INAUGURAL CEREMONY

Tuesday, 15 August 1961 at 10^h 15^m

The Inaugural Ceremony took place, in the open air, on the Plaza in front of Dwinelle Hall on the Berkeley Campus of the University of California, in the presence of a distinguished gathering of representatives of the U.S. Government, the U.S. Academy of Sciences, the University of California, the diplomatic services and many local organizations. Apart from Members of the Union and their guests, it was attended by several thousand members of the public, of whom a large proportion were students.

The Union was honoured by the presence of the Honorable the U.S. Ambassador to the United Nations Organization, Adlai E. Stevenson, representing the President of the United States of America; and by the Chancellor of the University of California, Edward W. Strong.

Professor Leo Goldberg, Chairman of the U.S. National Committee for Astronomy, acted as chairman for the ceremony. After a few words of welcome to Members and guests, he read the following telegram of welcome from President John F. Kennedy:

TELEGRAM FROM THE PRESIDENT OF THE UNITED STATES OF AMERICA

August 15, 1961

To: Dr J. H. Oort, President, International Astronomical Union

I would like to extend my greetings to all of the delegates to the Eleventh General Assembly of the International Astronomical Union. It is a privilege for the United States to be host to this distinguished meeting and to welcome the assembly once again to our shores.

Astronomy is an ancient art, and from the earliest times has known no national boundaries. Today, American astronomers work with their colleagues in observatories all over the world. I hope that tomorrow this collaboration will extend to observatories in outer space.

The breadth and freedom of scientific exchange among astronomers sets a high example for other disciplines, I know that this exchange will continue, even as man's curiosity about the structure and history of the universe continues.

My very best wishes for a successful meeting.

(Signed) JOHN F. KENNEDY

He then read the following message from the Governor of the State of California, Edmund G. Brown.

MESSAGE FROM THE GOVERNOR OF THE STATE OF CALIFORNIA

It is with extreme pleasure, as Governor of California, that I welcome the Eleventh General Assembly of the International Astronomical Union to Berkeley and to California. I also join with other Americans in welcoming those from foreign shores to our United States.

The work of your organization in uniting professional men from all over the world into an effective organization for the advancement of science is an outstanding example of what can be accomplished by friendship among men. There are many advantages to this kind of

cooperation, such as the elimination of waste in the duplication of effort. But the most important, of course, is that men who work together, whether in science or any other field, come to know each other and have respect for their fellows.

Citizens of a nation become citizens of much more when pursuing knowledge. Thus it could be among all men, regardless of the cause which unites them, if sense and reason could prevail.

We in this city, this state and this nation are honored by the convening here of the General Assembly of the International Astronomical Union.

(Signed) EDMUND G. BROWN

The Chairman then called upon Dr Donald H. Menzel to address the gathering on behalf of the National Academy of Sciences.

ADDRESS BY THE REPRESENTATIVE OF THE U.S. NATIONAL ACADEMY OF SCIENCES DR DONALD H. MENZEL

Professor Detlev Bronk, President of the National Academy of Sciences, joins me in extending the Academy's welcome to you—our friends and colleagues of many countries. We are grateful to you for having come so far to share with us your friendship and your knowledge.

Dr Bronk and I wish that we could adequately express the many special reasons why the friendly associations of international gatherings such as this give so much pleasure to American Scientists. It is in part because we Americans have so recently come from your native lands. The brothers of your fathers built our nation. Your ancestors are our ancestors too.

Another reason for a feeling of close association stems from the fact that our science has grown from seeds imported by our teachers who first studied in your lands. From the days of Franklin on, we have had a deep debt of gratitude for this friendly nurturing of our scientific education.

Every gathering such as this is a significant breach in the walls that separate people of good will. Such gatherings make statesmen aware that, through science, nations can peacefully gain those material benefits they have fruitlessly sought to acquire through war.

Scientists are uniquely fitted to persuade their fellow citizens that shared knowledge enriches the intellectual resources of all people. As you well know, the science of Copernicus and Galileo and Newton has extended the intellectual and spiritual horizons of people in every nation.

Fifty years ago, when Lord Bryce was the ambassador from Britain to this country, he expressed the international significance of science as follows: 'one of the most delightful things of science is that it knows no allegiance to nationality. Science is a republic in which there is no passport to greatness except service and genius. It is a republic of which everyone is a citizen and where everyone has equal rights in every part of the world'.

