) proceeding to Beijing at the earliest possible time on other airlines at additional cost. The delegation was unanimous in adopting the latter option. On Saturday, May 2, we departed Seattle on Northwest Airlines flight number 7, a Boeing 747, arriving at Narita Airport (Tokyo) at about 2:30 PM on Sunday, May 3. At Narita, we transferred to China Air flight number 952 (a Boeing 737), departing at 5:00 PM. After an intermediate stop at Dalian, we arrived at the Beijing Airport at 10:00 PM, only 11 hours 45 minutes later than our original schedule. In response to a fax we had sent to the Chinese Society of Astronautics (CSA) in Beijing at the time of our departure from Seattle, we were met at the airport by Mr. Chen Rongying (Head of the Office, CSA), Mrs. Li Furong (Deputy Head of the Office, CSA), and a host of assistants. We were transported to the International Hotel, which was our residence while in Beijing. There we were presented with welcoming kits consisting of maps, schedules, light-weight travel bags or tote bags, and wide-brimmed hats (to help guard against sunburn problems experienced by previous visiting groups).

May 4, 1992
Monday

Reporter: Mr. W. Geissler

Beijing

Visit to the Beijing Institute of Satellite Environment Engineering (BISEE) (Also known as the 511 Institute. Until sometime in 1990, this organization was officially named "The Beijing Institute of Environmental Test Engineering (BIETE).")

We left the hotel by bus at 8:45 AM for the BISEE, accompanied (as we were throughout the trip) by Li Furong and Chen Rongying of the CSA, arriving at approximately 10:00 AM. We were welcomed by the Director, Professor Ke Shou Quan, and Deputy Director, Professor Huang Ben-Chen. Professor Ke related that the BISEE comprises two facilities. One is located in the northwestern outskirts of Beijing. The other, where we were now visiting, is near the village of Xiazhuang, in Huairou County about 40 km northeast of Beijing. They have a total staff of 750 and are responsible for all environmental ground testing of their satellites and the development of environmental facilities. Testing includes thermal vacuum, acoustics, and dynamic vibration. They will also test customer avionics devices on request to see if they will withstand the launch environment. With help from Mr. Chen, he also discussed the general makeup of the Chinese Academy of Space Technology (CAST). It is composed of 14 institutes and factories including the BISEE.

Following Professor Ke's introduction, we asked a number of questions whose answers are summarized in the following:

- CAST is performing early concept studies on manned spacecraft.
- The CSA is responsible for technical exchange (including foreign) and local education.
- The CSA is a voting member of the International Space Federation.
- The CSA has flown one Shuttle GAS experiment and plans to fly a tomato seed experiment on one of their satellites in the near future.
- Their space program "flight design" is done by the Beijing System Engineering Institute which is part of the CAST organization.

We then toured the facility and were shown two large thermal/vacuum test chambers. The first, designated KM3, is 3.6 m diameter and 7.3 m long. It was built in 1970, but has undergone several upgrade modifications. It has a liquid nitrogen cooled internal shroud, cryopumping, and operates at pressure levels as low as 5×10^{-7} Pa.

We also saw the KM4 facility, which at the present time is China's largest thermal/vacuum chamber. It has been used to test Chinese synchronous communication satellites, and polar orbit meteorological satellites. Its shape is that of an upright cylinder 7.0 m diameter and 12.0 m high. Originally built in 1976, it has also undergone a major upgrade over the past 20 months. The original oil diffusion pumps have been replaced by three sets of valved 48" oil-free cryopumps with a pumping speed of 5×10^4 L/s. A new helium

May 4 (cont.)

refrigeration system rated at 1200 W cools internal cryopanel to 20 K for an O₂ and N₂ pumping speed of 2×10^6 L/s at chamber pressures of 10^{-4} to 10^{-5} Pa. An LN₂ system rated at 70 kW cools the internal thermal shroud. The overhead solar simulator system was also recently upgraded. It comprises 19 sets of Cassegrain optics, each with a 25 kW xenon short arc light source. The beam area is 12 m².

Professor Ke mentioned that he has received approval and funding to go ahead with a new T/V chamber which has been in preliminary design for several years. Designated KM6, it will be 12 m diameter and 22 m high, and will incorporate state-of-the-art performance features.

Following the tour, we were served a wonderful multi-course lunch at their very modest dining facility.

Visit to the Great Wall

After lunch, we boarded the bus and were taken for a tour of the Great Wall. The section we visited was near Xiazhuang and had been recently (1984) restored. The restored section was 2000 m long and was originally built in 1500 A.D. We rode a gondola to the wall on top of a mountain and some of us walked the 1000 steps back down to the parking area. The wall and the periodic guard stations were very impressive to see.

Evening Activities

We arrived back at the hotel at 5:30 PM and immediately (5:45) left for a "western" dinner at the International Club. Our hosts for the dinner were senior officials of the Chinese Society of Astronautics including the First Secretary General Liu Jingsheng and Deputy Secretary General Fu Bingchen. Their definition of a western dinner is where each person is served individual portions (salad, entree, etc.) in contrast to their style which is shared dishes which you access via a lazy susan in the center of a shared table. The dinner was supposed to be Italian but it lacked oregano in the sauce. Other than that, it was good. Following dinner, we went to an excellent acrobat show at the same club. However, after our long overseas trip, a very full day in Beijing, and a heavy dinner, most of us slept, to various degrees, through the show. We were back at the hotel at 8:30 PM.

May 5, 1992
Tuesday

Reporter: Dr. B. Goldsberry

Visit to the Chinese Academy of Space Technology (CAST)

It was raining at 9:00 AM when we left by bus for the CAST Headquarters building in the northwestern section of Beijing. Upon arrival we were escorted into the President's conference room on the second floor. There, we were welcomed by Prof. Qi Fa Ren, President of CAST. Others present were Prof. Yang Jiachi (CAST), Prof. Chen Fangyun (Academia Sinica), Prof. Wang Xiji (CAST & VP Chinese Society of Space Research), Prof. Min Guirong (President of Science & Technology Commission, and past President of CAST), Mr. Wang Yuan (Director, International Cooperation Div.), and Mr. Meng Bo (Program Mgr., Intl. Coop. Dept.). Prof. Qi provided the delegates with brochures describing CAST, and delivered a brief overview of their organization, responsibilities, and accomplishments.

Following an exchange of souvenirs, the group moved to a large auditorium equipped with video screens and cameras, where over one hundred CAST faculty and students were waiting. A video was shown about CAST, BSIEE, and other Chinese institutes supporting the aerospace effort in this country. It also identified the more than 32 (scientific and communication) satellites successfully launched by the PRC.

Prof. Wang Xiji presided over the symposium which followed the video. The following presentations were given:

- W. Geissler: Space Station Freedom Overview
- T. Hua: Shuttle/Station Berthing Operations Dynamics & Control—An Overview.
The second presentation was accompanied by a 2 minute video of a berthing simulation.
- Dr. Kwei Tu: Digital Communication System Design
- Andrew Petro: Concepts for Future Human Spacecraft

Then there was an open forum in which the Chinese and American delegates participated in a question and answer period. Questions:

- What impact have the recent budget cuts had on the SSF configuration? Answered by Geissler: Modules have been reduced in size.
- How do contractors manage the changes? Answered by Geissler: With much difficulty.
- How does China manage spacecraft design? Answer: CAST does research, development and fabrication.
- Is there competition for the design in China? Answer: There is no competition but the customer is difficult to satisfy.
- Where are the satellites assembled? Answer: Beijing Scientific Instrument Factory.

May 5 (cont.)

- How is cooperative program between Brazil and CAST? Answer: There are plans to jointly build two satellites... Cost 1.5 million.
- There were also several organizational questions asked and answered clarifying organization chart.
- How much attention does China pay to Total Quality Management? Answer: There is an active program which has been successful. There has been a failure rate of less than 1%. Only 5 failures of the 16 systems in space. "Quality is life."
- What is the final budget for SSF? Answer: To date, it will require 30 billion to complete (estimate).
- What is the fault tolerance for STS computers? Answer: There are 5 computers (3 identical, 1 backup). The software on backup computer was developed by different company. Inflight maintenance is used to work around problem.

Lunch was served at the Jing Cheng Restaurant. The food was very good and everyone ate with chopsticks. After lunch, we stopped to visit the Summer Palace. It was still raining but we had a wonderful time and ran into the spouse tour group before leaving.

Visit to the Institute of Space Medico-Engineering (ISME)

We proceeded from the Summer Palace to the ISME, arriving about 3:00 PM. Our hosts, Prof. Dr. Jinhe Wei (Director of the Institute) and Prof. Dr. Zhang Ruguo (Chairman of the Committee of Science and Technology), welcomed us and provided an introductory overview of the Institute. A considerable number of Institute staff and students were gathered in an auditorium where two presentations were given by members of the delegation:

- Jerry Goodman: Crew Compartment on Shuttle
- Grace Hua: Intelligent Training Systems for Space Systems Programs (Computer-Aided) – Application of Artificial Intelligence

The interpreter for this session was a former classmate of Betty Goldsberry's from the 1990 class of the International Space University. Chen Shangang is his name and he is an Assistant Professor at the institute.

