14. Opening Ceremony
Cérémonie d'Ouverture
Eröffnungsfeier

Friday, July 1, 1988 9:30—12:00
Music KOTO (Japanese Harps) and SHAKUHACHI (Bamboo Flute) Introduction by the Congress Director-declare the Congress open
Prof. Sunji Murai

Opening Address by the President of Japan Society of Photogrammetry and Remote Sensing
Prof. Hideo Nakamura
Welcome by the President of ISPRS
Prof. Gottfried Konecny
Address by the Director General, Geographical Survey Institute
Mr. Kazuhiko Ohtake
Welcome Address by the Govenor of Kyoto Prefecture
Mr. Teiichi Aramaki
Honorary Membership Proposed by Secretary General
Prof. K. Torlegard
Presentation of Brock Award and Sckemerhorn Award by First Vice President
Dr. George Zarzycki
Presentaion of Samuel Gamble Award by First Vice President
Dr. George Zarzycki
Presentation of Schwidefsky Medal and Von Gruber Award by Second Vice President
Prof. John Trinder
Presentation of the Published "History of Photogrammetry" by President
Prof. Gottfried Konecny
Greetings by the President of the International Federation of Surveyors (FIG)
Dr. Juha Talvitie, Finland
Greetings by the Vice President of the International Cartographic Association (ICA)
Prof. Werner Lichtner, F.R. Germany
Greetings by the Executive Director of the International Union of Surveys and Mapping (IUSM)
Dr. Fred Doyle, USA
Greetings by the Executive Member of International Association of Geodesy (IAG) and International Hydrographic Organization (IHO)
Prof. I. Nakagawa, Japan
Keynote Address by Dr. Duane Brown
Closing Remarks by Congress Director, Prof. Shunji Murai

Opening Address of Congress Director

Shunji Murai

Distinguished guests!
Distinguished delegates!
Ladies and gentlemen!

I am Shunji Murai, the Congress Director of the 16th International Congress of International Society for Photogrammetry and Remote Sensing. Since I was ratified as the Congress Director at Rio de Janeiro Congress in 1984, I have done all my possible efforts to organize a successful congress. This is all what I could do. In these past four years, I received a lot of suggestions, cooperations and encouragements from many friends who are eager to improve the ISPRS Congress. I must say I am a lucky man because I have been supported by excellent volunteers, attractive scientists, respectful sponsors, challenging exhibitors, unforgettable donators and knowledgeable advisors. I thank all of them.

In spite of many difficulties and problems which the Organizing Committee has met in the finance, call for papers, registration, printing of proceedings etc., we still now survive. I am very pleased to declare now that the 16th International Congress of International Society for Photogrammetry and Remote Sensing is officially open.

All of participants present here are to be very lucky because so many people absent here wanted to come to attend this congress but could not come mainly because of lack of budget. Instead of these people, we should make the Congress successful.

I received more than 1,000 abstracts and about 800 final papers, the biggest number in the ISPRS's history. I received more than 1,000 registration forms from 71 countries plus about 150 accompanying persons. This is a real international congress. In this sense I request your cooperations based on international sense and friendship. The significance of international congress is to communicate each other amongst scientists in the world and also to understand the culture and people of the host country. I really hope you to enjoy the ISPRS Kyoto Congress, the first congress to be held in Asia.

Thank you for your attention.

Now I want to introduce you the key members on the stage.

The Council Members of ISPRS;
The President, Professor Gottfried Konecny
The Secretary General, Professor Kennert Torlegard
The First Vice President, Dr. George Zarzycki
The Second Vice President, Professor John Trinder
The Treasurer, Professor Giovanna Togliatti
The President of Japan Society of Photogrammetry and Remote Sensing, Professor Hideo Nakamura
The Governor of Kyoto, Mr. Teiichi Aramaki
The Director General of Geographic Survey Institute, Mr. Kazuhiko Ohtake
The President of International Ferderation of Surveyors (FIG), Dr. Juha Talvitie
The Vice President of International Cartograhic Association (ICA), Professor Werner Lichtner
The Executive Director of International Union of Surveys and Mapping (IUSM), Dr. Fred Doyle
The Executive Member of International Association of Geodesy (IAG) and International Hydrographic Organization (IHO), Professor Ichiro Nakagawa

Address of the Minister of Science and Technology Agency (Telegram)

I congratulate the Opening of the 16th International Congress of International Society for Photogrammetry and Remote Sensing.
I really expect the Congress will contribute to the advancement of photogrammetry and remote sensing. *Soichiro Ito,*
The Minister of Science and Technology

Address at the Opening Ceremony

Prof. Hideo Nakamura
President,
The Japan Society of
Photogrammetry and Remote Sensing

Mr. President and Council Members of International Society for Photogrammetry and Remote Sensing, Honourable Guests, and Ladies and Gentlemen!

On behalf of the Japan Society of Photogrammetry and Remote Sensing, I would like to extend my hearty welcome to all participants who have gathered here, from seventy three countries and regions for the 16th Congress of ISPRS.

The congres of ISPRS has a long history and has been always world's information exchange center. It was done tremendous contributions in development of human activities as well as protection of environment through the applicaton of photogrammetry and remote sensing.

Indeed, all the Japanese concerned in photogrammetry and remote sensing have been very much looking forward to this occasion. Let me think back. The first time a Japanese participant attended the congress of the International Society for Photogrammetry was 62 years ago in Berlin at the occasion of the 2nd congress.

At that time it took nearly two months for the Japanes participant, the director of the Land Survey Bureau, to get to Europe by ship. Then he brought back to Japan the latest knowledge of Photogrammetry, which he had obtained at the congress. Since the Berlin congress, we have been sending participants from Japan to most of the following ISP congresses, though the number was quite small. Surely, the technology and knowledge which we got through the congresses have contributed so much to the development of photogrammetry as well as to the other sciences and national economy of the country.

We have been very sincerely interested to contribute to the activities of the ISPRS to which we owe a lot in such a way. Therefore, it is our great honor and pleasure that Japan has become the first host outside the European and American continents, of the ISPRS congress. I hope that the participants of this congress will get the newest knowledge in the field of photogrammetry and remote sensing in the world as well as have more experience of the technology of our country. In addition, we wish you also familiarize yourself with the traditional culture of Japan in Kyoto, one of the best places for it. That is one of the reasons why we chose Kyoto as the venue.

We think that we have been doing our best for the preparation and management of this congress. However, I regret to say the there still remain two matters of discomfort. One is that it is the worst season in the year in Japan, because it is hot and very humid. Nevertheless, we chose this time, because it was found to be more convenient for foreign participants, particularly for university persons to travel on leave during the term break. Moreover, the rush of mass tourism due to school vacation will start at the end of this month. Considering these, now seems to be the best time.

The other matter of our concern is the unexpected high appreciation of Yen since the Rio de Janeiro Congress 4 years ago. As the Yen nearly doubled with most of other currencies, we understand that you have to bear additional expenses. We will try to compensate for these situations with our hearty hospitality.

Let me conclude; we sincerely wish that this congress will make much contribution to the further development of the Photogrammetry and Remote Sensing. We also hope the congress will promote friendship among all participants.

Once again, I would like to welcome all of you to this 16th ISPRS Congress and wish you enjoyable stay in Kyoto and Japan.

Thank you very much.

Welcome Address

Gottfried Konecny
President ISPRS

Honourable Governor of the Kyoto Mr. Teiichi Aramaki
Distinguished Director General of the Geographic Survey Institute, Mr. Kayuhiko Ohtake
Mr. President of the Japan Society of Photogrammetry and Remote Sensing, Prof. Hideo Manamura
other authorities present here,
distinguished guests, ladies and gentlemen:

On behalf of the Council of the International Society for Photogrammetry and Remote Sensing I extend a cordial welcome to the 16th International Congress of Photogrammetry and Remote Sensing to you. Since the foundation of our Society in 1910 this is the first congress in Asia, and it is most fitting that here in Kyoto we are being introduced to the rich cultural heritage Japan and the continent of Asia has to offer to the world.

We owe our being here to the untiring efforts of Prof. Shunji Murai, our Congress Director and his Congress Committee staff, who have prepared this Congress on behalf of the Japan Society of Photogrammetry and Remote Sensing so well in these excellent surroundings. In the name of our Society I would like to thank this team and the many governments and organizations in Japan who stood behind in support of this effort during the past 4 years to make it all possible that we as photogrammetrists and remote sensing experts also get a first hand impression here what makes Japan a leading nation in the world in terms of technology, economic development and also in living together on the foundation of our historical roots. For many of us the next 10 days will be formative for our own future philosophical outlook. For this we thank our Japanese hosts.

As we move forward in technological development we recognize that the influence of computer technology has changed the road to specialization back to a renaissance toward the integration of the traditional disciplines. For this reason the International Society of Photogrammetry and Remote Sensing strongly believes in the future of the Union of Surveys and Mapping in which the efforts of surveying, photogrammetry and remote sensing as well as cartography are united.

As a visible expression of this successful effort I welcome here Mr. Talvitie, President of the International Federation of Surveyors, and Prof. Lichtner, Vice President of the International Cartographic Association. The International Association of Geodesy and the International Hydrograhic

Organization is also represented here by Prof. Nakagawa as one of their executives. It has been our custom in the last years to visit our congresses and to prepare the next steps for bringing the Union to life. I great especially Prof. Vassil Peeosky, Honorary President of the Int. Federation of Surveyers, one of the originators of the idea of the Union.