Your own National Academies and Royal Societies comprise this republic of science, wherein inquiring men continually engage in the great adventure of advancing the frontiers of human knowledge.

The U.S. National Committee of the IAU operates under our National Academy of Sciences. Many of you have received grants in support of your travel to this meeting. I should like to point out, however, that these funds came not from the Academy, but from many

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sources: U.S. Government agencies, numerous industrial companies, charitable foundations, and scientific institutions. These donors join Professor Bronk and me, for the National Academy of Sciences, in a most hearty welcome and with best wishes for a successful and profitable meeting.

After thanking Dr Menzel for his address, Dr Goldberg then invited Dr D. H. McLaughlin, Regent of the University of California, to speak.

ADDRESS BY THE REPRESENTATIVE OF THE UNIVERSITY OF CALIFORNIA, DR D. H. MCLAUGHLIN

Dr Oort and Members of the International Astronomical Union:

On behalf of the President and the Regents of the University of California, I welcome you most cordially to our Berkeley campus. We are very pleased that you have elected to hold your second meeting in the United States after an interval of twenty-nine years. Your selection of this once remote site on the far western side of the North American continent is truly a gracious recognition on your part of the value of the contributions that the staff of the University of California has made to the advancement of astronomy and the sciences on which it depends to such an increasing degree.

The University of California is a relatively young institution. Less than a century ago, this plaza, in which we are gathered this morning, was an open field—a sunny spot on the long, grassy slope from the hills to the bay which was then unbroken except for scattered clusters of oaks and a few low buildings at the distant landing. Yet, in that short time, a University has been created that has won a respected place among institutions of learning in the world, and our setting has been transformed from its quiet emptiness to the extensive urban region that surrounds us.

In a century of growth such as this, when this pleasant land with its mild Mediterranean climate was being rapidly filled with energetic people who built cities, developed vast orchards, farms and ranches and created a host of industries, it might have been expected that emphasis on the practical needs of life would have completely diverted attention from scholarly or scientific interests. Fortunately, it did not, for even in its earliest days the University was generously supported not only by the people of the state through their legislature, but by individuals whose gifts made possible the prompt initiation of work in many fields that otherwise might have been cultivated much more slowly. Among them was the bequest of James Lick from which the first structures of the observatory that bears his name was built and which provided California with the first great refracting telescope that enabled the young institution to attract and hold astronomers of highest competence.

It is, I think, particularly significant that this early benefaction—in fact one of the very first the University received—was to support a science that could hardly be expected to pay its way in direct service to the needs of the growing state. Its appeal was solely intellectual and it is surely greatly to the credit of the spirit of the early pioneer days that men were stirred by such visions and that the people at large through their representative bodies provided the continued financial means necessary to carry on the work that the private donors had started.

Men tend to express their gratitude for material wealth—or perhaps their pride in it—in many different ways, some admirable, some otherwise. The Spanish conquerors and settlers, from California to Peru, were inclined to build churches and many a mining town is richly

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Men tend to express their gratitude for material wealth—or perhaps their pride in it—in many different ways, some admirable, some otherwise. The Spanish conquerors and settlers, from California to Peru, were inclined to build churches and many a mining town is richly

adorned with worthy examples of the architecture of the sixteenth to eighteenth centuries that achieved some of its loveliest expressions on the Pacific side of the Americas. In Mexico, towns such as Guanajuato or Tasco, built near the bonanzas of silver—or the town of Huancavelica in Peru where great deposits of quicksilver were mined—are adorned with numerous churches with rich facades and towers that are still a joy to see. Their contruction was an expression of the desire of those who had been made affluent by the precious metals they had won from the earth to express their belief in something more enduring than mere wealth—or perhaps to record their repentance for some aspects of their behavior when they were winning their wealth.

We can be grateful for the beauty of the early churches and monuments left us by the Spaniards—and they are particularly good to have in this age when most of the fine arts are so sterile—but we can be even more appreciative of the early Americans in California who very wisely gave their support to schools, to laboratories and to the creation of instruments for observation and precise measurement. Our forebears here, who had comparable good fortune in the mines and in the early development of the country, perhaps showed less skill in architecture, but they were equally eager to find a worthy way to make an adequate return for the riches they had won in this new and growing land.

Devotion of fortunes to such causes was truly an act of faith, and that to me is far more impressive than the earlier expression of belief through the building of churches, worthy though it may have been.