The presentations were followed by visits to 1) a centrifuge to test the effects of large gravity forces (up to 15 g with an onset rate of 2 g/s) on the human, 2) a rotating chair to study motion sickness, 3) a regenerative life support system using lithium hydroxide, and 4) a pressure chamber where humans have lived up to one month under various temperatures and pressures. Bedrest studies are also conducted in the pressure chamber. It was interesting to note the Chinese have successfully used herbs and drugs to control motion sickness.

May 5 (cont.)

Evening Reception

At 6:30 PM, in a ballroom of the China World Hotel, we attended a reception held in our honor by the Chinese Society of Astronautics. Approximately 40-50 officers and members of the CSA attended, including many with previous ties to the Houston Section. A delicious buffet with perhaps thirty or more beautifully prepared food dishes was served. The welcoming remarks and toast were to have been given by the President of CSA, Dr. Ren Xinmin; however, his arrival was delayed by urgent business. This function was assumed by Mr. Ma Ji, Vice President of the Society, and a former V.P. of the National Defense Commission for Science and Technology. A response to Mr. Ma's welcome was given by our delegation leader, Jim McLane. On behalf of the CSA, Mr. Ma accepted a framed certificate from JSC and the Houston Section AIAA signed by AIAA Fellow and Center Director Aaron Cohen. The certificate commemorated the International Space Year and Space Shuttle mission No. STS-42, on which a CSA-sponsored get-away-special payload was flown. Among the mementos mounted with the certificate was a PRC flag flown on the mission. On behalf of the Houston Section AIAA, Mr. McLane accepted a mounted spherical crystal trophy with a brass plate CSA inscription. Inside the clear crystal ball was a white ceramic likeness of the Moon Goddess, Chang E, who often is seen in graphical presentations of the Ministry of Aerospace Industries. (This trophy was subsequently presented to the Houston Section Chairman at the annual awards ceremony in June, 1992.) The reception ended at 8:00 PM.

Spouses' Program

Reporter: Mrs. J. Geissler

The tour of the Summer Palace was attended by camp followers and Lou. It was to have gone to Fragrant Hills but because of rain went shopping at a very good government store—cloisonné, jade, pearl, silk embroidery, clothes and rugs. Spent all my yuan; had to get another supply for the next spree. Had lunch at the Fragrant Hills Restaurant—the food was similar to the day before, only three soups—hot and sour, egg drop and squid soup which I thought was excellent. The tour of the Summer Palace was very interesting—had to climb over a sill 6 to 12 inches to enter and exit each large room, difficult for those on crutches. Saw theater stage and walked the 750 m long hall to see the Marble Boat, 17-arch bridge and Tower of Buddha of Innocence. Returned to hotel to get ready for reception at World Hotel.

May 6, 1992
Wednesday

Reporter: Mr. T. Hua

Beijing Cultural Activities

We left the hotel at 9:00 AM in two buses. Our first stop was at the Beijing North Suburbs Industrial Art Factory. This factory manufactured cloisonné ware. Cloisonné, also called "copper-body and wire-inlaid enamel," has a long-standing history of several hundred years. We watched the elaborate and complicated processes: base hammering, copper-wire curving, soldering, enamel-filling, enamel firing, polishing, gilding, etc. Several souvenirs were purchased.

We then went to the area where 13 of the 16 Ming emperors were buried, stopping at the Dingling site. This is the only one which has been completely excavated and restored. We walked the gardens with beautiful trees. Cypress trees were growing right out of the bricks. The courtyard has many cement tables with elephant statues for chairs. We learned how the tomb was built and discovered. Many steps led down to the underground palace and the tomb of the fourteenth emperor, Wan Li. It held large red boxes for the Emperor Wan Li and his two Empresses—one on each side of his. The floor of the tomb was made of rare marble. The cost of building the Ming tomb was very expensive for the Chinese people. More than two years' worth of the national income was spent on its construction. We also saw thrones made of alabaster. Lunch was at a restaurant on the site (only for foreigners).

Returning to Beijing, there was a short visit to the Daoist White Cloud temple. This temple contains many small temples, each constructed at different times in history. Our guide told us a story about the luck of the temple. Once another Buddhist temple (Black Wind) was built next to it. For a time it stole its luck. A fortune teller told the Daoist leaders to build a bridge to stop the black wind of bad luck. After the bridge was built, good luck returned to the White Cloud Temple and the Black Wind Temple fell on hard times and closed.

In the evening, we went to the Nationalities Hotel for Peking Duck. Other items on the menu were 1) snake-headed fish egg soup and 2) sea cucumber with chile sauce.

May 7, 1992
Thursday

Reporter: Mrs. J. Tu

Beijing to Chengdu

Cultural Activities

After breakfast, we checked out of the International Hotel and headed for the Forbidden City about 9-10 AM. We all boarded on one bus and all baggage was loaded on the other bus.

When we arrived at Tian'anmen Square, across from the front gate to the Forbidden City, two group pictures were taken. We were led to the Tian'anmen gate through the underground tunnel from the Square. Once through this main gate, we were guided through the Palace Museum, the Forbidden City. Several magnificent gates and halls were toured. Since there were 9,999½ rooms in the palace ground, only a few rooms were open to the public including the hall housing the imperial throne.

About 12:20 PM, the group completed the tour and boarded the bus at the Shengwu-men Gate and left for the China Trust Investment Club (CTIC) for luncheon. Classical Chinese food with 12-course dishes were served. At 2:20 PM, we left for the Beijing International Airport where we said goodbye to our tour guide, Mr. Chui Ping, and several members of the CAST staff.

Travel

We boarded a plane of the China Southwest Airlines, flight number 4104, for Chengdu around 4:10 PM. Mr. Chen, Ms. Li and Ms. Zhong of the CSA Headquarters office accompanied our group. About 6:50 PM, the plane landed at Chengdu Airport. Ms. Liu Yen, a staff member of China Domestic Travel Service (CDTS) stationed at Chengdu, greeted us. She introduced the city of Chengdu to the group on the bus. This city is the capital of Sichuan Province with a population of 8.8 million. On the road to Jin Jiang Hotel, all automobiles must go through car wash lines by ordinance of the city. Also a toll must be paid through a checkpoint.

After we arrived at Jin Jiang Hotel, we were led to dinner before checking into the room. During the dinner, typical music from Taiwan was played. At 9:00 PM all the members retired to the assigned rooms. The hotel is a four-star level and comparable to Holiday Inn.

May 8, 1992
Friday

Reporters: Mrs. G. Hua and Mr. C. Jacobson

Chengdu to Xichang

Cultural Activities

We packed overnight bags for the trip to Xichang and stored the remaining luggage at the Jin Jiang Hotel. First thing we did was to motor across the street to the Min Shan Hotel for a "western" breakfast (eggs, sausage, etc.). After breakfast we set out on a 70 km drive through the center of Chengdu and the old town to the Du Jiang Dam in Ke Shen County. The weather was cloudy and pleasant. The associated Du Jiang irrigation system was built in 251 B.C. Our guide for the day was Ms. Liu Yen and our driver was Mr. Wong. On the morning drive we gained the greatest appreciation yet for what 1.2 billion population country is. The first stop was at Er Wang (Two Princes) Temple which afforded a view of the all-over dam and irrigation project. Two emperors who were father (Li Bing) and son (Er Lang) built the dam and irrigation system. This system provides irrigation for the entire province of Sichuan. The temple was built in 494 A.D. on the slope of Yulei Mountain to commemorate the two princes. The mountain is right next to the Du Jiang Dam. At this location, Min Jiang is divided into two branches, one of which flows year round. The other branch is controlled by the dam for irrigation purposes (the dam is not open during this rather wet season). Even though Chengdu is situated on a low plain, it is rarely flooded because of the existence of the dam here. Pedestrians can cross the two river branches by suspension bridges which are each roughly 100 yards long.

From the Du Jiang Dam, we took a 20 minute bus ride to the heart of Du Jiang City to visit the Le Dui Park. The park has several small gardens. Its major attraction is the Fu Lung Kuan ("Dragon Taming Monument"). It houses a stone carved statue of Li Bing and a few items from his time. From here, we can see the original dam site which Li Bing and Er Lang built 2000 years ago. It is downstream from where we see the present dam in a very picturesque valley. We stopped at the Du Jiang Yan Great Hotel for lunch. The food was mostly regional vegetables. We left Du Jiang City at 2:15 and arrived at the Chengdu railroad station at 3:30.

Travel

We boarded train number 93 at 4:00 PM and departed at 4:15 PM as scheduled. We traveled through beautiful rolling farm country. Crops were rice, wheat and rape, very neat and tidy and irrigated by the system that we saw earlier in the day. Our accommodations on the train were well worn but fairly comfortable. There were four people per compartment. Dinner was served at 6:00 PM in the dining car and by 10:00 PM everyone had packed it in for the night.