There is another group of organizations, those in remote sensing, with which we share the concern for the utilization of space for mapping and other applications. In trying to maintain contacts between these organizations, we have formed the Joint Board of Remote Sensing Activities. It is my pleasure to great the representatives of regional remote sensing organizations from Africa, Asia, Europe and Latin America, of International space organizations such as the International Astronautic Federation and of space agencies in various countries.

In reviewing the 4 years of my presidency I first have to recall the passing of a number of fellow photogrammetrists, who have shaped this society:
General Karl Loefstroem, Honorary Member and Congress Director of 1976 passed away on August 14, 1984.
Professor Kurt Schwidefsky, Honorary Member and past president of the German Society of Photogrammetry died on August 10, 1986.
I have recently been informed of the death of Monsieur Henri Bonneval.

In their memory and in the memory of all other colleagues, who have died since the 1984 Congress I ask you to rise for a moment of silence.

Thank you.

We have come together at this Congress to review technical progress in our field and to discuss its consequences. While the Council of our Society has only prepared the framework under which these technical exchanges can take place our 7 technical commissions and their working groups have been very active during the past four years. The impressive technical program of this Congress is the result of this activity which will become apparent in the papers to be given, in the poster sessions to be presented and in the exhibits displayed during the next few days. It has been my privilege to attend all of the 7 technical commission symposia and many of the working group meetings.

Further to this I had many opportunities to meet with the member societies at their own events. While I could not visit all 75 members, I had official encounters at least with 40 of our members during the past 4 years.
It is my special concern to express my gratitude to these members for their friendliness.
It is precisely these contacts, which make the work of the president of the society very satisfying; because he learns that human society, the world over, not only in the technical sense but also in general life has more things in common than those which separate groups or nations. It is my hope that the participants of this 16th International Congress utilize the chance of this gathering to reinforce their belief in technical and human cooperation with the aim to improve the conditions of living on this earth in peace.

Our Society believes in the principles established by the International Council of Scientific Unions which subscribes to non-discrimination on account of racial, religious or political grounds. Our 75 members, the scientific and technical bodies of diverse countries or regions thereof, such as from the United States of America and the Union of Sovjet Socialist Republics, from China represented by our members from Beijing and Taipei, from Jordan and Israel, from Iran and Iraq, and also from Nigeria and South Africa recognize the value of scientists being able to communicate on technical progress beyond political, religious and racial boundaries in nutual respect for each other. No matter how hard we try as scientists to be non-discriminatory, sometimes political realities are against us. Upon arrival in Kyoto I was saddened to learn of the unsuccessful attempt of the Congress Committee through the Ministry of Foreign Affairs in Tokyo

To conoince the Japanese Consulate General in Pretoria to accept vise applications from South African nationals. This is the first time in the 78 year history of our society that a member delegation is prevented from coming to our Congress. Despite of my strong beliefs for racial equality I am convinced that such political measures against international scientific bodies can serve no useful purpose. I hope that we will not become tired in our convictions, that our scientific and technical society remains free form political interference of any kind in these and in other matters.
In this respect let us keep on in our tradition of friendship between photogrammetrists and remote sensing experts. May I especially greet our immediate past president from 1980 to 1984 Fred Doyle, who is applying these principles now as executive director of the International Union of Surveys and Mapping.
I regret that Jean Cruset, president 1976 to 1980 cannot be present. But I have his letter saying:

> Kyoto est bien loin, et ton serviteur est deja bien age. Veux-tu transmettre au Congres le message a-dessou: "Being unable to attend the 1988 ISPRS Congress I ask my friends President Gottfried Konecny and Congress Director Shunji Murai to convey my best wishes to all those persons taking part in this very important event, which I wish to become a total success."

Among our further honorary members I greet Prof. Placidino Fagundes, our past Congress Director. Mr. Masson d'Autume and Prof. Solaini send their best wishes to the Congress participants.

In closing let me acknowledge the great support which I have received during my term of office. It was foremost the Council of our Society who fully shared the burden of the task.
But is was also my local and federal government in the Federal Republic of Germany which provided me with the freedom and most of the means to conduct my work as President of the Society.
It was last not least the members of my own University Institute who have given me moral support for my ISPRS duties. I take pride that 4 of them have come to the Congress with me. Many of them have helped in the organization of the Hamburg Congress, and we appreciate fully and with admiration the diligent and efficient preparations Shunji Murai and his team has accomplished. Because of this the Kyoto 1988 ISPRS Congress will not only become the largest of our 16 congresses but also one of the best run.

In this respect we extend to our Japanese hosts our best wishes.

Address

Kazuhiko Ohtake
Director General
Geographical Survey Institute
Ministry of Construction

Mr. Teiichi Aramaki, Governor of the Prefecture of Kyoto
Professor Gottfried Konecny, the President of the ISPRS
Professor Shunji Murai, the Congress Director
Other Authorities at the table, distinguished guests, ladies and gentlemen:

On behalf of the Japanese Government, Japanese Surveyors and Cartographers, I would like to express our hearty blessings to the 16th International Congress of international Society for Photogrammetry and Remote Sensing. It is our great honor to host this Congress here in our country.

For more than three quarters of a century, this society has led the scientific progress in surveying and mapping. The achievements of this society has been so fruitful that it has made us possible to assure the preparation of basic mapping and thematic mapping remarkably.

Map is an indispensable basic source of information for social development. It is probably fair to say that the progress of surveying and mapping technology has contributed to the development and prosperity of the society. Especially photogrammetry has improved the accuracy and efficiency of map making so much that it has contributed in diminishing the unmapped areas of the world. As an international cooperation, Japan has assisted the promotion of map preparation in developing countries through technical cooperation programs such as mapping over 500,000km, dispatch of over 300 experts and receipt of over 300 trainees. These accomplishments were made possible by photogrammetry.

It took more than 50 years to complete 1/50,000 scale topographic mapping all over Japan which had been accomplished by field mapping. However, it took only 15 years to produce 1/25,000 scale maps for most of Japan upon introduction of photogrammetry. Therefore, Japan is, in my opinion, one of the countries that benefited the most from conventional photogrammetry, whose peek overlapped with the peek of Japanese 1/25,000 basic mapping.

Currently, Japan is completely covered by 1/25,000 scale topographic maps and they are revised every five to ten years. The national government and most municipalities have made 1/2,500 topographic maps for most of the areas except mountainous areas which are mostly revised every five years. Besides, larger scale maps as 1/500 through 1/1,000 have also been produced. It is the progress of photogrammetric technology which has enabled the preparation of such wide variety and large quantity of maps.

For aerial photographs, 1/10,000 through 1/20,000 scale photos have been repeatedly taken for all Japan every five years. Those photos have been used for mapping as well as preserved as precious records of Japanese lands. 1/10,000 color aerial photographs had been taken for 5 years since 1974 for all of the territory of Japan, and repetitive photographing have been made about every 5 years for major urbanized areas, which have played important roles in urban administration.

Besides topographic maps and photographs, as far as collection of national land information is concerned, thematic map preservation of 1/25,000 land-use maps and land condition maps started in1975, publishing of Japan National Atlas in 1977, creation of grid database of national land information from 1973 and digitization of 1/25,000 topographic maps from 1984 are some of the highlights. The smooth implementation of these projects are much indebt to technologies of photo-interpretation and digital cartographic data processing. Remote sensing technology is also expected to be used for preparation of these information base.

Recently, geographical information system has been often discussed. In this regard, national technical standards of Japan for digital cartographic data have been established and GIS is getting very popular in Japan. I expect that the new technology being discussed in this congress will help the preparation of digital cartographic information and the development of dense information society as conventional photogrammetry helped the preparation of maps and the growth of economy and social development.

In the long history of ISPRS this congress is the first congress held in Asia. We sincerely appreciate what we have received from this society which has contributed to the accomplishment of our surveying and mapping projects. And I wish to make this congress an excellent opportunity to extend our efforts and to contribute to ISPRS.

Finally, I wish all colleagues gathered here will deepen our friendship in the following ten day sessions, exhibitions and parties, hoping that you will enjoy Japanese nature and culture, which we are very proud of. And may this congress be very fruitful and make remarkable progress in the scientific and technological development in the field of photogrammetry and remote sensing.

Thank you very much for your attention.

Welcome Address

The Governor of Kyoto
Teiichi Aramaki

Distinguished Guests, Ladies and Gentlemen!
I should like to extend my cordial welcome to you all who have gathered from various parts of the country and abroad to attend this 16th International Society for Photogrammetry and Remote Sensing held in our prefecture, kyoto.

I find it a great honor and previlege that the 16th ISPRS Congress is being held in Kyoto for the first time in Asia with the presence of Prof. Gottfried Konecny of F.R. Germany, the President of ISPRS.

Understanding that photogrammetry and Remote Sensing is an advanced science and technology with which you conduct 3-D topographic measurement and environmental survey on the glove, I am looking forward to the great outcome of the congress under the recent remarkable development of the computer engineering.

We are well aware that the modern advanced technology has realized various things which were once considered to be impossible, and has contributed to the convenience and the well-being of humanbeings. Therefore I believe the dissmination of the state-of-the-art technology will

bring about the human progress with a high hope toward the congress to act for the benefit of such an international exchange.