It was faith in the scientific method that led to the generous support astronomy has received here and elsewhere, and particularly faith in the men who are called scientists. And today, even more, the generous support of our laboratories and observatories reveals the same deep trust in the ends of science and in the integrity of the men who are devoted to it.

The acceptance of the concepts of modern astronomy requires faith of the highest order on the part of a layman—faith in the accuracy of instruments, in the precision of measurements and in the interpretation of seemingly obscure data. The acceptance of the idea that a distant star is receding from us at some fantastic speed simply from the observation of the displacement of a line on a spectrogram must remain an act of faith on the part of most non-scientists—even on the part of those whose learning in the humanities may be profound. But the faith is widely held, and continues to be demonstrated by the persistent and growing respect and steady support given to the work of men, such as yourselves, whose devotion to the highest ideals of science is unquestioned.

The existence of this Union, however, is not only an expression of such confidence on the part of men, but is also a demonstration that devotion to the ideals of science and belief in the integrity of fellow scientists is not restricted to national boundaries. Through it, the intellectual unity of competent and thoughtful individuals of all nations and races should be made clear to the smaller minds that would create dissention. From its example, we can find hope even in times as troubled as the present, that wise co-operation for worthy ends will displace strife, that competition will be fair, generous and exciting, and that faith in the men of science will be justified.

As the high priests of this great cult—if I may use these words in a new and better sense—you are indeed welcome here and we are proud to be your hosts.

The Chairman thanked Dr McLaughlin and then invited Professor J. H. Oort, President of the Union, to address the gathering.

ADDRESS BY THE PRESIDENT OF THE INTERNATIONAL ASTRONOMICAL UNION, PROFESSOR J. H. OORT

Mr Chairman, Ambassador Stevenson, Doctor Menzel, Regent McLaughlin, Representatives of our sister Scientific Unions, Ladies and Gentlemen:

It is a pleasure to open the second General Assembly which the International Astronomical Union is holding in America. It is a special privilege to be able to do this in California, to which astronomy owes so much of its development in this century. We are deeply indebted to the Government of the United States and the National Academy of Sciences for inviting us to their country and in particular for providing the means to enable us to hold so complete a meeting at such a large distance from Europe. I thank President Kennedy and the Governor of California for their messages of welcome. That you, Ambassador Stevenson, have come to Berkeley especially for this occasion to welcome us, is a source of particular gratitude. You may be assured that we astronomers will do all we can to make our small contribution to international understanding as perfect as possible. World-wide international co-operation in astronomy dates back much further than such co-operation on political or economic levels. And I think that *we* have already arrived at the point where competition between nations has become almost entirely replaced by the strong conviction that it is only by helping each other internationally that we can really succeed in penetrating into the Universe.

An important part of the history of the American people is connected with the migration to the west. It even seems that, after having reached the western boundary of their continent they could not resign themselves to halt there, and, becoming possessed by a desire to penetrate further and further, they reached out into the skies. Thus they became pioneers of large telescopes, through which their thoughts travelled out into space. Here there was no boundary to stop them and they boldly headed for the outer limits of the physical universe.

It was near this West Coast that the first large mountain observatory was founded on Mount Hamilton. Under the auspices of the University, which has received us with such great hospitality, a large 36-inch refractor was there installed in 1888. Already early in its history the Lick Observatory has made basic contributions to our knowledge of the motions of the stars. It is continuing this today with an invaluable survey in which stellar positions are tied to the motionless background of distant galaxies. With a new 120-inch telescope it is now entering a new phase of its existence. I may use this opportunity to extend to the Lick Observatory and to the University of California the good wishes of all astronomers who are here today, and to express the impatience with which we wait for the treasures which the Lick astronomers will gather out of the depths of the Universe.

At one time there was a personal union and triple alliance between the Lick Observatory, the University of California and the Astronomical Union, when W. W. Campbell, who had been director of the Lick Observatory and later president of the University of California, became president of our Union. We are happy that this alliance of the past is now reborn in an actual coming together.

The greatest development of astronomy in the United States has been inspired and led by a man who appeared to have combined almost all of the best human qualities. It is fitting that on this first large international gathering in California tribute be paid to George Ellery Hale, without whose penetrating foresight, idealism and perseverance neither the Mount Wilson Observatory nor the giant telescope on Mount Palomar would have come into existence.