May 9, 1992
Saturday

Reporter: Mr. A. Petro

Xichang

Visit to the Xichang Satellite Launch Center

We arrived by train in Xichang at 5:30 AM and went by bus to the Teng Yu Lou ("Satellite") Hotel, arriving by 6 AM. The delegation rested in the hotel until 7:30 AM. The hotel was fairly well equipped with spray shower and TV—complete with dust cover. Breakfast was a combination Chinese-Western style: Chinese appetizers, steamed rolls, rice cereal, and scrambled eggs.

We departed the hotel for the launch site visit at 8:10 AM. The launch site is about 65 km from the town of Xichang. Along the way we saw the usual road traffic—bicycles, bicycle carts, handcarts carrying vegetables, pigs, etc. The land on both sides of the road was used for growing rice and many other crops. We saw many farmers at work, in all phases of the growing cycle. There were also many water buffalo in the fields. We saw many carts being pulled by ponies.

The delegation got to participate in the agricultural work since the farmers pitch their wheat out onto the road. They take advantage of the auto traffic to thresh the grain. The road was covered with grain stalks nearly continuously for many miles. In some places there were even rock barricades in place to ensure that the vehicles drive over the grain.

We arrived at the launch site complex at 9:35 AM. We were first shown the Technical Area which consists of the spacecraft processing building (which we did not enter) and the launch vehicle processing building. We were told that the Hughes 601 communications satellite was in the spacecraft building. We were shown into the launch vehicle processing building which is used to receive and check out the Long March 2 and 3 vehicles. We were first shown the receiving area which was empty and then the checkout area which housed a complete Long March 3 vehicle, lying horizontally on transport carts. The Long March 3 is a three-stage vehicle with a payload capacity of 1.5 tons.

We discussed the disposal of spent Long March stages and learned that the first stage falls on a relatively unpopulated region of Guizhou Province. The second stage falls in the Pacific Ocean. The Long March 3 is used primarily for geostationary payloads. Spacecraft are launched to the east into an initial orbit of 100 by 400 km. The site is at an elevation of 1800 m and a latitude of 28 degrees north. The launch vehicle stages are moved out of the building on their transport carts under human power. Then they are pulled by truck to the launch pad. At the pad, the stages are raised by cranes and stacked for launch.

We next rode by bus to the launch pad area. We parked between the two launch pads. A pad used for Long March 3 was on one side and a pad for Long March 2 was on the other side. We were able to walk to within a few feet of the base of the Long March 3 pad. The Long March 2 pad, the more sophisticated of the two, was about 500 m away from our

May 9 (cont.)

vantage point. Each pad was surrounded by three very tall lightning arrester towers which also had weather instruments attached to them.

The Long March 2 pad had a fixed service tower and a movable enclosure which is pulled away from the vehicle 80 minutes before launch. The structure is 96 meters high. The Long March 2 tower will be modified in the future for use with the Long March 3A. The Long March 3 pad had a single tower with 12 levels. Two levels had movable enclosures for the payload area. Propellant was stored in the area beneath where we parked. A new cryogenic propellant storage area was under construction. We could see primitive construction techniques being used.

We next went by bus to the Command Control Center. The center is used for controlling the launch and coordinating data flow from the tracking network to the satellite control facility in Xi'an. The center had the look of the Houston Mission Control Center but there were only four functional control positions in the front of the room. The rest of the seating was for observers. The back of the room had an area with more sophisticated consoles. We were told it is used for launch range safety control. The area was sectioned off with room dividers. They treated this area with more sensitivity than the rest of the room. We were allowed to take photos in the main area but not the range safety area. We were told an upgrade to the main area is planned. There was a glass-enclosed gallery for visitors behind and above the control room. We did not go in there.

We were told that there are three tracking stations in the area using optical and radar devices. There are also two more remote stations and two tracking ships used for launches. The control center has two IBM 360 computers (or something similar) and an upgrade to the VAX 6000 is planned.

We left the launch site area at 11:45 AM to return to the hotel in the town of Xichang. We had lunch which was similar to our previous meals in Sichuan Province.

The personnel that escorted us did identify themselves to the group; however, we expect formal introductions at the reception later today. The delegates were generally impressed with the extent of the tour and the openness of our hosts.

Reporter: Mr. L. Livingston

Afternoon Activities

After a Sichuan lunch (very spicy) at the hotel, we rested for two hours, then drove to the Soil Forest, a trip of about an hour. This is a formation of deep erosion of soft soil covered by a harder surface layer, resulting in strongly vertical shapes perhaps 50 feet high. The more agile members of the delegation enjoyed climbing these formations; the rest enjoyed watching the performance.

May 9 (cont.)

Formal Banquet

We returned to the hotel in time for a banquet hosted by Wang Yuxian, Deputy Chief of Engineering at the Xichang Satellite Launch Center (XSLC). Also present were Zhang Jianqi, Deputy Head of Planning of the XSLC; Cheng Zhan Bing, President of the Xichang Science and Technology Association; Huang Shengzhang, Security Director XSLC; and a representative of the Xichang Tourist Bureau. The lavish banquet was initiated by an exchange of greetings and toasts by Mr. Wang and Jim McLane. After the banquet, Mr. Wang was presented a Houston Section 30th Anniversary poster signed by the artist, Pat Rawlings, and 30th Anniversary lapel pins. Mr. Wang presented each member of the delegation a Long March 2E lapel pin and an album of photographs of the XSLC, including group photographs taken that morning at the site.

May 10, 1992
Sunday

Reporter: Mrs. M. Jacobson

Xichang to Chengdu

Cultural Activities

Beautiful sunny day; mountains surround us here! After a good night's sleep and a 7:30 breakfast at the Teng Yun Lou Hotel, we took a short trip to tour Qianzhai Lake and Lushan Mountain. Rode around the lake on a typical river boat. The lake was very clean with no pollution. The humidity quite low at this time. Lovely trip. Chinese brought tape recorder for dancing. Had the usual coconut drink along. After the trip we visited the connecting park, and saw some beautiful bougainvillea and other recognizable foliage. Natives enjoying the day off everywhere.

Bus trip to Buddhist temple. Came upon a special ceremony for Buddha's birth. Buddhist temple priests in residency here. Back to hotel for lunch. Free time until 3 PM.

The food in this province is very good, also very spicy. Chinese open and friendly to us everywhere. I'm beginning to enjoy the green tea—very mild and never bitter. The wheat is being harvested here and all roads are covered with it. A unique way to thresh (cars run over it) but no doubt effective. Roads are being improved rapidly, probably due to the space activity.

At 3 PM we took the bus on a shopping spree to downtown Xichang. Remarkable how the free enterprise works on the streets. Shopkeepers very polite compared to most street vendors. Also visited a department store briefly. Hurried back to hotel to eat quickly and leave for train at 7 PM for Chengdu. Socializing for the rest of the evening.

May 11, 1992
Monday

Reporter. Mrs. M. Jacobson

Chengdu

Cultural Activities and Attempted Travel

6 o'clock wake-up on train to Chengdu. Cloudy and raining. Streets alive with colorful rain ponchos. Stopped by Jin Jiang Hotel (4-star) to check our luggage; it will be sent to airport from here. Breakfast at (5-star) Min Shan Hotel. Same as on Friday.

Went to the zoo and saw the pandas. Much shopping there. Proceeded to the hand-sewn embroidery factory. More shopping. Then to the Sichuan Brocade Factory where all of the weaving is done by machine. Arrived back at Min Shan Hotel for great American lunch. Off to the airport; arrived at 3 PM for 3:40 flight, then the wheels fell off. The CDTs person responsible for bringing our stored luggage (and airline tickets) to the airport simply forgot about it until he was reminded too late. Missed the flight.

4:45 PM. We waited in airport to find out the new plan. Leaving now to go back to the hotel. Of all things, we got caught in the wash trap. The bus got a quick once-over. Arrived at new Hotel Chengdu. Very nice, better than 4-star.

7 PM. After shower, etc., all met again in second floor restaurant for the best meal yet. Tomorrow we will attempt again to go to Shanghai.

Reporter: Mrs. G. Hua

Meeting with Prof. Xu Tingwei

[Editor's Note: In March of 1989, Prof. Xu Tingwei, Director of the Computer Center of Sichuan University, was a house guest of Dot and Jim McLane in Houston for three days. He was accompanying Prof. Hua Ben Chen from BISEE, and had performed some computer thermal modeling for the cryogenic pumping system of the proposed very large BISEE T/V chamber KM6. Accordingly, he was invited to join the delegation for lunch as we came through Chengdu on our way from Xi-chang to Shanghai. Because of their professional interest in the status of computer technology in China, Grace and Tuyen Hua were asked to join Prof. Xu for discussions before lunch. The meeting took place in the lobby of the Min Shan Hotel.]