Since 794 when it was designated as a capital for 1,100 years, Kyoto has been prospering as the imperial castle town and today not only as a town view in Japanese culture but also it is known for the traditional industry of wearing, textile dyeing and ceramics.

On the other hand, new industry or such high technology as microelectronics and fine ceramics are dramaticaly developing in this region.

We determined to exert our effor so that Kyoto will lead the culture and academia in Japan to grow further in the global scene.

Kyoto Prefecture together with the neighboring Osaka and Nara is constructing the Kansai research park in the southern part. This project will creat a city that Japan can take pride in together the Tsukuba academic town toward the future in the 21st century.

The construction is underway at the hillside between Kyoto and Nara where you are taking a tour to during the congress period. When completed we are assured that the city will greatly contribute to the promotion of various reasearches and vigorous international exchange.
We sincerely hope that despite your tight schedule full of plenary session and indvidual meetings during a short stay, you will be able to enjoy the most of our Kyoto blessed with the historical heritage as a cultural capital of Japan.

Last but not least, I should like to express my deepest appreciation to President Prof. Nakamura of Japan Society of Photogrammetry and Remote Sensing, Prof. Murai the Congress Director, and each and everyone of the association for your efforts to prepare for this congress.

Again wishing the significant and fruitful 10 days for the participants, I conclude my address.
Thank you, *July 1st, 1988*

Honorary Members

Kennert Torlegard,
Secretary General, ISPRS

Your Excellency, Governor of the Kyoto Prefecture, Mr. Teiichi Aramaki
Director General of the Geographic Survey Institute of Japan, Mr. Kazuhiko Ohtake
Mr President of JSPRS, Prof Hideo Nakamura
Distinguished guests
Ladies and Gentlemen

In recognition of distinguished services to the ISPRS and its aims, an individual may be elected an Honorary Member of the Society. Honorary Members shall be nominated by Council and elected by the Congress. There may not be more than seven living Honorary Members at any given time.
Honorary Members shall have the right to attend all meetings of the Society and its constituent parts with the exception of Council meetings. They shall not be called upon to pay registration fees at functions sponsored in the name of the Society.

To-day the Society has four Honorary Members: Mr. Jean Cruset, Dr Placidino Fagundes, Mr Georges de Masson d'Autume, and Prof Luigi Solaini. As mentioned by President Gottfried Konecny in his welcoming address, two Honorary Members, Dr. Karl Löfström and Prof Dr Kurt Schwidefsky have passed away since the last Congress. Council has decided to nominate three new Honorary Members to be elected by this Congress. May I ask the nominees to come up on the stage. They are in alphabetic order: Dr. Frederick Doyle ; USA, Mrs Aino Savolainen ; Finland, and Prof Dr Wang Zhizhou ; China.

Frederick Doyle was born 1920. He graduated from Syracuse University 1951, spent a year in ITC, continued his academic career at Ohio State University and Georgetown University. During the 1960s he worked for Raytheon Autometric Corporation. 1969 he joined to USGS responsible for research and development in remote sensing and as director of the Earth Resources Observation Systems. One of Doyle's major accomplishments was his work in fostering the development of the large format camera that was flown on the space shuttle mission of Oct 5, 1984. He has been awarded the degree of honorary doctor from the four universities; the Technical University of Hannover FRG, Ohio State University USA, the University of Bordeaux France, the Royal Institute to Technology KTH in Stockholm Sweden, and he is an honorable fellow of ITC. Frederick Doyle has served the ISPRS in many ways: he was Secr Gen 1976-80. and President 1980-84. He has also worked in several adhoc committees that have played an important role for the Society: he was chairman of the committee that incorporated remote sensing into the Society and he chaired the group that revised the Statues and Bylaws to bring them in accordance with this. He is now Executive Officer of the International Union of Surveys and Mapping (IUSM).

May I ask the Congress to approve with an applause the election of Frederick Doyle an Honorary Member of the Society.

Thank you.

Dr Frederick Doyle, please receive your certificate and my congratulations.

Aino Savolainen was born 1921. She was may be the first female student of the world in photogrammetry and she graduated 1948. She was working in the late Gen Karl Löfström's topographic mapping establishment in Helsinki in the early 1950's. This has made her the only female army officer in Finland with the rank of major. 1960 she became a member of the department of photogrammetry at the Technical University of Helsinki, a position she has held until her retirement recently. She has been to every Congress of this Society since the 1956 Congress in Stockholm. With late Prof Sakkari Halonen as President she was Secretary of Commission VI 1960-64. She was Secretary of the Finnish Society of Photogrammetry and the Congress Committee during the Congress period 1972-76 which ended with the Helsinki Congress. Aino Savolainen has served the Finnish Society in various capacities including as President. She was Treasurer of ISPRS 1976-80 and Chairperson of the Financial Commission 1980-84. During that period she studied how our Society should meet the increasing costs of translations between the official languages of ISPRS. She has also been Secretary of Commission III during the two periods from 1980 to 88 when Finland has hosted that Commision.

May I ask the Congress to approve with an applause the election of Aino Savolainen an Honorary Member of the Society. Thank you.

Mrs Major Aino Savolainen, please receive your certificate and my congratulations.

Wang Zhizhou was born 1910. He studied in Berlin under Prof Lacmann and presented his dissertation for the Dr degree 1939. Soon after that he went to Paris and later back to China. Prof Wang Zhizhou was one of the leaders when the Wuhan college of Surveying and Mapping was established 1956. This centre for College Geodesi & photogrammetry and cartograpy in China has now become a University. Before the cultural revolution Prof Wang was dean of the dept of photogrammetry He was also responsible for the cooperation with the USSR within the fields of our Society. Wang Zhizhou became president of the University of Surveying and Mapping after the cultural revolution. He has fostered a great many of the Chinese photogrammetrists, and he has written two larger text-books on photogrammetry, and a large number of other publications. He is still active, also in the Asian Association of Remote Sensing. He is now Honorary President of the University in Wuhan and he has been a member of the National People's Congress of China. He is now twice Chairman of the Hubei Provincial People's Congress.

May I ask the Congress to approve with an applause the election of Wang Zhizhou an Honorary Member of the Society. Thank you.

I have also been asked to convey to Prof Dr Wang the following invitatino from the German Society of Photogrammetry and Remote Sensing. I read the original text in German:

(Applause). Thank you.

Prof Dr Wang Zhizhou, please receive your certificate and my congratulations.

Let me now hand over the word to the First Vice President of ISPRS, Dr George Zarzicky.

Awards Presentation

George Zarzycki
First Vice President, ISPRS

Honorary Members

Your Exellency, Governor of the Kyoto Prefecture,
Mr. Teiichi Aramaki
Director General of the Geographic Survey Inst of Japan,
Mr Kazuhiko Ohtake
Mr President of JSPRS, Prof. Hideo Nakamura
Distinguished guests
Ladies and Gentlemen

It is my pleasant duty and a great honor to make presentations of three awards given by ISPRS at each Congress. These are: The Brock Gold Medal, the Samuel Gamble Award and the Willem Schermerhorn Award.

The Brock Gold Medal is the oldest Award given by ISPRS. It was instituted by our society at the Washington Congress in 1952 to encourage the advancement of photogrammetry and now also remote sensing and in memory of two American inventors and pioneers of photogrammetry, Arthur and Norman Brock. The funds for the provision of medals were donated by the late Virgil Kauffman, founder and long time president of Aero Service Corporation of Philadelphia, U.S.A. and himself a pioneer of photogrammetry and remote sensing. The American Society for Photogrammetry and Remote Sensing administers this endowment.

The rules governing the award state that "The medal shall be awarded only in respect of an outstanding landmark in the evolution of photogrammetry or remote sensing which shall be a proven contribution to those fields of whatever form, whether a major completed photogrammetric or remote sensing mapping project, some fundamentally new equipment of fundamentally new technique or other new departure. The selection of the recipient is made by the Council of ISPRS.

I am pleased to inform you that the Council at its meeting in Stockholm in April of this year has unaminously selected Duane C. Brown of U.S.A. as the recipient of the 1988 Brock Gold Medal.

Duane C. Brown was born August 20, 1929 and grew up in Grand Forks, North Dakota. After graduating with honors in 1951 from Yale University with a Bachelor of Science degree in mathematics, he began his professional career at the Ballistic Research Laboratories, Aberdeen Proving Ground, Maryland. Under the direction of Dr. Helmut Schmidt, he performed research in photogrammetry, geodesy and statistical error theory in the application of ballistic cameras to determining rocket trajectories. This was the beginning of his brilliant work that has earned him international recognition as a leader in the development of photogrammetric theory.

Concern with the problem of calibration of cameras led him to extend the theory of photogrammetric resection to encompass smultaneously the calibration of coefficients of radial distortion and elements of interior orientation. In a publication entitled "A Solution to the General Problem of Multiple Station Analytical Stereo Triangulation he synthesized Schmid's basic theory of photogrammetric resection and his earlier treatment of photogrammetric triangulation to produce what is now referred to as the modern bundle method. The practical key to the bundle method was Brown's development of what was later termed the algorithm for first order partitioned regression. This algorithm has also provided the basis for the solution of a broad class of other problems in photogrammetry, geodesy, trajectory analysis and satellite tracking. The patented multi laterative monocomparator invented and developed by Brown was conceived largely as a practical demonstration of the power of the concept of self-calibration when expressly applied to the design of instruments.