It was with the 60-inch telescope on Mount Wilson that Harlow Shapley obtained the first insight into the actual size of the Galactic System and the Sun's eccentric position in this

System. It was also with the 60-inch that he found the characteristic colour-magnitude diagrams of globular clusters which theoreticians together with astronomers on Palomar later developed into such a wonderfully penetrating picture of stellar evolution. Hale's second large instrument, the 100-inch telescope on Mount Wilson, was, at its completion in 1917, as much ahead of its time as the 60-inch had been in 1909. With this instrument Edwin Hubble and, later, Walter Baade, revealed the true character of the 'great nebulae', indicating that they were enormous star systems, like our own Galaxy. In the same period Hubble began his great attack on the universe, an attack that was to be completed with the new telescope on Palomar. This new telescope, which was named after Hale, was such a grand conception that, though it is now thirty-three years since the plans for it were started, the instrument still completely commands the field. It is in the 200-inch telescope that the courage and skill of the American people are shown at their best. It is perhaps the most exquisite blossom that has ever grown from the meeting of science and technique.

Practically all we know about stellar systems outside the Galactic System and the Clouds of Magellan, has been discovered with the giant telescopes in the Western United States. It may therefore be fitting at this occasion to dwell for a moment on some of the problems in this domain by which astronomers are now confronted.

If you look through the Hubble Atlas of Galaxies, which has just been completed by Sandage, and which you will certainly find on display, you will be particularly struck by two things: In the first place by the great variety of forms, in the second place by the fact that the majority of galaxies have structures that cannot possibly be in equilibrium. These galaxies seem to be midway between a curious kind of chaos and a stage in which they would become well-mixed and regular. They clearly bear the imprint of their birth in a past and quite different phase of the universe. One of the most fascinating problems is to penetrate into that distant past and to find out what it was that gave the galaxies the curious spiral and other shapes that we observe today. The investigation is as difficult theoretically as observationally. It requires among other things a much more advanced knowledge of the role of magnetic fields in galaxies and of plasma physics than we possess today. So far, we have hardly been able to decipher any of the hieroglyphs of these galaxies. And more riddles appear to come up all the time. We can only optimistically hope that when we have amassed enough enigmas the solution may be near. There are two other roads beside that of the structure and dynamics of galaxies that appear to lead to that most distant past. One goes through the star clusters and their ages. The oldest clusters appear to be between twenty and thirty billion years old and probably date from the time when the Galactic System was born. The third road is that of the expanding universe, which indicates that the entire Universe was born at about the same time as these oldest star clusters. Or, at least, that it evolved at that time from something different from the present universe. On this point, however, there is still some divergence of opinion. All of the three fascinating fields that I have mentioned are in a rapid state of development. The large reflectors on the American continent, headed by the 200-inch, play a leading part in the observational and most important side of this development.

Since the war a totally different kind of observing has come to our aid, namely, observations at radio frequencies. There can be no doubt that radio telescopes, when sufficiently large, permit observations penetrating much deeper into the Universe than is possible by optical means. It is clear from the outset that this possibility contains a promise for extremely interesting discoveries. Radio instruments have already helped the 200-inch to find a galaxy running away from us with half the velocity of light, and having an age of about half that of the universe directly around us. It is most likely that a search out to much larger distances, such as appears possible with the largest radio telescopes, will reveal quite novel things. In fact, there are indications that they are already doing so. These observations will be a topic of

discussion at this meeting. The radio galaxies which form these most distant signposts in the Universe are themselves most enigmatic objects. We have not yet the slightest idea what causes some galaxies, or pairs of galaxies, to become such powerful radio emitters.

Here, as in many other domains of astronomy, it is a symbiosis between different observing techniques which is making the big advance possible. It would be interesting to speculate how far radio astronomers could have developed the subject of radio sources if they had not had the help of large optical telescopes. I think that it would long have remained a hopelessly speculative field. In a sense one might say that, but for the help of large optical instruments, radio telescopes are almost blind.