Prof. Xu talked about where the Chinese are as far as computer technology is concerned. Most of the hardware is imported from the United States, Japan and Hong Kong. Because of patent issues and other trade restrictions and lack of resources, the Chinese cannot make progress in their own R&D as quickly as they hope. The latest systems Professor Xu's Computer Center bought were a Unisys mainframe, a lot of Sun workstations and 386/486 PCs. The major activities the Computer Center are undertaking are R&D and city management. In other parts of China, the Chinese are producing scanners, and developing diagnostic expert systems and natural language parsers.

May 12, 1992
Tuesday

Reporter: Mr. M. Robinson

Chengdu to Shanghai

Cultural Activities in Chengdu

Good western breakfast in Chengdu Hotel, 3 (4?) star hotel. At 6:30 so foggy could not see street from eighth floor. Fog burning off quickly. Wow! Clean fellow travelers all showered, etc. after 24 hours (including train from Xichang to Chengdu).

Chengdu sightseeing at Wu Hou Temple, also known as Temple of Marquis Wu. It is dedicated to Zhuge Liang (181-284), prime minister of the state of Shu during the Three Kingdom Period (220-280). He was conferred the title of Marquis of Wu. The temple was integrated in the Ming Dynasty. 28 statues of the Shu ministers and generals are in side rooms along the long straight walk. Also 40 stone tablets and 30 inscribed plaques. The calligraphy and engraving are considered outstanding. The beautiful park-like walk with multiple open air gates is spotted with sculptures of animals along with large ornate carved pots (to 6' dia.). The gates are decorated with large 2'x4' brightly colored Chinese lanterns and 4' gold leaf Chinese characters attesting to the goodness of the prime minister (Marquis of Wu) and the king (Liu Bei). On one side of the main walk and structures is a water walk, on the other a garden walk. The gates are ornately decorated with carvings, etc. On the beautiful tile roof peak are sculptures of humans, non-humans, monkeys and other animals. Also on the last building halfway up the tile roof is an unusual 20 foot long sculpture of a Buddha-like figure with monkeys at the end and other figures in between. At the end of the wall behind and off to the left is a souvenir shop with nice items and our (no shopping?) tour again went wild and bought like crazy.

Left the temple and had a great lunch. Either the food is getting better or we are all developing a taste for same. A new very tender bamboo dish and delicious string beans were my favorites. Jane-Dee Tu asked the waiters if she and Kwei could sit with the tour guide group and was told no. They should sit at a separate table. Leaving the restaurant, another buying spree of Chinese ceramics and scroll paintings.

Travel to Shanghai

Left for the airport; saw at least 6 identical bicycle assemblies each with a 5-gallon tank and a tall mast and a whitewashing roller on top. Saw three parasails descending en route. Arrived at airport at 12:40, waited 3 hours to board and took off at 3:40. Most were nervous about the flight after yesterday's failure. Plane left on time and arrived at Shanghai. Drove across the city of 11 million people to the 2 year old 5-star hotel Portman Shangri-La in the Shanghai Center. Beautiful. We were met at the airport by Dr. Liang Jin-Cai (Director, Shanghai Astronautical Society), Mr. Song Yun-Peng (Secretary-General, Shanghai Astronautical Society), Mr. Wang Yue (Director, Foreign Affairs Department, Shanghai Bureau of Astronautics), and Mme. Lu Fu-Zhen (Shanghai Bureau of Astronautics).

May 12 (cont.)

Walked across the street to the Seafood Restaurant. Great meal, best yet. The clams were the best I have ever eaten. After dinner, much discussion on the new travel and meeting agenda since a scheduled day in Shanghai had been lost because of the delay in Chengdu. Although our Chinese hosts suggested that we make up the day by forgoing the excursion to Suzhou, it was decided to eliminate the tour of Shanghai instead.

May 13, 1992
Wednesday

Reporter: Mr. C. Jacobson

Shanghai

Visit to the Shanghai Aircraft Manufacturing Factory (SAMF)

Through special arrangement, at 0800 Mack Robinson and Chuck Jacobson left the main delegation and departed the hotel for the SAMF at Da Chang. The weather was foggy/hazy with pleasant temperature. We were accompanied by Mr. Du Wei of the International Cooperation Dept., Shanghai Bureau of Astronautics, Ministry of Aerospace Industry. Mr. Du served as interpreter. The taxi ride took a little over an hour with an intermediate stop to drop off group tickets for reconfirmation of the flight to the U.S.

Upon arrival we were met by Mr. Wong from the Foreign Visitors Office for a brief introductory discussion. Soon we were joined by Mr. Ken Yata, Director of Administration, McDonnell Douglas China Technical Services, Inc. (MDCTS). Following is what we saw and heard.

MDCTS is supporting the SAMF under a co-production agreement which involves technology transfer to the PRC. Under this agreement MDCTS provides advice, guidance, training and technical (manufacturing) expertise to SAMF. Originally, all parts and subassemblies were shipped to SAMF from Long Beach for final assembly of the MD-82 series aircraft. The original agreement was for co-production of 25 aircraft. Later, 10 more were authorized for 35 total. More recently agreement was reached to build an additional 40 aircraft.

28 aircraft have been delivered to date (to China Eastern and China Northern). At this point production of the MD-83 began. The MD-83 is a longer range MD-82 with the same passenger configuration. 4000 additional kg of fuel was added and the range was increased from 3932 km to 4676 km.

The last 5 (of 35) aircraft will be purchased by Douglas for resale to non-PRC airlines. Planning is in progress to produce the MD-95 at SAMF. MD-95 is a 105 passenger short haul version.

Gradually, more sub-assemblies will be fabricated at SAMF. As of today the most significant sub-assembly is the horizontal stabilizer. A five-axis milling machine has been installed for hogging out wing skins and stiffeners. Not much saving yet. Only 10% of cost is in final assembly. Much greater gains will be made as sub-assembly fabrication at SAMF increases. The nose section is being fabricated at Chengdu then shipped to Long Beach for stuffing and return shipped to SAMF.

At the present time the production rate is only 7 aircraft per year. Two (29 & 30) have wing and fuselage mated. Three (31, 32 & 33) are in pre-mate flow. The factory is a carbon copy of the Long Beach plant insofar as procedures and processes are concerned. All paper

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has been translated into Chinese. What this has enabled has been early certification by FAA (an amendment to the DAC certification) and ease of teleconference discussions of design or production issues with Long Beach.

Following this very fine tour Mr. Yata excused himself to attend a meeting and we were accompanied to lunch in the factory lunchroom by Mr. Wong and Mr. Du. (An interesting point: in our earlier discussion with Mr. Wong we conversed in English. At lunch we only spoke through the interpreter.) Following lunch we returned to the Shangri-La by taxi arriving at about 1330.

Reporter: Mrs. D. McLane

Spouses' Program

After breakfast, our group boarded a bus and was escorted to the Grand View Garden (Daguanyuan) about 40 miles west of downtown Shanghai. This is a 25 acre reconstruction of the pavilions, ponds and bridges featured in the classic novel *Dream of the Red Chamber*. The architecture is that of China several centuries ago. Lunch at a roadside restaurant on the return trip was outstanding.

Reporter: Mrs. E. Robinson

Visit to the Shanghai Institute of Satellite Engineering (SISE)

After breakfast at the hotel, the delegation was driven to the SISE in the Men Hang district of Shanghai, arriving about 9:00 AM. We were greeted by Prof. Meng Zhi-Zhong, Director of the Institute, and others of his staff. We relaxed on sofas and overstuffed easy chairs in his main reception room, and sipped tea and soft drinks while he briefed us on the work of the Institute. SISE falls under the CAST umbrella. They are responsible for design, manufacture, and test of meteorological and scientific satellites. There have been three meteorological satellites of the FY-1 series launched into polar orbits, permitting two views daily of every point on earth. The first was an experimental test mission of short duration. The second was launched in September of 1988 and operated successfully for some time. Eventually, cosmic radiation damaged the stabilization system, causing the satellite to tumble. They have been able to analyze this failure with considerable confidence, and their designs now include features to cope with that environment. The third FY-1 continues to function, with the data being accessible to anyone in real time. Foreign meteorologists have assured them that the data ranks in quality along with the best of western satellites. Their main project now is a new meteorosat designated FY-2 which will soon be launched into a geosynchronous orbit. Professor Meng said that most of the facilities of the Institute are currently undergoing major rehabilitation and upgrade, so we would be limited in our tour.

The walk to a "clean" assembly room provided a good look at the wooded setting of the Institute, with lots of pines and shrubs. After donning the customary clean-room garb,

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we were shown elements of the FY-2, as well as engineering models of several of their satellites. We also visited a vacuum calibration facility, said to be the only one of its kind in Asia, where calibration of earth sensing apparatus was underway.