In 1963 he formed DBA Systems, Inc., leading a talented team in effecting a practical application of the "bundle adjustment" for large blocks of aerial photography.

While at DBA Systems, Brown also worked extensively the fields of close-range photogrammetry and satellite Doppler positioning. He directed the design and development of several, large-format plate cameras, including special, remotely controlled, automatic plate-changing cameras for use in environmental test chambers.

His extended version of the bundle adjustment which exploits short arc orbital constraints made possible the efficient reduction of extensive blocks generated by Lunar

Orbiter and other systems employing satellite photogrammetry.

Brown served as President and Chairman of DBA Systems until May 1977 when he resigned to found a new company, Geodetic Services, Inc. (GSI). At GSI, Brown's primary interest has been the further advancement of close-range photogrammetry, particularly in industrial applications. To this end, he designed and had manufactured a microprocessor-controlled, large-format, roll-film camera incorporating a reseau platen.

This camera, the CRC-1, coupled with interactive software operating on-line with a monocomparator form the basis of a comprehensive turnkey system for industrial photogrammetry. The system is referred to as STARS (Simultaneous Triangulation and Resection System). To extend the capabilities of STARS Brown designed a computer-controlled monocomparator AutoSet-1 which exploits digital image processing to perform automatic setting on images of targets to accuracies and speeds for beyond the capabilities of human operators. Introduced in late 1984, AutoSet has propelled Close-Range Photogrammetry well into the regime of submicrometer closures of triangulation.

Duane C. Brown is the holder of several professional awards, and has served on a number of National Committees.

These are but a few of the accomplishments of Duane Brown selected from a long list of many. I was just informed by Prof. Ackermann that University of Stuttgart has award Duane Brown a honorary Doctor degree and that the ceremony will take place on December 2 this year.

Ladies and gentlemen, may I present to you the outstanding scientist in photogrammetry, Dr. Duane Brown.
It gives me great pleasure to present the Samuel Gamble Award to be given for the first time at this Congress.

This Award is sponsored by the Canadian Institute of Surveying and Mapping in honour of the late Dr. Samuel Gamble, former president of the ISPRS and Director of the 1972 Congress in Ottawa Canada, a person who has devoted a lot of his efforts to further the cause of our society and to spread the knowledge and apllication of photogrammetry and remote sensing in developing countries. He succeeded in persuading the Canadian International deveopment agency to assign substantial sums of Canadian aid to surveying and mapping programs in developing countries and to the education and training of indigenous surveyors, photogrammetrists and cartographers.

The deed of the Samuel Gamble Award states that a recipient of the Award should be a person who, like Dr. Gamble, has contributed significantly to the development, organization or professional activities of photogrammetry and/or remote sensing at the national or international level.

The three recipients of the Samuel Gamble Award fit these conditions perfectly. They are:

Chief Oluwole Coker, retired director of the Federal Surveying Department, Lagos, Nigeria

Berhard A. Sikilo, Director General, Regional Centre for Services in Surveying, Mapping and Remote Sensing, Nairobi, Kenya

Prof. Anton Jan van der Weele of the International Institute for Aerospace Surveys and Earth Sciences, Enschede, The Netherlands.

I have the privilege of knowing all three of the recipients for over 25 years and working with them on numerous occasions during that period.

Let me briefly introduce these gentlemen to you.

Oluwole Coker was the first Nigerian Director of the Federal Survey Department after Nigeria gained independence and held this office until his retirement. He has expanded and modernized the Federal Surveying Department, equipped it with the most up to date photogrammetric instrumentation, photo mechanical equipment and printing press. He has built up a highly qualified cadre of professional surveyors and photogrammetrists by arranging for education and training abroad, many of them in Canada and by strengthening survey education in Nigeria. He succeeded with assistance from Canada and other countries to complete 1:50 000 map coverage of most of Nigeria. After retiring from the Government Service, Chief Oluwole became Chairman of Kenting African Ltd. an inter? and surveying company. He is a staunch supporter of ISPRS and it was his invitation that led to Nigeria becoming a member of our Society. He is a highly respected professional and leader in surveying and mapping.

Bernhard A. Sikilo was born in 1936 in Tanzania and received his academic education in England. He attended the University College, London University where he received his M.Sc. in surveying and photogrammetry in 1967. He also received training at the school of Military Surveying in NLWBury, England. He is an associated member of the Royal Institute of Chartered Surveyors (U. K.), Chartered Land Surveyor (East Africa) and a fellow of Registered Surveyors in Tanzania.

In 1970 Mr. Sikilo became Commissioner for Surveys of Tanzania and he immediately began to modernize and expand the Tanzania Surveying Department and to implement a systematic mapping program for Tanzania. He was instrumental in training a large number of surveying engineers some at the PH.D. level.

In 1972 he was promoted to Permanent Secretary, Ministry of Lands, Housing and Urban Development, which also included the Surveying Department. He was responsible for the establishment and constitution of ARDHI Institute while training over 500 Tanzanians in surveying, urban planning and land economics took place.

In July, 1979, Mr. Sikilo was appointed Director General of the Regional Centre for Services in Surveying, Maping and Remote Sensing in Nairobi, Kenya, which was established under the auspices of the United Nations.

Under his direction the Centre began to flourish. Today the Centre serves the whole African continent with panticular inpharis on countries of eastern and southern Africa.

He spearheaded the study for construction of the subregions Resource Satellite Ground Receiving Station and assisted in the establishment of national remote sensing centres in Sudan, Ethiopia and Tanzania. He contributed

significantly to the education and development in remote sensing in Africa.

Prof. Vam Der Weel joined the ITC in 1963 as professor of photogrammetry after 25 years of service in the Surveying Department of the Netherlands. In 1965 he became Rector succeeding Prof. Schemerhorn and held this position until his retirement in 1979.

Prof. van der Weele's achievements are too numerous to mention in this short space of time. He devoted many years of his professional career to the education and training of photogrammetrists from almost every country on the globe and particularly the developing countries. He influenced directly and indirectly the establishment of first-rate photogrammetric mapping departments in the developing as well as developed countries. He was very active in the affairs of ISPRS, as the secretary of Commission III, President of Commission IV, Treasurer and Chairman of the Finance Committee. He is the long standing editor-in-chief of Photogrammetria, the official journal of ISPRS.

Ladies and gentlemen, the three recipients of the Samuel Gamble Award have each made very significant contributions to the development of the profession and the practical application of photogrammetry at the national and international level.

On behalf of ISPRS I am pleased to present them with the Samuel Gamble Award.

The last award I have the honor to present it The Willem Schermerhorn Award.
This award is sponsored by the Netherlands Society of Photogrammetry in honor of the late Dr. Ir. W. Schermerhorn, founder of ITC and Honorary Member of ISPRS. It is given to a person, who has most significantly contributed to the work on an ISPRS Technical Commission during the past four year Congress period.

Dr. Gerard Guyot of France was selected to receive this Award for his outstanding performance as chairman of Working Group 3 of Commission VII.

Awards Presentation

John Trinder
Second Vice President, ISPRS

Director General of the Geographic Survey Inst of Japan, Mr Ohtake
Mr President of JSPRS, Prof Nakamura
Distinguished guests!
Ladies and Gentlemen!

It is my pleasure to present 3 awards at this congress. Two Schwidefsky Awards and the von Gruber Award.

The Society is honoured by the inaugural award of the Schwidefsky Medal, awarded by the German Society for Photogrammetry and Remote Sensing (Deutsche Gesellshaft für Photogrammetrie und Fernerkundung).

The award is in honour of Prof. Dr. Kurt Schwidefsky honorary member of ISPRS and outstanding photogrammetrist in the Federal Republic of Germany.

Two awards will be presented at each congress comprising a medal manufactured in porcelain, together with a certificate to persons who have made a significant contribution to photogrammetry and remote sensing either through the medium of publication as an author or editor or in another form.

The medals for 1988 will be presented to Prof. Rinner of Austria and G. Carper Tewinkel of U.S.A..

Professor Karl Rinner is unable to come to Kyoto due to ill health.

Professor Dr. Karl Rinner was born in Gratkorn, Austria on 4th October, 1912. He qualified in Mathematics and Geodesy at Graz University, Austria in 1930 and Doctorate in 1936. He qualified as a lecturer at the University of Berlin from 1936 to 1945.

Following his return to the Technical University of Graz, he qualified as a lecturer in 1953. He was director of the German Geodetic Research Institutey in Munchen, and then from 1959 till his retirement Professor at the Technical University of Graz where he was rector from 1970 to 1972.

In 1974 he was awarded the degree of Honorary Doctorate by the Technical University of Darmstadt, in 1976 appointed as honorary member by the Hungarian Academy of Science and awarded the degree of Honorary Doctorate at the Technical University of Hannover in 1981.

Professor Rinner has received many other honours and awards. He authored more than 200 publications, especially on the mathematical relations of analytical photogrammetry.

He has been responsible for the campulation of the volume of "Photogrammetrie" of the German comprehensive work "Handbuch der Vermessungskunde"

Professor Rinner is a worthy recepient of the Schwidefsky award. Could you please join me in congratulating Professor Rinner.