The advent of the radio telescope has brought a large change in astronomy. Not only by extending its scope, but also in changing the character of our science. Our ranks have partly been filled by electronic engineers and physicists. Moreover, astronomy, which used to share with music, mathematics and painting the privilege of being something for which there was little direct practical application, and which because of that was left quietly to pursue its own ideals, has now become something of the world: the technical world, which is interested in the low-noise amplifiers as well as in other problems connected with the electronics part of radio astronomy. In addition, an entirely new situation has arisen, where astronomy has come into conflict with society. Communication services, television and broadcast transmitters are rapidly filling the ether with so much noise that it becomes impossible for the radio astronomer to hear the extremely weak signals coming from the outer limits of the Universe. This is a matter of life or death for radio astronomy as well as for scientific space research. Other grave dangers for astronomy have arisen by plans to put reflecting screens consisting of small dipoles in orbits around the Earth. The International Astronomical Union has an important duty in backing by its full authority the Inter-Union Committee which it has entrusted with the task of obtaining free channels for radio astronomy and space research, and of protecting the interests of astronomy from human inroads in the sky.

A still greater change in the character of our science has come through the development of that younger brother of radio astronomy: space research. In opening the congress of the Union in 1958 Professor Danjon expressed his admiration for what had then been accomplished in the successful launching of sputniks and other space vehicles, in connection with the International Geophysical Year. Since then, there has been a still more rapid development than could have been foreseen. I may remind you only of that wonderful first experiment made by our colleagues of the Soviet Union in which they obtained pictures of the rear side of the Moon and also of the interesting investigations on cosmic-ray particles outside the atmosphere which led to the discovery of the Van Allen belts, about which we shall hear a first-hand report during this meeting.

Particularly important for astronomy are the projects for putting telescopes of considerable size in vehicles above the atmosphere. There can be no doubt but that the realization of these plans will offer immense new possibilities for astronomical research. I would not try to predict the nature of the results. For, like in radio astronomy, the most interesting are likely to be the things of which nobody has any inkling. These purely astronomical space projects, as well as the enormous Government plans for manned journeys through the planetary system, are absorbing an increasing number of our small astronomical family, but they are at the same time adding a large fringe of distant relatives in the form of electronic engineers, space physicists and future space travellers.

The astronomical workshop is seething with life. Almost everybody appears to be hammering and building. It is a joy to watch this activity and it is making the old astronomers wish to live long enough to see the results.

But it also poses problems for our Union. Problems for which we shall have to find a solution if we wish to keep it successful. I have been in close contact with the Union throughout its life. I may, in fact, be the only astronomer who has been to all eleven General Assemblies, although in 1922 I attended only by accident and quite unofficially. At that Rome meeting there were eighty-three members and guests; it was the nicest General Assembly I have seen! Since then every meeting became larger than its predecessor, and after the war they began gradually to grow out of hand. At the same time also the administration of the Union became too much for a single general secretary, even for such exceptionally efficient secretaries as we have recently had.

Though the General Assemblies of the Union continue to fulfil a most useful purpose in bringing together representatives from all different branches of astronomy, thus helping to develop these branches in such a way that they are most useful for one another, and though they continue to be a fruitful meeting place for old and young astronomers from all nations and vocations, we must nevertheless ask seriously whether or not we should go further in this way. I must confess that I feel quite uneasy about this. We must not run the risk that by an unwieldy size of our meetings the possibility of forming close ties and friendships is lost, or that some of our best astronomers refrain from attending because of disappointment about the too large meetings. The Union should, in time, take steps to ensure that its fine tradition of international co-operation is preserved. But what should be the steps? Is the only way out to arrange for separate Assemblies for different subjects, for instance, the Planetary System, the Sun, Stars and Galaxies?

For the present we still have all subjects of astronomy united. And we must enjoy this meeting to the fullest extent.

That this gathering of astronomers will be a successful and happy one can hardly be doubted since we are meeting in California. For this state of California was named after a fabulous island described in the sixteenth century by Ordonez de Montalvo as being situated *close to Paradise*; for astronomers it *is* the paradise!

May some of this paradisian spirit pervade our meetings and also the new international ties that will be knotted during these days.

The President then repeated part of his address in the French language, as follows:

C'est un plaisir pour moi d'ouvrir la seconde Assemblée Générale que l'Union Astronomique Internationale tient en Amérique. Mais c'est pour moi un privilège tout à fait spécial d'ouvrir cette assemblée en Californie, pays qui a contribué d'une façon si éminente au développement de l'astronomie dans ce siècle.

Nous sommes infiniment reconnaissants au gouvernement des Etats-Unis et à l'Académie Nationale des Sciences de nous avoir invité dans leur pays. Nous avons été particulièrement sensibles aux facilités qu'ils nous ont accordées pour nous permettre d'organiser une assemblée générale si nombreuse dans un pays aussi éloigné de l'Europe. En particulier je souhaite la bienvenue à l'Ambassadeur Stevenson qui est venu de si loin pour ouvrir notre Assemblée.