Visit to the Xin Zhong Hua Machinery Factory

It was a short ride from the SISE to the Xin Zhong Hua Machinery Plant where Long March launch vehicles are assembled. "Long March" translates in Chinese as "Chang Zhen", thus the launch vehicles in this series are designated "CZ-***". Our principal host for the visit was Professor Deng Conggu, Director of the Science and Technology Commission. He briefed us in a large conference room, with a good supply of tea and soft drinks to slake our thirst while we listened. Like many aerospace facilities in China, the plant has a collateral responsibility to support the civilian economy, in this case by manufacturing 100,000 refrigerators each year. Work in the factory has been concerned with both the CZ-3 and CZ-4, and variations of these. The staff of 2,500, which includes about 650 engineers, has a range of R&D, engineering and manufacturing responsibilities. Trade agreements with the U.S. limit Chinese commercial launches of foreign satellites. If there were no restrictions, the PRC could perform as many as 20 launches each year. When the rocket is shipped to the launch site, a group from this facility travels with it, but once it is there they only monitor the tests conducted by launch site personnel.

After an exchange of mementos with our delegation leader, we donned clean room clothes again and went out into the high bay assembly area. There was no activity there; however, we were permitted to closely examine a full size vibration test model of the CZ-3. We then went to a nearby restaurant for a delicious lunch.

Reporter: Mr. J. McLane

Joint AIAA/SAS Afternoon Symposium - Group I

Before the delegation left Houston, an agreement was reached with the (SAS) to hold a joint symposium in Shanghai with speakers from both the AIAA and the SAS during our visit. Because of the number of delegates who wished to present papers, it was decided that there should be two concurrent sessions so that no more than one half day would be required. Accordingly, the delegates were divided into two groups after lunch and transported to facilities where SAS participants had already gathered for the event.

Group I went to the Min Hang Science and Technology Society Meeting Room, a fair sized auditorium with a complete array of modern projection and sound equipment to support the presentations. The building was of a modern design. It was only three years old but already suffered from lack of maintenance attention to detail. We were warmly welcomed by Vice-Secretary General Xia Wei of the Minhang District Association of Science and Technology. An estimated 125 to 150 engineers of all ages were in attendance. Dr. Liang Jincai, Director of SAS, acted as the Session Chairman, providing brief introductions of each speaker and subject. He also presided over the question/answer session which

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followed an intermission after all presentations were complete. Mr. Zhu Weiguo from SISE was the principal interpreter; however, Mr. Wang Yue from SBA stepped in to help when the going got rough. The papers and authors were as follows:

1. Space Shuttle - Orbiter Crew Compartment
Jerry R. Goodman
Manager, Crew Module and EVA Engineering Office
Orbiter Project, NASA Johnson Space Center
2. Space Station Freedom Overview
William H. Geissler
Project Manager
Lockheed Engineering and Science Company
Houston, Texas
3. Space Shuttle/Space Station Berthing Operations
Tuyen Hua
Project Engineer, G & C Systems Branch
NASA Johnson Space Center
4. Concepts for Future Human Spacecraft
Andrew Petro
Engineer, Systems Engineering Division
NASA Johnson Space Center
5. "Fen Yun" Meteorological Satellite
Yu Weimin
Senior Engineer
Shanghai Institute of Satellite Engineering

The audience was very attentive. In keeping with regular Chinese meeting protocol, the most senior people present were allowed to ask questions of the speakers first, but everyone was eventually given a chance. Andrew Petro's paper elicited the most questions, perhaps reflecting interest stimulated by the announced PRC policy to soon undertake a manned program, though certainly not on the scale of the Space Shuttle or Space Station Freedom.

Reporter: Dr. K. Tu

Joint AIAA/SAS Afternoon Symposium - Group II

The Group II technical exchange was held in the conference room of the Xin Zhong Hua Machinery Factory. Professor Deng Conggu, Director of the Science & Technology Commission, presided over the technical presentations:

1. A Program for More Effective Use of Engineering Personnel
Emyré B. Robinson
Director, Public Relations
Barrios Technology, Inc., Houston, Texas

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2. Intelligent Training System for the Space Shuttle Program

Grace C. Hua

Computer Scientist

Computer Sciences Corp., Houston, Texas

3. Digital Communications System Design

Dr. Kwei Tu

Senior Advanced Systems Specialist

Lockheed Engineering and Sciences Co., Houston, Texas

4. Is There Life on Mars?

Cai Ji

Associate Professor

East China Normal University

A fifth scheduled presentation, "International Design for Extreme Environment Association," was canceled at the request of the author, Dr. B. Goldsberry, Engineering Manager, Lockheed Engineering and Sciences Co.

There were about 35 attendees including most of the senior staff from Xin Zhong Hua Machinery Plant. Mr. Song Yun Peng, Secretary-General of SAS, also attended the technical presentations.

The presentation by Mrs. Robinson caused the audience to be curious about Mrs. Robinson's personal background. After Dr. Tu's explanation in Chinese about Mrs. Robinson's successful story of private business venture, the Chinese realized that under the free enterprise system anyone can become his own boss and manage his own business as long as he has innovation and works hard.

The presentations started about 1:30 PM and concluded about 3:15 PM in a cordial manner. Mr. Lei Shu Liang of the Shanghai Precision Instrument Institute conducted the translation.

Reporter: Mrs. E. Robinson

Reception and Banquet

In the evening a formal reception and banquet was held in our honor by the Shanghai Bureau of Astronautics (SBA) at the Ren Min Restaurant. Mr. Su She Kun, Director of the SBA, served as the host. Others in attendance included: Dr. Liang Jin Cai, Director-in-Charge of SAS; Mr. Song Yun Peng, Secretary General, SAS; Dr. Chen Xin Sheng, Dep. Director, SBA; Mr. Cheng Pei-jin, Dep. Director, Foreign Affairs Dept., Shanghai Assn. for Science & Technology; Mr. Lei Shu Liang, Head of Research Dept., Shanghai Precision Instrument Factory; Mr. Chen Rongying, CSA; Mrs. Li Furong, CSA; Mr. Zhu Weiguo, SISE; and Mr. Wang Yue, SBA. The banquet followed the standard Chinese format, with the welcoming remarks and toast by Mr. Su Shi Kun, and a response from our delegation leader. Mementos of the visit were exchanged, highlighted by the presentation of a framed

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certificate and PRC flag virtually identical to the one presented to the CSA earlier in Beijing except for the wording on the certificate. Dr. Liang accepted it on behalf of the SAS. The banquet ended at about 9:00 PM.

May 14, 1992
Thursday

Reporter: Mr. J. McLane

Shanghai

Daytime Excursion to Suzhou

After breakfast at the hotel we departed by bus for the ancient city of Suzhou. In addition to the professional guide retained by the SAS, we were accompanied by Mr. Song Yun Peng, Mr. Lei Shu Liang, and Mr. Du Wei all of the SBA. On the two hour ride through heavy traffic the guide provided an interesting running commentary on living conditions in the contemporary PRC. For the last 15 km or so before arriving at Suzhou, the highway paralleled the Grand Canal. It was built in the 6th century as one of the greatest public works projects of all time, and still teems with shipping from Beijing to Hangzhou.

In Suzhou we visited the Tiger Hill Pagoda (where Suzhou's 5th century B.C. founder, King He Lu, is said to be buried), the Hanshan Temple, and the Xiyuan Garden. After lunch at the Suzhou hotel, we visited the Friendship store and returned home. Dinner that evening was once again at the Seafood Restaurant near the Portman hotel.

May 15, 1992
Friday

Reporter: Mr. J. McLane

Shanghai to Houston

After breakfast at the Portman, the delegates had the morning free to attend to last minute chores and packing for the long trip home. After checking out of the hotel Dr. Liang headed a delegation to escort us to lunch at the Ren Min Cafeteria, a unique experience carried out in the glare of TV camera lights from an SAS crew recording it all. Check-in at the new international departure facilities at the airport was a vast improvement over the chaotic conditions in the old terminal. Our China Eastern flight number MU983 (an MD-11) departed on time at 4:00 PM, and arrived in Los Angeles slightly ahead of the scheduled 1:00 PM on the same day (after regaining the day previously lost crossing the international date line). The continuation to Houston was also uneventful on Continental flight number CO476 (a Boeing 727), arriving at 10:15 PM.

APPENDIX A

PERSONAL OBSERVATIONS AND IMPRESSIONS

By Mr. Charles A. Jacobson	A - 3
By Mr. Louis E. Livingston	A - 4
By Mr. James C. McLane, Jr.	A - 7
By Dr. Kwei Tu	A - 8

China Impressions

Mr. Charles A. Jacobson

Space Program

I was not prepared for how simple the process is nor for how long it has been going on. I think that there is a lot to be said for that simplicity. The accommodations for the customer in the mission control center are very good. A good sales feature. I still think that we should show JSC photos of the flower gardens in front of the control center as an idea for improvement of the MCC.

Amount of Development

Having read about the amount in China I was still not prepared for the amount of construction in progress and planned for in the near future.