I would like to call upon Dr. Waldhausel of Austria to receive the award on behalf of professor Dr. Rinner.

May I now call upon. G. Carper Tewinkel to come forward to receive his award.

G. Carper Tewinkel received B.S. in Mechanical Engineering from Washington State College in 1932 where he was elected to Sigma Tau honorary engineering fraternity.

From 1939—40 he received Masters degree in Civil Engineering from, Syracuse university, following which, he was employed from 1941—72 at the U.S. Coast and Geodetic Survey (Retired in 1972).

He also undertook Graduate studies in Civil Engineering at MIT from 1959—60 and was awarded the Department of Commerce Gold Medal in 1966 for accomplishments in analytical photogrammetry.

Carper Tewinkel was president, Commission III, on Aerotriangulation, International Society of Photogrammetry, 1964—68, Secretary-General, from 1968—72, Editor of ISPRS Newsletter from 1972—76, and member of ISPRS Publications Policy Committee from 1980—84.

During all these years, Mr. Tewinkel served the American Society of Photogrammetry in many important capacities.

He was a member of the Board of Directors 1949—51 and was President of the Society in 1960. He also served as editor of PHOTOGRAMMETRIC ENGINEERING. He represented the Society and the Coast and Geodetic Survey at five Congresses of the International Society of Photogrammetry.

For his service to ISRPS and the Science of Photogrammetry, Carper Tewinkel is awarded the Schwidefsky Medal by German Society for Photogrammetry and Remote Sensing.

Now I wish to present
The Otto von Gruber Award

The Office of the "ITC-Foundation" , has set aside funds for the assignment of an award in honor of the services rendered to photogrammetry and remote sensing by Otto von Gruber, and in testimony to the recognition of the founder of "ITC-Foundation" , this award is called the "Otto von Gruber Award" . It will be granted every four years and consists of a gold medal and a sum of money having a maximum value of 1000 Dutch Guilders.

The von Gruber Award will be presented according to the regulations which have been approved by the Committee of Governors of ITC and by the Council of the International Society for Photogrammetry and Remote Sensing.

The regulations state that:

a. The recipient shall have written within four years immediately preceding the Congress at which the Award is declared, an article of outstanding merit on photogrammetry and remote sensing which shall have been adjudged by the jury to be the best article submitted to them.
b. The recipient shall, within the preceding 12 years, either:
1. Have graduated from a recognised university of photogrammetry and remote sensing as a major subject; or
2. After having graduated in other subjects from a university of similar educational institution, have satisfactorily completed a post-graduate course in photogrammetry and remote sensing at a recognized university, technical college;
3. Have graduated from the I.T.C.

The selection between the award candidates will be made by a jury of individuals composed as follows:
a. The President of ISPRS
b. Three highly esteemed and very well technically qualified individuals,
(1) The Council of the "German Society of Photogrammetry and Remote Sensing" .
(2) The Council of the photogrammetrie Society in United Kingdom.
(3) The rector in service of ITC.

The winner of the award in 1988 is Paul James Curran of the United Kingdom.

Dr. Paul Curran was born in Leicester, England on 17th May, 1955.

He gained a BSc with Honours in Geography from the Department of Geography University of Sheffield in 1976 and PhD from the Department of Geography University of Shefield in 1979 on the subject of remote sensing of vegetation and soil. He has subsequently been employed at the University of Reading and University of Sheffield.

Dr. Curran has written a text book entitled "Principles of Remote Sensing" published in 1985 and has contributed to 8 books on Remote Sensing.

He has been an author of 74 publications on remote sensing in Journals and Conferences.

His research support has been drawn from a wide range of sources in UK and elsewhere; and he has visited many countries around the world, including Europe, North America, India, USSR, China, Iraq and Australia.

Two publications in particular have been identified for consideration by the judges.

(i) "Airborne multi-spectral scanner data for estimating dye dispersion from sea out falls" in Proceedings of the Institute of Civil Engineers Part 2 1987 which was submitted to the judges by Dr. Curran as a basis for consideration.

and

(ii) "Remote Sensing methodologies and Geography" in the International Journal of Remote Sensing.

The judges state: the individual paper submitted by Paul Curran is a highly rigorous study, developing and demonstrating a practical method for environmental monitoring using existing (airborne MSS) remote sensing equipment. The paper should not to be judged on its own but as a sample only, of the work of this leading young member of the remote sensing profession. That he is a practicioner is clear from this paper; his curriculum vitae and his book "Principles of Remote Sensing" show that he is a successful teacher, and his review article "Remote Sensing Methodologies and Geography" characterises him as a thinker. For his accumulated work from 1984 to 1987, showing him to be practitioner, teacher and thinker of high stature, he fully merits the award.

I would like to call upon us walter Smith chairman of the National Committee for Photogrammetry and Remote sensing to receive the award on behalf of Dr. Curan.

I would now like to call upon prof. konecny to present the new books on the History of Photogrammetry.

Presentation of History of Photogrammetry

Gottfried Konecny
President, ISPRS

Distinguished Dignitaries, Ladies and Gentlemen!

The Council and the Organising Committee of this Congress has invited Dr. Theodor Blachut and Professor Rudolf Brukhardt to present the membership the international volume of the History of Photogrammetry as an effort of the society. This effort was initiated by the late Dr. Lofstrom, Congress Director of the 1976 Helsinki Congress. The idea was brought by Professor Sitek the 1976 to 1980 Commission President of Commission VI, which is responsible for economic, professional and educational aspects of photogrammetry and remote sensing, and includes the topic of history of our discipline. Professor Sitek of Poland asked Dr. Theodor Blachut of Canada to organise the effort of compiling this history of photogrammetry and remote sensing.

Dr. Blachut started the task with support of Council and

chose the volume on analog instruments and methods together with Professor Rudolf Brukhardt of Berlin(West). The manuscript, von heu originally in English, will be printed in language by the American Society for Photogrammetry in the months to come.

On behalf of Dr. Blachut and Prof. Brukhardt I am pleased to announce to the congress that the translations of this manuscript have been published in Chinese with the help of the Chinese Society of Photogrammetry in Beijing, in German with the help of the German Society Photogrammetry and Remote Sensing and the Dushtule of geodesy in Frankfurt, in Japanese with the help of the Japan Society of Photogrammetry and Remote Sensing, and in Spanish with the help of the Pan American Freshfule of Geography and History. These volumes will be on desplay in a special booth of the exhibit. Translation in more language has been arranged by Dr. Blachut, and Council is looking forward to the completion of two further volumes on analytical methods and on image interpretation by other methods during the next congress period.

On behalf of Council I would like to express thanks to all those who have helped in the completion of this effort.

Opening Session

Greetings from the International Federation of Surveyors (F.I.G.) by Mr. Juha Talvitie, F.I.G. President

Mr. President, Ladies and Gentlemen

I have the pleasure of bringing greetings to the International Society for Photogrammetry and Remote Sensing and to the participants of your Congress on behalf of the International Federation of Surveyors, F.I.G.

Your kind invitation for F.I.G. representation at this opening session is considered not only as a great honor but also as a recognition of mutual interests our societies have.

F.I.G. is now 110 years old and has 56 member associations in 51 countries. Our nine technical scientific commissions and their working groups are responsible for promoting and stimulating scientific and technical development within the surveyors profession.

The next F.I.G. Congress will be held in 1990 in Helsinki, Finland and our Congress Director will provide you our kind invitation to participate in it. The theme of this Congress "The Challenge of Information Society for Surveyors" indicates the spirit and main goal the current F.I.G. administration has. The theme refers not onluy to the rapid technological development in our field of activities but above all to the fundamental societal changes which are reshaping our living conditions.

All our activities, called surveying, evolve from the relationship between man and land. This relationship is changing all the time. This change is the driving force for the development of our activities.

It emphasized especially the growing importance of land and property management matters and the opportunities new technology offers for the development of surveying methods. The technical development and societal change also require close cooperation with all sister organizations in the field of surveying and mapping. Only in good cooperation it is possible to see when joint efforts are needed. For this cooperation we have the Joint Board for the coordination of our activities and the IUSM for the integration of the techniques of surveying, photogrammetry and cartography especially in the fields of modern mapping and land information systems.

Thus our organizations have their individual areas of interest but also areas of common interest. I thank the International Society for Photogrammetry and Remote Sensing for good cooperation with F.I.G. and I hope we can continue in the same manner.

I wish your Society all the success here in Kyoto and during the years to come.

Opening Session

Frederick J. Doyle
Greetings from IUSM

Mr. President, members of Council, distinguished guests, ladies and gentlemen:

I bring you greetings on behalf of the International Union for Surveys and Mapping (IUSM). Mr. President, I believe that from all the people assembled here today, only you, Prof. Peevsky and I have been present from the conception of the IUSM. Many of the rest of you are entitled to wonder what and why is IUSM.

The Union had its origin in 1976 when an exchange of letters between the Presidents of the International Cartographic Association (ICA), the International Society for Photogrammetry (ISP), the International Federation of Surveyors (FIG) and the International Association of Geodesy (IAG) resulted in the formation of a Joint Board to consider activities in areas of common interest.

Consider the disciplines represented in the current buzzword GIS-geographic information systems. Does this topic belong exclusively to FIG, to ICA, or to ISPRS? Can it get along without a sound geodetic basis. Would the community not be better served if we worked on these problems together rather than separately.