Une grande partie de l'histoire du peuple Américain est intimement liée à la migration vers l'Ouest. Il semble même qu'ayant atteint les limites extrêmes de leur continent ces hommes n'ont pu se résoudre à s'arrêter là, et toujours possédés par le désir d'aller de plus en plus loin, ils s'échappèrent dans les cieux. Ainsi ils devinrent les pionniers de ces grands télescopes qui permirent à leurs pensées de voyager dans l'espace. Là il n'y avait plus de limites pour les arrêter et ils partirent hardiment vers la découverte des frontières de l'univers physique. C'est sur cette côte ouest que fut fondé au Mont Hamilton le premier grand

observatoire de montagne. Sous les auspices de l'université même qui nous reçoit aujourd'hui si généreusement, un grand réfracteur de 90 cm y fut installé en 1888.

Le grandiose développement de l'astronomie aux Etats-Unis a été inspiré et dirigé par un homme qui réunissait en lui toutes les plus grandes qualités humaines. Il est opportun de rappeler, à l'occasion de cette première grande réunion internationale de Californie, avec respect et reconnaissance le nom de George Ellery Hale. Sans son intuition, son idéalisme et sans sa persévérance ni l'observatoire du Mont Wilson ni le télescope géant du Mont Palomar n'auraient vu le jour.

C'est avec le télescope de 60 pouces du Mont Wilson que Harlow Shapley a pu se faire une idée des dimensions actuelles du système galactique et de la position excentrique du soleil dans ce système. C'est encore grâce à ce même télescope de 60 pouces qu'il a pu construire pour les amas globulaires les diagrammes couleur-luminosité si particuliers et dont l'interprétation récente par les théoriciens et les observateurs du Mont Wilson a fourni une image si merveilleusement nette de l'évolution des étoiles.

Le second grand instrument de Hale, le télescope de 2,50 m, lui aussi installé au Mont Wilson, était au moment de son achèvement en 1917 aussi perfectionné pour son époque que l'était en 1909 le télescope de 1,50 m. C'est avec ce nouvel instrument que Edwin Hubble et plus tard Walter Baade nous ont révélé la véritable nature des "grandes nébuleuses" en découvrant qu'il s'agissait d'énormes systèmes stellaires ressemblants au système galactique. C'est à la même époque que Hubble a commencé à s'attaquer sérieusement à l'univers lui-même; cette attaque a d'ailleurs été développée et continuée avec le télescope du Mont Palomar. Ce nouveau télescope, auquel on a donné le nom de Hale, était d'une conception si grandiose qu'actuellement encore, 33 années après le début du projet, il est toujours l'instrument par excellence dans le domaine des recherches sur les galaxies.

Pratiquement, tout ce que nous savons des systèmes stellaires situés en dehors du système galactique et des Nuages de Magellan a été découvert à l'aide des télescopes géants de l'ouest des Etats-Unis. C'est pourquoi je voudrais m'attarder un peu en examinant avec vous quelques uns des problèmes sur les galaxies que discutent actuellement les astronomes.

En regardant l'atlas des galaxies de Hubble, qui vient d'ailleurs d'être complété par Sandage et dont vous pouvez feuilleter un exemplaire exposé ici même, on est frappé surtout par deux choses: d'abord par la grande variété des formes et ensuite par le fait que la majorité des galaxies ont des formes qui, sans doute, ne peuvent pas être des formes d'équilibre. Ces galaxies semblent se trouver à mi-chemin entre un ancien état de chaos et un état dans lequel leur matière est bien mélangée. Ces galaxies portent nettement l'empreinte de leur formation pendant une phase antérieure et très différente de l'univers. Un des problèmes le plus fascinants qui se posent à nous est de pénétrer dans ce passé lointain et d'essayer de découvrir ce qui a donné aux galaxies leur forme en spirale ou ces autres aspects curieux que nous observons actuellement.

Il y a deux autres voies, en dehors de celle qui passe par la structure et la dynamique des galaxies, pour nous mener à ce passé si lointain. L'une est celle qui nous y mène par les amas stellaires et la détermination de leurs âges. L'autre est celle de l'univers en expansion qui nous apprend que l'univers dans son ensemble a pris naissance à peu près en même temps que les amas stellaires les plus vieux.