Lack of Farm Mechanization

At first this was puzzling to me. However, upon reflection, can you imagine what would result from a full scale mechanization of the farm communities? Six hundred million people heading for the cities where unemployment and lack of housing would be catastrophic. It surely must be well thought out government policy to continue with the centuries old farming methods. Addition of incentives for farmers has evidently created a very prosperous and satisfied group.

Adoption of Western Dress

The young people especially were very nicely dressed. This was observed in the cities only. There was no opportunity to see this in the rural areas where we only traveled through in busses and trains.

Funding for Preservation of the Antiquities

It is remarkable that, in a climate of putting every yuan possible into development, the government budgets such a substantial amount for this purpose. Not the sort of thing that I would have thought carries a top priority with a communist government.

Pride in Quality of New Hotels

Our hosts were always quick and very proud to point out that our accommodations were 4 star or 5 star as the case may be.

Relaxation of Political Repression

There seems to be some of this. The comment by our guide to Suzhou that people do not have to be afraid of being overheard in being critical of the government, if true, is dramatic change. To some degree this may have been for our consumption but I believe there is some substance to it.

Noise Free Markets

A lot of activity and it looks like both the entrepreneurs and the customers are having fun. An encouraging development recently is that state owned companies must compete with privately held enterprises. Failure to do so results in bankruptcy and the auction block.

People Everywhere

This is indescribable. There is no conceivable way for anyone to snatch a bit of privacy except, perhaps, in the middle of a wheat field.

Bicycles Everywhere

Segregating bicycle traffic from that of motorized vehicles seems to work quite well. I saw no collisions of bicycles with cars or trucks and only one bicycle-bicycle incident.

China — A Systems Solution

Mr. Louis E. Livingston

By almost any measure, China has had a highly successful space program. As relative latecomers to space, and with less industrial development than most spacefaring countries, China might not have been expected to achieve success as soon as they did. Part of the reason, of course, is the fact that China is by no means as backward as we may sometimes imagine. The stereotype equating China to a billion coolies in rice paddies is only partly justified; it certainly describes a large portion of the Chinese population, but China is also an industrial nation of substantial capacity. Nevertheless, there must be more to the story than that.

Observing not only their space efforts but other aspects of the country as well, two factors emerge repeatedly. First, there seems to be a systems approach to everything they do; that is, they optimize the total system (whatever it may be) rather than individual elements of the system. Second, there is a willingness to adopt the simplest solution that will get the job done. This contrasts sharply with common practice in the U. S. space program, where we have a strong tendency to continue refining a design as long as possible, and sometimes even longer.

At first glance, the Chinese way of doing things—almost anything—seems hopelessly sloppy and wasteful to Western eyes, but appearances can be deceiving. After all, their methods have worked for thousands of years and should not be dismissed out of hand.

Chopsticks

Chopsticks are a case in point, albeit a trivial one. Chopsticks should not be viewed in isolation, but as part of an eating system. For a long time in China, food has been cut into bite-sized pieces in the kitchen so as to cook more quickly, thereby conserving fuel. This being the case, there is no need for knives at the table, and chopsticks are cheaper than forks (anyone with a knife and a piece of bamboo can make serviceable chopsticks in a few minutes) and more versatile. They may seem clumsy, and *are* clumsy when first tried, but all the delegates achieved reasonable mastery very quickly, and most of us didn't even lose weight on the trip. In any case, both of the above mentioned factors (simple solutions and a systems approach) are very much in evidence.

Traffic

Chinese traffic patterns can also be instructive. At first, a Westerner sees nothing but chaos, and marvels that anyone gets anywhere without a major accident. Even on narrow roads, there are men pulling carts, bicycles and tractors trying to go faster than the pedestrians, and cars and trucks going faster than the tractors, yet in two weeks we saw few accidents. More to the point, everyone reaches their destination sooner or later. During rush hours the traffic jams are horrendous, but Houston traffic moves no better at rush hour.

In fact, although the traffic appears chaotic, rules *are* being followed; it's just difficult to tell by casual observation what the rules are. Certainly the rules, especially the unwritten rules that we all know but seldom think about, differ from those in common use in the West. Lanes are marked on the roads, for instance, but no one seems to pay any attention to the markings. This is not surprising, because there aren't enough lanes to accommodate all the different types and speeds of traffic without interference. The cost would be prohibitive, especially in a country with limited investment capital. Consequently, the unwritten rules seem to be "If there isn't enough road for everyone, use common sense" and "Everyone is entitled to get where he's going, and no one is entitled to get there in a hurry." The net result is to utilize the limited paving as efficiently as possible.

Here, the systems approach is not only in use, but is apparently deeply ingrained into the thought patterns of the "man in the street." Multiple use implies that everyone using the road—drivers, cyclists and pedestrians—must continually make decisions as to right of way. These decisions are relatively complex because of the wide variety of traffic using the same roads. The interesting thing is that nearly every potential conflict seems to be worked out in the most efficient overall way. It would be possible, in principle, to devise a specific set of rules covering all possible situations, but the average driver or pedestrian, Chinese or American, could not reasonably be expected to learn and use them. Consequently, the individual must sort out each situation as it arises and resolve it. The fact that the system

works suggests a highly developed, if not virtually instinctive, sense of the general good on the part of all concerned.

This doesn't mean that the typical Chinese driver always defers to the other fellow. Everyone does what he can to reach his destination expeditiously, and doesn't hesitate to assert himself toward that end. However, the typical Westerner's tendency to take personally a failure to yield the right of way isn't in evidence. If you're cut off, you accept the fact and proceed. I suspect that a Houston driver suddenly transplanted to China would almost surely come to grief within the first hour or two; a Chinese trying to drive in Houston would hardly fare better. But in China, the Chinese way works.

Wheat Threshing

The wheat threshing operation that we observed around Xichang is another instance of a simple and, overall, efficient solution to a problem. (It's also an example of fairly rapid adaptation to a new environment—heavy rubber-tired vehicles moving at relatively high speed over a hard surface—to facilitate a tiresome task.) The farmers piled the wheat toward the center of the road and let passing vehicles do the threshing for them, sweeping up and winnowing the grain between vehicles. Now and then a vehicle (generally a sedan) would prefer the thinner areas near the side of the road, presumably not wanting to clean the straw from the crevices in the car afterwards. However, only occasionally did we see stones arrayed on the pavement to coax vehicles over the thickest part of the wheat; most drivers seemed willing to do their part by going where it did the most good. Most of the people involved seemed to be thinking and functioning at the system level, even though perhaps not consciously.

Long March RCS

As a more technical example, the reaction control thrusters on the Long March launch vehicle we saw have only a single gimbal axis. Four such thrusters 90° apart, firing aft and gimballed about a radial axis, provide three-axis attitude control. The propellant feed lines constitute the gimbal axis. The installation could hardly be simpler, and our first impulse might be to look down our noses at such a "primitive" design, but it works. There is a cost in diminished redundancy, but it doesn't appear to be a problem. The reliability enhancement that results from the simpler design tends to offset the reduced redundancy, of course.

Summing Up

On balance, there is much to be said for Chinese methods. Since these methods manifest themselves at so many levels, they must be a fundamental part of the Chinese way of life. It follows that they wouldn't work in the West without adopting at least some Chinese philosophy, and that would take generations. Many of us aren't really ready to adopt the idea that other people, and society as a whole, are important (unless it doesn't cost us anything). It could also be argued that Western, particularly American, individuality and "go

get 'em" spirit made the West, and America, what they are, but that doesn't mean there isn't room for improvement. It's worth thinking about.

Personal Observations and Impressions

Mr. J. C. McLane, Jr.

When Shakespeare wrote "there is nothing new under the sun" he certainly did not have present-day China in mind. One of the things that make return trips to China so interesting is looking for changes in, and new facets to this rapidly developing society. While China is very, very old with the heritage and culture of a population dating back more than four thousand years, its society, bureaucracy, and economic system were essentially reborn at the end of the "cultural revolution" only about twenty-two years ago. Even considering the brutal put-down of the student protests at Tian'anmen Square in 1989, Government policy since 1970 in social and economic matters can be characterized as cautiously pragmatic. The Chinese haste to rejoin the rest of the world after centuries of virtual isolation has resulted in progressive changes being made at a pace not readily matched elsewhere in recent times. These are made visible to the visiting observer with a retrospective baseline as short as twelve to eighteen months, which is the vantage point I have had almost annually since 1986. Looking on in a familiar context, that of the aerospace industry and its associated professional activities, reveals a pattern of change repeated in virtually every sector of the society. Here are a few of the changes (or lack of them) observed on this visit:

Cooperation with organized foreign professional activities: On this trip, the SAS and CSA support of our "Sister Section Initiative" was found to be continuing with the same high level of enthusiasm with which it began six years ago. The staff of both organizations expended a great deal of time and effort in organizing and conducting the visit. Very high ranking space program officials personally welcomed us at every stop of our technical tours, and at appropriate receptions and banquets. Without exception, they expressed approval of our cooperative activity, and hopes for its continuation. It is noted that participation by PRC engineers in foreign technical meetings has been expanded. International conferences in China with Western nation co-sponsorship have been resumed.