There have been annual meetings of the Joint Board from 1977 to the present. They have served the useful function of coordinating dates for meetings, and several other organizations have been added in the meantime. In 1984 at Hannover, Federal Republic of Germany, the Joint Board decided to formalize its organization and a set of guiding principles were adopted. These were presented to the General Assemblies of each of the organizations, and ratified by ICA, FIG, and ISPRS. In 1985, the IUSM was founded by those three societies, and in the following years several drafts of Statutes have been considered. According to those Statutes the objectives of the Union are:

1. To promote interdisciplinary study of problems related to surveys and mapping of the Earth and other celestial bodies;
2. To initiate, facilitate,and coordinate research and investigations of problems in surveys and mapping which require international co-operation or which are of international scope;
3. To provide scientific and technical advice on practical projects in surveys and mapping which have international aspects;
4. To participate in any form of international cooperation such as education, training, and technology transfer;
5. To provide an international basis for discussion and publication of the results of research and projects;

6. To arrange scientific and technical meetings among Union Members and to hold international congresses to present the results of intersociety activities;
7. To represent the common interests of Union Members before international bodies such as the United Nations, the International Council of Scientific Unions, the Committee on Space Research, and others.

Tomorrow, Saturday July 2, the Executive Committee of IUSM will meet in Room I from 9 : 00-12 : 00. The meeting is only for Members of the Executive Committee, but if you wish to attend as an observer, it can be arranged.

On Wednesday July 6, there will be a general information meeting about IUSM in Room D from13 : 30 to 15 : 00. This is listed as Special Session SS-5 in your time table. Anyone interested is invited to attend.

Mr. President, Mr. Congress Director, the IUSM thanks you for the invitation to attend this ISPRS Congress and for the splendid arrangements you have made for us. You have planned a most interesting program of technical and social activities, and a superb scientific and commercial exhibit. We shall all be better informed and make many new friends during the days to come.

I am personally very conscious of the fact that one of the most significant advantage of such a Congress is the opportunity to meet and know people from many countries around the world. Our field of knowledge-particularly since the advent of Earth observing satellites-transcards national political boundaries. And if we are friends, we can never be enemies. In these ways we make our own contribution to peace and progress on Earth.

The IUSM looks forward to sharing these opportunities with all of you. Thank you very much.

Greetings

Ichiro Nakagawa
Executive Member of the International Association of Geodesy (IAG)
and International Hydrographic Organization (IHO)

It is my great honor and pleasure to address at the opening in the 16th International Congress of the International Society for Photogrammetry and Remote Sensing as a representative of both the International Association of Geodesy (IAG) and the International Hydrographic Organization (IHO), which are sister societies each other and have being kept our friendship for a long time.

Recently, a method to observe and to measure the earth from the space has made remarkable progress. It depends greatly on the techniques of satellites launching, sensor and remote sensing.

In the geodetic fields, we began to study the shape and the size of the earth, and its gravity fields by analyzing the orbit of satellites around the earth, since the early time when we could employ the data obtained through the satellites. A great advance has rapidly been made in those studies year after year. They were not confined to investigate the shape and the size of the earth and the accurate determination of the gravity fields, but extended to the knowledge of their changes with time. They have greatly contributed to the research of geodynamics. It is, in itself, marvelous to get informations about the changes in the shape and the size of the earth as well as those in the gravity fields with high accuracy, and it is still more important to get homogeneous data over the whole earth from satellites on the earth's ground. The progress of the techniques for remote sensng brought us such a useful situation. In this sense, our geodetic and geophysical researches tie to your efforts and the results of your researches.

On the other hand, the International Hydrographic Organization has employed photogrammetry for drawing coastal lines and land in its operations, making traditional nautical chartings. At present, the relation between your Society and the IHO is much stronger in modern nautical chartings, with computer assisted chartings and digital data. The IHO has a close relation with physical oceanography, geodesy and geophysics besides photogrammetry, and it contributes to the research and exploitation of nautical resources at the ocean floor, marine environmental preservation and so on.

The IAG and the IHO have tried to promote study and training for the developing countries and technical support to them. We would like to advance such activities more positively from now on.

Recently, photogrammetry, geodesy and physical oceanography are getting closer each other. The boundary among them has gradually disappeared. It is the techniques of remote sensing to make a great contribution to build up such a desirable relationship among them. This is a good time we will take a chance to promote our joint researches. It will not be long before the Global Positioning System operates fully to its ability for determining the position on the earth and for measuring the changes of spots. In case of the employment of the GPS, we, your Society and our IAG and IHO, must organize in a closer cooperation each other than usual and join the researches in the fields around our boundary. We eagerly hope so. It is our desire that we will keep stronger relationship as true sister societies.

Properly speaking, the Presidents of the IAG and the IHO should make their addresses here, but they could not come here owing to their unavoidable business. Excuse me mentioning about myself, but I learned here in Kyoto and I am now engaging my business here in Kyoto. For me, it is extremely happy to have the ISPRS Congress here in Kyoto.
Therefore, it is the supreme honor and pleasure for me, local inhabitants, to have an opportunity to be here by order of the Presidents of the IAG and the IHO.

Finally, I would like to conclude my address hoping for a great and fruitful success of this Congress and a further development of your Society. Thank you.

BREAKING THE MICRON BARRIER

Duane C. Brown
Geodetic Services, Inc.
Melbourne, Florida 32901, USA

Keynote Address

As we gather here in lovely Kyoto, former imperial capital of Japan for more than a millennium, I would like to reminisce a while on a quest lasting over three decades of my professional life—a quest concluded surprisingly abruptly and only rather recently.

As a 'green' mathematician fresh from college in 1951, I began my career at the Ballistic Research Laboratories of Aberdeen Proving Ground, Maryland—my assignment, to work under the direction of Dr. Helmut Schmid in the field of ballistic photogrammetry. Now 'ballistics' I had heard of—it had something to do with trajectories of projectiles —but 'photogrammetry'?—it was utterly foreign to me.

Now it so happened that I had some background in photography, for in my high school year I had worked after school in the darkroom of a photographic studio and was an avid amateur photographer. That photographs and mathematics could be combined to measure things to accuracies almost beyond belief came as a revelation. And so began what was to be a fruitful four-year apprenticeship in the then-just-emerging field of analytical photogrammetry. Dr. Schmid introduced me not only to photogrammetry but also to least squares through the work of Helmert as set forth in the Jordan-Eggert classic Handbuch der Vermessungskunde. But an even greater influence with regard to least squares came to be the work of W. E. Deming.

Here let me digress a bit to say a few words about Deming, who today is an octogenarian still active and preeminent in his field. As many of you may know, Deming is a household name here in Japan. He is revered as a great teacher who, starting in the 1950's, provided the statistical and procedural tools essential to effective programs for quality assurance in manufacturing. From the beginning Japanese industrialists took Deming's teachings to heart and implemented them assiduously, thus setting the stage for Japan's emergence as a world leader in manufacturing productivity and quality. Today, firms throughout Japan vie annually for the prestigious Deming Prize for quality, an award instituted several years ago in his honor. Deming's towering presence in the field of quality assurance has overshadowed his singular contributions to the theory of least squares published in a series of three papers nearly 60 years ago. These papers advanced the theory of least squares well beyond where Helmert had left off and served as a source of inspiration to me in the formative years of my career. In fact, the essence of what I regard as my first significant scientific paper consisted of converting Deming's development of least squares from scalar to matrix formulation, a process which permitted immediated generalization of least squares to embrace correlated observations, Like the Japanese, I too am indebted to Deming and wonder at times what the course of my career might have been but for him.

Ballistic photogrammetry had its heyday from 1955 to 1965, a period coinciding with the early development of long range rockets. Following specification set by Helmut Schmid, Wild Heerbrugg produced in the mid 1950's the superb BC-4 series of ballistic cameras (Figure 1). These cameras utilized 6mm thick photographic plates of fairly large format (18 x 18cm) in the micro-flat grade that Kodak had recently introduced. An extensive network of BC-4's was employed on the Atlantic Missile Range to track rockets launched at night from Cape Canaveral, Florida. The typical function of the ballistic camera was to photograph critical portions of the trajectory as defined by a missle-borne flashing light recorded against the background of start (Figure 2). Images generated along star trails through periodic interruption by a precisely timed camera shutter served as photogrammetric control points against which the directions of recorded flashes could, in effect, be interpolated. Spatial triangulation of such directions from a suitable configuration of camera stations produced highly accurate, three dimensional coordinates of points along the trajectory.

The foundations of modern analytical photogrammetry, including the origination of the bundle method, were established in support of ballistic camera technology. So too were standards of quality for photographic mensuration. It was found early on that when the most rigorous procedures of calibration, observation and mensuration were followed, least squares triangulation produced residuals of measured plate coordinates which were satisfactorily random and had rms values generally in the range of 2 to 3 μm. Thus starting in the mid 1950's, an rms closure of two to three microns emerged as a well-accepted criterion for excellence of photogrammetric triangulation (from here on I shall use the traditional term 'micron' rather than the more cumbersome 'micrometer'). This criterion presented to me a personal professional challenge—namely, to push towards closures of one micron and ultimately to break the so-called micron barrier. Thus began a quest I thought might last a few years.