Depuis la guerre une technique d'observation tout à fait différente est venue à l'aide de notre science: l'observation dans le domaine des fréquences Hertziennes. Il n'y a pas de doute que les radiotélescopes, pourvu qu'ils soient suffisamment grands, nous permettent d'observer des régions beaucoup plus lointaines que celles que nous pouvons atteindre avec des moyens optiques.

Dès maintenant ces possibilités nous font entrevoir des découvertes du plus haut intérêt.

Ce sont les radiotélescopes qui ont aidé les télescopes du Mont Palomar à découvrir une galaxie qui s'éloigne de nous avec une vitesse égale à la moitié de celle de la lumière. Cette galaxie a un âge égal à la moitié de celui de l'univers dans notre voisinage immédiat.

Il est tout à fait certain que la poursuite de ces recherches vers de plus grandes distances, comme cela est possible avec les plus grands radiotélescopes, révèlera des choses tout à fait nouvelles. En fait, certaines indications nous montrent que nous sommes déjà sur cette voie.

Ici, comme dans beaucoup d'autres domaines de l'astronomie, c'est la symbiose entre différentes techniques d'observation qui permet les grands progrès. L'avènement du radiotélescope a produit un grand changement en astronomie, non seulement en étendant son domaine, mais encore en changeant le caractère de notre science. Des ingénieurs électroniciens et des physiciens ont rejoint nos rangs.

De plus, une situation tout à fait nouvelle s'est présentée: l'astronomie est entrée en conflit avec la société. Les services de télécommunication remplissent si rapidement l'éther avec de si nombreux bruits qu'il devient impossible aux radioastronomes d'entendre les très faibles signaux qui parviennent des limites extrèmes de l'univers. Ceci est devenu une question de vie ou de mort pour la radioastronomie aussi bien que pour les recherches scientifiques de l'espace. D'autres graves dangers guettent l'astronomie par le projet de mettre en orbite autour de la terre un écran réfléchissant constitué par des petits dipôles.

Un changement encore plus grand dans le caractère de notre science est arrivé avec le développement de la jeune soeur de la radioastronomie, la recherche spatiale.

En ouvrant le Congrès de l'Union en 1958, M. Danjon exprimait son admiration pour ce qui avait été accompli dans le lancement réussi des spoutniks et d'autres véhicules spatiaux à l'occasion de l'Année Géophysique Internationale. Depuis lors les événements se sont développés beaucoup plus rapidement qu'on aurait pu le prévoir. Je vous rappellerai seulement cette merveilleuse expérience faite par nos collègues de l'Union Soviétique lorsqu'ils ont obtenus pour la première fois des images de la partie invisible de la lune.

Je vous rappellerai aussi les très intéressantes recherches sur les rayons cosmiques en dehors de l'atmosphère qui ont conduit à la découverte des ceintures de Van Allen. Nous entendrons d'ailleurs au cours de notre Congrès un rapport de première main sur cette question.

Les projets de placer des télescopes de diamètre considérable dans des véhicules spatiaux sont particulièrement importants pour l'astronomie. Sans aucun doute la réalisation de ces projets offre d'immenses possibilités tout à fait nouvelles pour la recherche astronomique.

L'atelier astronomique regorge de vie. Presque tout le monde semble avoir pris le marteau pour construire. C'est une joie d'observer cette activité et les astronomes âgés souhaitent de vivre assez longtemps pour en voir les résultats. Mais cela pose aussi des problèmes à l'Union, problèmes que nous devons résoudre si nous voulons que l'Union continue à travailler avec succès.

A la première assemblée de notre Union qui s'est tenue à Rome en 1922, il n'y avait qu'une assistance de 83 membres et invités. C'est l'Assemblée Générale la plus agréable que j'ai vue.

Depuis, chaque Assemblée devient plus importante que la précédente et depuis la Guerre il devient presque impossible de les diriger. Or, bien que les Assemblées générales de notre Union aient continué à poursuivre un but très important en permettant la rencontre des représentants de toutes les branches de l'Astronomie, et qu'elles aident ainsi ces branches à se développer de façon harmonieuse, et bien qu'elles continuent à être un lieu de rencontre des plus utiles pour les astronomes jeunes et vieux de toutes les nations, nous devons nous

demander sérieusement si nous devons ou non continuer dans cette voie. Je dois avouer que je suis très inquiêt et très indécis à ce sujet.