New space initiatives: Work on the new geosynchronous meterosat, FY-2, seemed to have slowed in the past year, for reasons not disclosed. Thermal vacuum tests of a full-scale thermal model of the FY-2 were completed at BISEE in August 1990. Given that milestone, I would have expected the FY-2 to be in orbit by now, but that has not occurred. Initiation of the long rumored Chinese Space Station program seems near, but the program is likely to be paced by slow release of funds. There was talk of several new facilities and facility modifications intended to be used on the "space station" program. Since our visit in May, a recoverable satellite of new design has been launched. Details have been sparsely reported by Western media, but the thought that this is another step in their slow, deliberate movement toward manned space flight seems credible.

Other Signs of Change:

- Everyone seems to be better dressed in western-style clothes, not just the young people. The Mao jacket has all but disappeared.
- In Chengdu, large (10-12" high display) digital countdown clocks tell the motorist when to expect the traffic light to change color.
- Everywhere in Sichuan Province, almost all motor vehicles, including buses, trucks and taxis, suspend a 3"×5" clear plastic card from the inside rear-view mirror. The cards mount a photograph of Mao Zhedong on one side and Zhuo Enlai on the other. Inquires failed to produce any explanation for this fad — it may or may not have political significance.
- All kinds of businesses from small tea shops to some large hotels have adopted the brand-new fashion of installing a blanket canopy of small electric lights over the entrance. In view of the widely proclaimed general shortage of electric generating capacity in China, this phenomenon will probably be short-lived.
- Airline passenger terminals in Beijing and Shanghai have been greatly improved, and an upgrade is underway in Chengdu.
- Except in major hotels, large airport terminals, some restaurants, and a few other places where major tourist traffic exists, the public and institutional toilets are still unbelievably filthy.
- In spite of all the technological progress, and the opulent architecture of new hotels and public buildings, most laboratories, shops, and offices are still dingy, drab, dreary workplaces.

Personal Observations and Impressions

Dr. Kwei Tu

The delegation visited various Chinese space related facilities including thermal/vacuum test laboratories, launch site and control center, launch vehicle manufacture plant, satellite assembly facility, space medical research laboratory, etc.

It is my observation and impression that the Chinese space technology is still several years behind the United States, but is way ahead of the third world countries. The launch vehicles—Long March series are adequate to launch satellites into various orbits from low earth orbits and polar orbits to geosynchronous orbits. Even though the equipment in the rocket launch control and monitoring center are primitive as compared to the Johnson Space Center Mission Control Center, the successful rate of launching is amazingly high. This indicates that the Chinese under limited resources have obtained by them selves without any outside assistance some critical technologies in the areas of materials, fuel,

propulsion, avionics, tracking, telemetry, and command as well as station keeping control and guidance. We must agree that this should represent a remarkable technology achievement by the Chinese.

However, the Chinese space technology cannot be advanced more in the years ahead unless their capabilities of software development and engineering can be greatly improved. The improvement of software capability is also closely tied to the country's overall education systems. The current rigid training programs, under the so-called "Socialism" which severely limits the thinking and innovation of young students, particularly those in the areas of science and technology, will never produce excellent software talents. In this regard, the short term remedy may be to encourage thousands of students currently studying abroad to return to China after they complete their academic and practical training.

Most electronic parts used in the Chinese space projects are still discrete components. Integrated circuits (IC), very large scale IC, and Application Specific Integrated Circuits (ASIC) are seldom employed and applied to the systems. This may be due to the lack of an IC industry in China. This explains why quality control for Chinese electronic products is hard to achieve and product life cycle is too short.

Most facilities we visited did not meet United States standards in the areas of cleanliness, lighting, air conditioning, computerized office desks, information networks, etc. This may be due to limited resource allocations and low priority list, or just the Chinese fail to recognize that improved productivity comes from a well conditioned workplace.

The shortage of electrical power was observed everywhere. This will impede the development and growth of various Chinese industry sectors.

There are many research and development facilities belonging to different State ministries doing the same kind of work. For example, the Chinese Academy of Space Technology of the Ministry of Aerospace Industry, the China Academy of Posts and Telecommunication of the Ministry of Posts and Telecommunications, and The Chinese Academy of Electronics of the Ministry of Machinery & Electronics Industry, all are engaging in telecommunications R&D. Some projects are different, but some are overlapping. If enough resources are available, this may lead to fair competition and check and balance. However, with limited resources, this may well represent duplication and waste.

APPENDIX B

OUR SISTER SECTION

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A PROCLAMATION

issued jointly by the

**SHANGHAI ASTRONAUTICAL SOCIETY
CHINESE SOCIETY OF ASTRONAUTICS**



and the

**HOUSTON SECTION
AMERICAN INSTITUTE OF AERONAUTICS AND
ASTRONAUTICS**

WHEREAS both the Chinese Society of Astronautics (CSA) and the American Institute of Aeronautics and Astronautics (AIAA) are organizations of learned scientists and engineers working in their respective countries to advance the arts, sciences and technology of astronautics and related fields, and

WHEREAS members of the Shanghai Astronautical Society of the CSA and those of the Houston Section of the AIAA share many technical interests, particularly those closely associated with the study of space sciences, the exploration of space, and its development to the benefit of mankind, and

WHEREAS it is the desire of the members of the Shanghai Astronautical Society and the Houston Section to establish and recognize a special relationship for the purpose of fostering good-will and understanding between their members,

NOW, THEREFORE do they declare themselves to be

SISTER SECTIONS

and do extend to each other the hand of friendship, and the pledge of cooperation in all things as befits this special relationship.

梁晋才

Chairman
Shanghai Astronautical Society, CSA

Carl R. Huss

AUG. 27, 1987

Chairman
Houston Section, AIAA

A BRIEF HISTORY OF OUR SISTER SECTION INITIATIVE IN CHINA

Jim McLane
Sister Section Coordinator, China

[The following is based on an article which first appeared in the June 1991 issue of the Houston Section newsletter, *Horizons*.]

In the Spring of 1986 while I was on a tour of China with a technical delegation of the People-to-People Citizen Ambassador Program, a casual discussion with a staff member of the Chinese Society of Astronautics (CSA) revealed that they were eager to "strengthen our ties with AIAA."

At the national level AIAA already had formal ties with CSA since both represented their respective countries in the International Astronautical Federation (IAF). It seemed to me that what was missing was some sort of a tie at the local level—something that would expand the professional horizons of our Houston Section members by learning about people who share their technical interests, but who pursue their careers in a completely different cultural environment.

Eventually this idea was shaped into a proposal for Houston to enter into a "Sister Section" relationship with an appropriate similar local unit of the CSA. The proposal gained the enthusiastic support of the 1986/87 Houston Section Chairperson, Karen Godek, and the Section Council authorized negotiations with the Chinese to determine interest. In April 1987 agreement in principle was reached at a meeting in Houston with a delegation headed by the Vice Secretary General of the CSA. This led to the designation of the Shanghai Astronautical Society (SAS), a local unit of the CSA, as our Sister Section.

The formal proclamation of Sister Section status was signed in September 1987 by Carl Huss and Liang Jin Cai, then chairmen respectively of the participating Sister Sections. It recognizes that the members of both organizations are scientists and engineers working in their respective countries to advance the arts, sciences and technology of astronautics and related fields. Further, that we share many technical interests, particularly those associated with the study of space sciences, the exploration of space, and its development to the benefit of mankind. It expresses the desire of our members to establish and recognize a special relationship to foster goodwill and understanding between members. Finally, the declaration of Sister Section status is stated, and pledges are made to extend to each other the hand of friendship, and to cooperate in all things as befits this special relationship.

At first, we agreed to initiate a number of mutual activities aimed at informing each side about the other. Exchange of publications has been one of the primary activities. We have regularly forwarded copies of our Houston Section newsletter, *Horizons*, and the JSC *Space News Roundup* to the SAS. They do not publish a comparable newsletter, but have from time to time sent write-ups of special events and occurrences that are passed on to you through *Horizons*. They've also sent their quarterly *Journal of the CSA* that is available

to the membership through our International Space Activities Committee library of foreign publications.

In 1988 both sides made a major effort to investigate the possibility of a joint real-time technical symposium conducted through satellite communications. This turned out to be not feasible then, primarily because of cost. As a substitute, we agreed to exchange video tapes of technical paper presentations made in Shanghai and Houston. The SAS organized and videotaped a special symposium for that purpose at the Science Hall in Shanghai on April 17, 1989. It was received just in time to show at a special add-on session at our Annual Technical Symposium on May 18. We reciprocated by taping ten of the best presentations from our May Symposium and sending the tape to China with special messages from the Section leadership. Plans for a similar taping of a few papers from our 1990 Symposium for the same purpose somehow failed in the implementation, but we are hoping to reinstate this exchange in 1992.