Little did I realize back then in 1955 that even thirty years later two to three microns would still stand as a generally accepted standard of excellence for closures of photogrammetric triangulation. However, I should hasten to add that as reported at the last ISPRS Congress, the micron barrier had been broken by 1984 in a special fashion by Burch, Forno and their collaborators at England's National Physical Laboratory. They achieved an rms closure of 0.5 μm from photographic plates of small circular format (6cm diameter) used in their newly developed Centrax camera. This camera employs a highly specialized lens capable of generating usable images only from intense pinpoints of light. Thus, it could be said that the micron barrier still held insofar as conventional photography was concerned.

It was not until 1986 that a number of factors converged to effect the long-sought breakthrough with conventional photography. This is not to imply that significant progress had not been made during the intervening 30 years. Far from it, but the cumulative effect of many lines of improvement had been mainly to nudge closures more towards two microns and sometimes a bit below. To cite one example of a fundamental improvement, I call your attention to Figure 3a which is a vector plot of residuals of stellar images from a zenith plate exposed by a ballistic camera of 600mm focal length newly introduced in 1963. As is evident, the residuals display pronounced systematic patterns and have an unacceptably high rms value of 3.9 μm. In due course, the source of the systematic error was found attributable to imperfectly aligned elements of the lens, or to what is termed decentering distortion. This led to a revision of the photogrammetric reduction to include the recovery of coefficients of a model accounting for decentering distortion, much as had been done years earlier for symmetric radial distortion. As can be seen from Figure 3b, the residuals resulting from the revised reduction are random and have a rms value of only 2.1 μm. The revised photogrammetric reduction accounting for decentering distortion has had far reaching consequences (especially so in close-range photogrammetry), for it has meant that virtually any lens capable of producing acceptably sharp images could be successfully employed in some of the most exacting of photogrammetric applications.

Time does not permit citing of several other examples of advances resulting from the resolution of departures from the two-to-three micron norm. Suffice it to say that by 1985 the stage had been set for a major push to new norms. During the course of the early to mid 1980's my associates and I developed from the ground up a turnkey system specifically optimized for close-range industrial photogrammetry, a system referred to as STARS, short for Simultaneous Triangulation And Resection System. All the elements of STARS as well as many of its applications have been described in a series of technical papers publi-

shed in recent years. Accordingly, let it suffice here to say that Stars consists of three major elements:

- the CRC-1, a large format (23 x 23cm) microprocessor controlled roll film camera incorporating a back-projected reseau platen (Figure 4);
- a comprehensive software package featuring bundle adjustment with self-calibration installed on an IBM compatible personal computer;
- AutoSet, a computer controlled monocomparator employing digital image processing to produce fully automatic settings on photographic images to a precision of a few tenths of a micron (Figure 5).

Until AutoSet was finally added to the system in early 1985, measuring was performed on conventional monocomparators employing human setting, and closures of triangulation remained largely in the traditional range of two-to-three microns. However, after AutoSet became operational, closures immediately improved consistently to a level comfortably below two microns but still tantalizingly above one micron. We nonetheless were so pleased with this improvement that it took us some time to appreciate that further progress could be made. One avenue concerned corrections for film deformation which were found to fall short of their potential (least squares fits of x, y polynomials to reseau images produced residuals subject to small but persistent systematic effects especially pronounced about the leading edge of each frame). This problems was solved by my son John who had designed the electronics of the CRC-1 camera and had programmed its microprocessor. He conducted a series of tests, varying both the time of transport of the film from frame-to-frame and the tension on the film, a relatively straightforward process because both functions were under programmable microprocessor control. Very substantial improvements in reseau fits resulted from a combination of slowing film transport from the normal three seconds per frame to five seconds while reducing film tension by more than half.

About the same time as the new film transport regime was formulated, an improved, strain-free method of mounting the platen in the magazine was developed. Still another line of improvement stemmed from the discovery of subtle effects arising from slight alteration of the position of the principal point with changing orientation of the camera. This led to implementation of suitable physical corrective measures.

When the foregoing improvements were introduced in 1986, the long-awaited breakthrough occurred: closures of triangulation of less than one micron were obtained on a reasonably regular basis. Indeed, rms closures as small as 0.6 to 0.7 μm have been attained over the past year on several projects and this, in turn, has led to accuracies of triangulation as great as 1 part in 500,000 of the diameter of the photographed object.

Although suitable physical improvements to the camera provided the ultimate key to breaking the micron barrier, this could not have been accomplished independently of several other factors. Most noteworthy was use of digital image processing of the output of a solid state (CCD) video camera to produce settings on images. This let to a precision of setting some 3 to 5 times better than could be expected from a skilled human technician as well as a tenfold increase in overall speed of mensuration. Among other contributing factors the following merit special mention:

- use in the CRC-1 camera of an ultra-flat vacuum platen incorporating a set of back-projected reseau marks thereby making possible the precise correction of nonlinear film deformation;
- mensuration of the film on a monocomparator of 0.10 μm precision and 0.3 to 0.4 μm absolute accuracy;
- reduction by means of the bundle method with self-calibration;
- Exercise of geometrically strong, highly redundant photohgrammetric nets leading to especially effective self-calibration;
- generation of nearly ideal imagery through use of optimally illuminated retroreflective materials for photographic targets; and
- use of Kodak Tech Pan film to produce images of retrotargets of extremely high contrast and extremely fine grain.

With regard to the last point let me call your attention to Figure 6 which shows in juxtaposition highly enlarged images of a ringed retrotarget on Kodak Tri-X film (left), a longstanding product, and Kodak Tech Pan film (right), introduced in the present decade. The Tri-X image is typical of the quality produced by the moderately fast photographic emulsions commonly used in ballistic cameras. As can be seen, with Tech Pan film image quality is vastly improved at the cost of only a modest decrease in speed. Such superior imagery considerably facilitates precise mensuration and contributed materially to the breakthrough.

Although the micron barrier has now been broken in close-range photogrammetry, it remains intact in aerial triangulation. However, by adopting several of the special tools just mentioned (including mensuration on AutoSet), we have recently attained an rms closure of 1.6 μm in aerotriangulation of a 405 photo block taken a 300mm Zeiss mapping camera flown at a scale of 1 to 20,000. The camera incorporated a reseau platen specially fabricated to replace the conventional Zeiss platen. It remains to be seen whether altering the camera magazine for slower and more gentle transport of the film is feasible, and if so, whether it will lead to significant improvements.

In his insightful keynote address to the 1985 annual meeting of the American Society of Photogrammetry, Professor Konecny, then newly installed as President of ISPRS, delineated a succession of four fundamental stages in the development of photogrammetry over the past 150 years (Figure 7). We are now well into the transition from the age of analytical photogrammetry to the age of digital photogrammetry. I think it significant that only by entering this new age through application of digital image processing were we ultimately able to break the micron barrier.

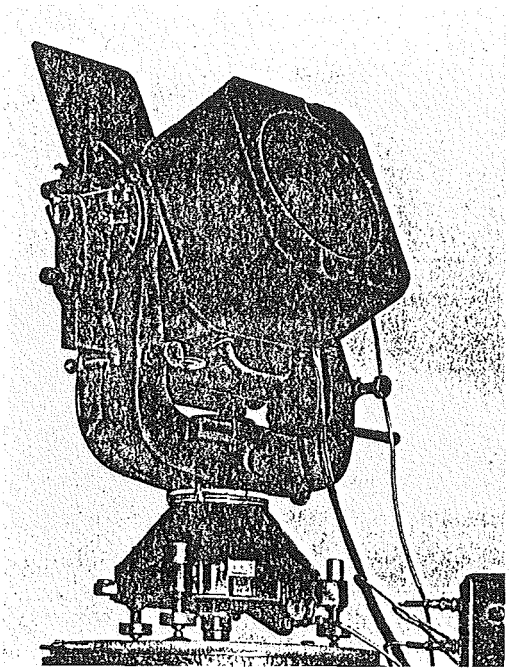

Figure 1. BC-4 Ballistic Camera.

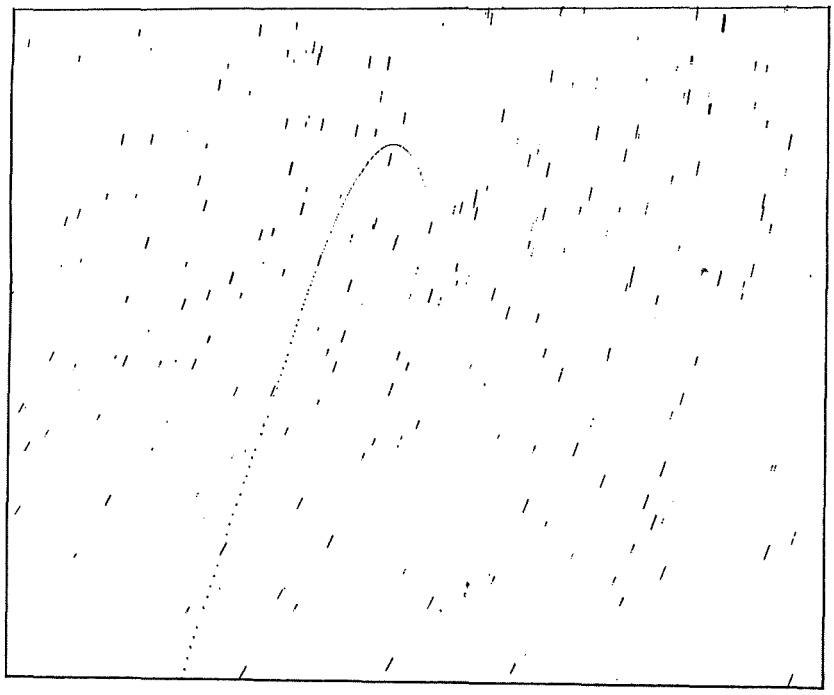

Figure 2. Trace of missile-borne flashing light recorded against star background by BC-4.