Since the basic idea behind the Sister Section initiative was to make it possible for members who have little or not opportunity for foreign travel to get to know something of their counterparts on the other side of the world, a very low priority was assigned to the proposed exchange of visits between the two organizations. Nevertheless, at the urging of the CSA who made all arrangements, a technical delegation from the Houston Section visited our Sister Section and many facilities of the Chinese space program in 1988. The SAS responded by sending a delegation to visit Houston in November of the following year (1989). This journal reports on the second delegation sent to China under the terms of the proclamation.

When the Sister Section initiative was first begun, many of us felt uncomfortable because of uncertainty surrounding restrictions on contacts and information exchange with foreign nationals, particularly those from "communist" countries. To clarify this situation we promoted and co-sponsored with NASA/JSC an April 1989 "Seminar on Exchange of Technical Information Between Nations." This left us with some simple, easy to understand guidelines that permit us to work together comfortably in a wide range of worthwhile activities.

We grow professionally when we learn as much as we can about foreign space programs, and about our professional counterparts who spend their lives working in them. Sister Section activities have opened the doors to this information, and made it available to any of our members who want to participate.



American Institute of Aeronautics and Astronautics

HOUSTON SECTION P.O. BOX 57524 WEBSTER, TEXAS 77598

April 30, 1992

Dr. Liang Jin-Cai
Director, Shanghai Astronautical Society
15 Zhong Shan Road, E-1
Shanghai-200002, China

Dear Dr. Jin-Cai,

It is my honored pleasure to extend our sincere greetings from the Houston Section of American Institute of Aeronautics and Astronautics to the Sister Section of Chinese Astronautical Society. Our mutual technical relation, now more than five years old, has been extremely fruitful to both of our sections. Particularly important has been the technical exchange of symposia papers, video presentations and technical visits by the delegates of the two sister sections. We thoroughly enjoyed the visits and presentations by your delegation last fall.

On the occasion of our present delegation visit commemorating International Space Year led by Delegation Leader Mr. Jim McLane, our China Sister Section Coordinator, and Deputy Leader Mr. Lou Livingston, our 'Horizon' Newsletter Editor, I want to reaffirm our resolve to support and continue the Sister section technical exchange program. I hope that the participation and presentations by our delegation at the various technical meetings will be useful to your group.

Sincerely,

A handwritten signature in dark ink, appearing to read 'Zafar Taqvi'.

Dr. Zafar Taqvi
Chairman,
Houston Section AIAA



American Institute of Aeronautics and Astronautics

HOUSTON SECTION P.O. BOX 57524 WEBSTER, TEXAS 77598

April 30, 1992

Dr. Ren Xinmin
President, Chinese Society of Astronautics
P.O. Box 838
Beijing-100830, China

Dear Dr. Xinmin,

It is my honored pleasure to extend our sincere greetings from the Houston Section of American Institute of Aeronautics and Astronautics to the Sister Section of Chinese Astronautical Society. Our mutual technical relation, now more than five years old, has been extremely fruitful to both of our sections. Particularly important has been the technical exchange of symposia papers, video presentations and technical visits by the delegates of the two sister sections. We thoroughly enjoyed the visits and presentations by your delegation last fall.

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Sincerely,

A handwritten signature in dark ink, appearing to read 'Zafar Taqvi', written over a horizontal line.

Dr. Zafar Taqvi
Chairman,
Houston Section AIAA

APPENDIX C

THE XICHANG SATELLITE LAUNCH CENTER

Reprinted from a publication of the XSLC, March 1992



中国西昌卫星发射中心简介

A Brief to China Xichang Satellite Launch Center

City".

Because of its lower altitude, XSLC is suitable for the launch of geosynchronous satellite. The transportation here is convenient with Chengdu-Kunming railway and highways that radiate in all directions. It is also near from the Yangtze River waterway. The Xichang Airport that can land and take off jumbo aircraft and the two hotels that can supply living services with complete facilities also lay the foundation for XSLC to open to the outside world.

XSLC is formed by the launch vehicle and spacecraft test & launch system, mission command & control system, tracking & measuring system, communications system, meteorology and technical support systems, etc. So it can supply various satellite launch services.

The main facilities of XSLC locate in the quiet valleys 65 kms away from Xichang City. The launch site is formed by two launch pads, Pad II & Pad III. Pad II is formed by a movable service tower which is 97m high with the weight of 4300T

A Window to the Space——

A Brief to China Xichang Satellite launch Center

China Xichang Satellite Launch Center, began its construction in early 1970's, is one of the biggest new type spacecraft launch sites with relatively complete facilities, more advanced technology and higher launch capability in China that are now open to the world.

XSLC is situated at the West-sichuan Plateau, in Liangshan Yi Autonomous Prefecture. This area is rich in scenic spots. It is about 1,500 meters above the sea level. The weather here is comfortably mild and it is just like in spring all the year round, with the average temperature around 17 °C, good visibility of the air and 320 days of sunshine a year. It is especially known for its beautiful moonlight, hence is referred to as "The Moon

and a 71-meter-high umbilical tower. The service tower is equipped with 13 levels of working platform that can ascend and descend. Apart from supporting the launch vehicle and satellite vertical testing, in the encapsulated environment of the service tower, the air has been cleaned, the temperature and humidity can be adjusted to ensure the satellite to be tested and stored in a desired environment before the lift off. On the top of the service tower, there is a bridge crane that is used for the launch vehicle and satellite lifting. Prior to launching, the service tower will roll back to the other end of the site. The umbilical tower is equipped with 11 levels of fixed working platform and 10 levels of movable working cable arms that can move 180 degrees levelly. After the service tower rolls back, the cable arms will close to support the prelaunch operation. At the bottom of the tower, there is a launch pad and a single-sided deflector that can be able to bear the pounding of the high temperature, high pressure airflow. Around the launch site, there are three lig-

lightning-proof towers of more than 170 meters high that can efficiently defend the site from being attacked by lightnings. Besides, there are facilities used to store, analyze and fuel various propellants as well as to treat sewage. Here on the launch pad, after the launch vehicle and spacecraft being moved from the technical processing area, lifting, mating and vertical test will be performed. Finally, under certain criteria such as the weather condition, the launch vehicle will be fueled, aimed and be launched at a proper time. On July 16, 1990, China's first LM-2E launch vehicle was launched here which successfully ejected a 8-ton-weight simulation satellite and a piggyback Pakistani scientific satellite into their expected orbits. LM-2E is 51 meters long with four liquid-fuel boosters around the first stage. The diameter of each booster is 2.25M. The lifting thrust capacity of LM-2E is 600T. So it can load a spacecraft of 8.8T into the expected orbit.

Pad III is at the other side of a river (the river is in the middle of the two pads), 300 meters

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far from Pad II. Pad III is equipped with a fixed service tower of 77 meters high. This launch tower has 11 movable working platforms that can move 180 degrees levelly. There are two cranes on the top, a launch pad and a deflector at the bottom. Around the tower, there are also three lightning arrestors more than 120 meters high and propellants storage, analysis, fueling and sewage disposal facilities. From this pad and by LM-3 launch vehicles, 6 domestic communications satellites and "AsiaSat-I" satellite (the first foreign satellite launched in China) have been successfully launched. LM-3 launch vehicle comprises three stages with the total length of 43.2 meters and diameter of 3.35 meters. Its lifting thrust capacity is 280 tons and a satellite of 1.5T can be loaded into the geostationary orbit.

The technical processing area (technical center) is in another valley 3kms away from the launch area. The technical area is beautiful with the green trees and with small rivers around. Here we built the unit test building, transition, testing and

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assembling halls, AKM testing building, spacecraft leakage checkout, fueling building and the solid motor X-ray detection building etc. After the launch vehicle and spacecraft arrive at XSLC, they will first be tested in unit, in subsystem and comprehensively in this area, then be moved to the launch site.

The Mission Command and Control Center (MCCC) is situated in a valley, 6Kms away from the launch site. It is the "brain" of the launch center. During the launch campaign, it performs the functions of commanding and control, data processing, transmission, timing, and so on. In the front of the command and control hall, there is a big TV screen of 5.3 meters long and 4 meters high. At each side of the big screen, there are several signal displaying boards by which the mission commanders, clients and specialists of each system can get the information concerning the working situation of the launch site, the testing parameters of the vehicle and the satellite as well as the working situation of the main equipments of each

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system.

In order to meet the requirements of the international space market, XSLC speed up its development. A more advanced launch satellite test building has been set up and put into use. The newly-built satellite earth communications station has joined the Intelsat communications network. The station is able to meet the clients' requirements of satellite testing data, pictures transmission.

XSLC has opened to tourists from China and abroad. Friends from each country and compatriots from HongKong, Macao and Taiwan are warmly welcomed to come here for visit, for business, for technical exchange and cooperation.

March, 1992

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