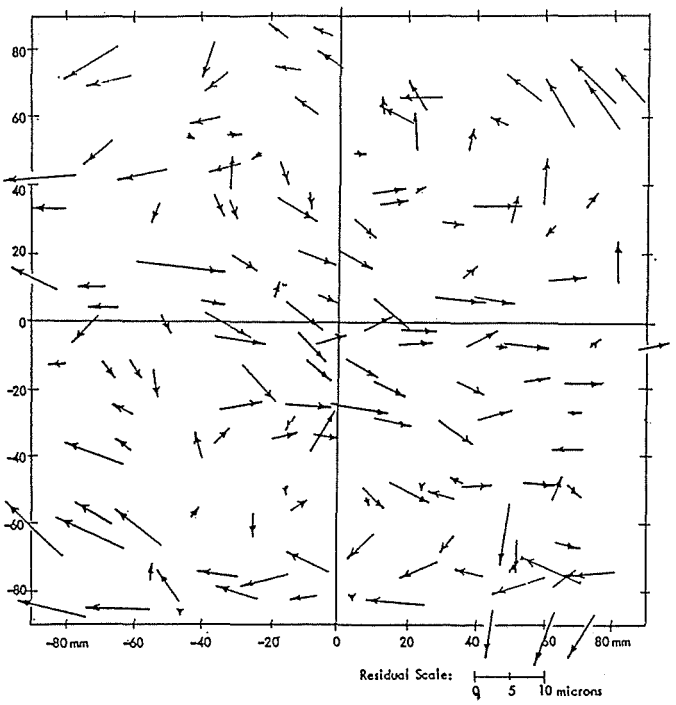

Figure 3a. Residual vectors from zenith exposure made by 600mm ballistic camera.
Residuals are highly systematic and have an rms value of 3.9μm.

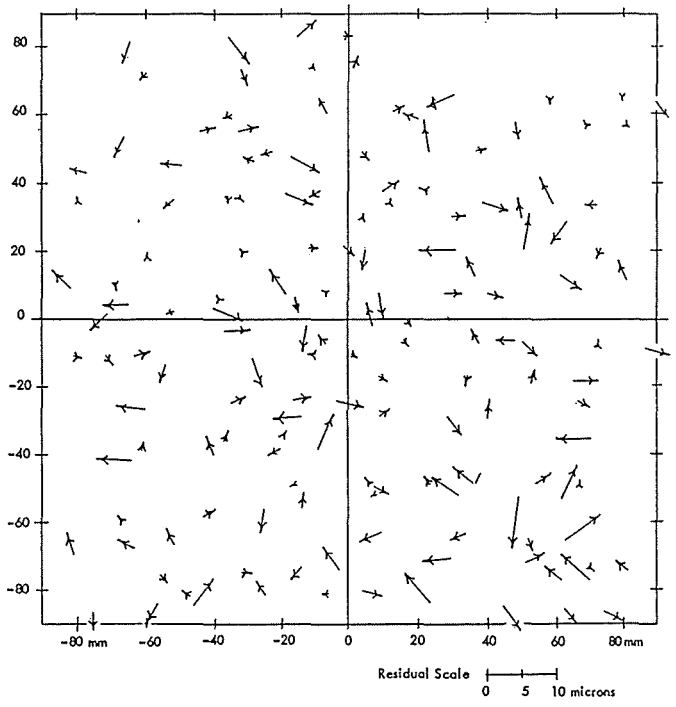

Figure 3b. Corresponding residual vectors after revisios of reduction to recover coefficients of decentering distortion. Residuals are now random and have an rms value of 2.1μm.

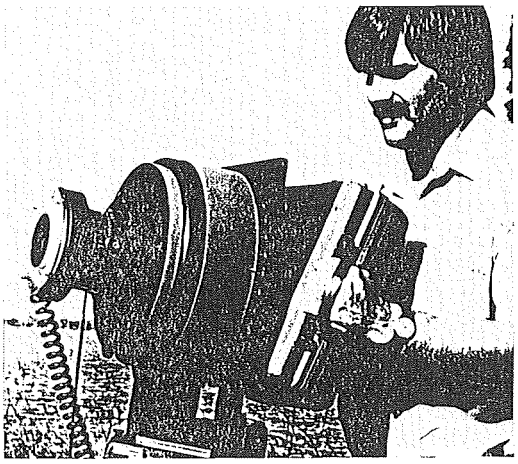

Figure 4. CRC-1 Close-Range Camera

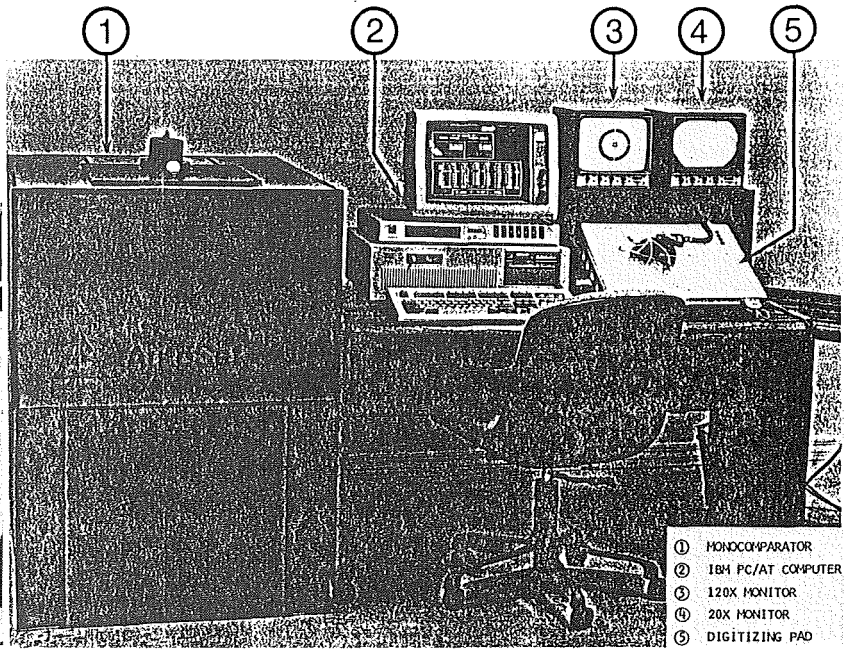

Figure 5. AutoSet system for automatic mensuration of CRC-1 negatives.

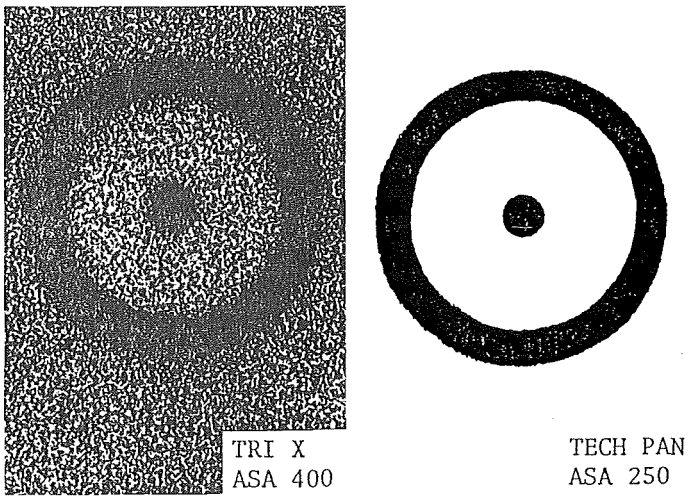

Figure 6. Comparative enlarged images of retrotarget as recorded on Kodak Tri-X and Tech Pan films.

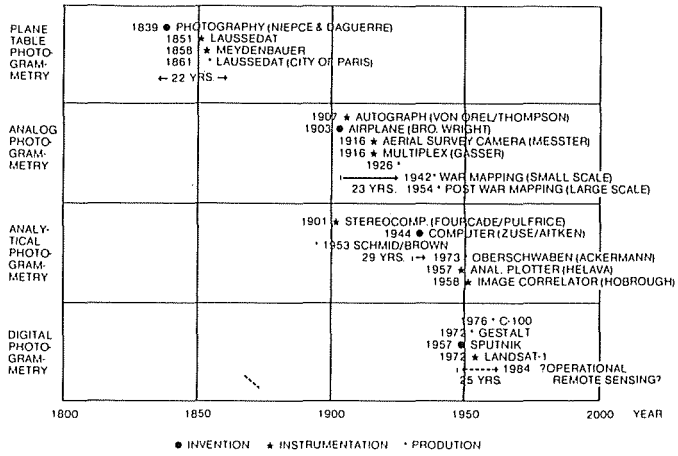

Figure 7. Stages of development of photogrammetry as propounded by Konecny.