Nous ne devons pas courir le risque que des assemblées trop nombreuses empêchent les astronomes de nouer des liens d'amitié, ni le risque de voir certains de nos meilleurs astronomes, déçus par ces trop nombreuses assemblées, éviter nos réunions.

L'Union doit, à temps, prendre des mesures pour assurer que cette belle tradition de coopération internationale soit préservée. Mais quelles doivent être ces mesures? Le seul remède serait-il d'organiser des réunions séparées sur différents sujets, par exemple, le système planétaire, le soleil, les étoiles et les galaxies?

Actuellement tous ces domaines de l'Astronomie sont encore réunis et nous devons nous réjouir et en profiter pleinement.

Comme cette réunion a lieu en Californie, nous ne pouvons douter, un seul instant, qu'elle sera une pleine et heureuse réussite. Cet Etat de Californie dont le nom vient de cette île fabuleuse décrite au seizième siècle par Ordonez de Montalvo comme étant située *près du Paradis*, pour les astronomes *c'est* le Paradis.

Puisse cette atmosphère de paradis régner sur nos réunions et aussi sur les nouveaux rapports internationaux qui seront renoués pendant ces journées.

Dr Goldberg thanked Professor Oort for his address and then called upon Ambassador Adlai E. Stevenson to address the assembly.

ADDRESS BY THE REPRESENTATIVE OF THE UNITED STATES OF AMERICA, AMBASSADOR ADLAI E. STEVENSON.

On behalf of the Government of the United States, and of the American people, it is my duty and my privilege to express to all of you, the distinguished members of the International Astronomical Union, a most cordial welcome to this country.

In this gathering are learned scientists from every continent and latitude, from Australia to that ancient cradle of astronomy, Egypt. We heartily welcome you all to the United States. And since Moscow was the site of your most recent Assembly three years ago, it is my particular pleasure to greet the large and distinguished delegation which has come here from the Soviet Union.

For yours is a community of the mind—ordered by reason, united in the single pursuit of truth about the universe. We who try to keep the peace among unruly nations cannot help envying and admiring your unity and purity of purpose. Would that all of us at the United Nations could follow your example, would that all of us could unite to end cold war and conflict, and concentrate on the arts of peace and the wider enjoyment of the benefits of this age of unparalleled technical progress.

I have been told that one of the reasons the astronomers of the world co-operate is the fact that there is no one nation from which the entire sphere of the sky can be seen. Perhaps there is in that fact a parable for national statesmen, whose political horizons are all too often limited by national horizons. In the United Nations we have mankind's greatest attempt so far—halting though it is—to widen all our horizons, to cause all men and all nations to accept the fact that there is but one world, without horizons other than the common horizon of illimitable space—one world not only in science, not only in the search for truth, but in the ordering of their international lives.

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But science is more than a search for truth and a noble exercise of the mind. For generations the scientist and his practical cousin, the engineer, have been widening man's grasp of nature with geometrically increasing speed. They have put into the hands of the statesman and the citizen unimaginable powers. And although science itself, and the powers it bestows, are ethically neutral with the cold neutrality of outer space, the ways in which men use those powers carry the greatest consequence for good or for evil.

The same hydrogen fusion process that gives the burning light of the Sun and the stars has been in our grasp for a decade—but will we use it for construction or for cataclysm? Earth satellites may soon give us direct and instantaneous communication and television spreading simultaneously around the world—but will we use them for truth or for falsehood, for tolerance or for hatred, for peace or for conflict?

Scientifically and technically the world has already become a single community—yet in our ethical response to this fact, and in our political institutions, we, governments and citizens, are lagging dangerously far behind you, the scientists.

You have given us dangerous powers, but we have not yet learned to control them. You have given us tools to abolish poverty—but we have not yet mastered them. You have given us means to extend the span of human life, but this may prove a curse, not a blessing, unless we can assure food, survival, and then health and a good life for the bodies and minds of our exploding populations. You have made the world small and interdependent, but we have not built the new institutions to manage it—nor cast off the old institutions which scientific progress has made obsolete.

Every great change wrought by science is foreshadowed years ahead in the laboratory and on the drawing board. But it is not until the new device is fully built and functioning, and has astonished the whole world, that we begin to think of its human and political implications. We are forever running today to catch up tomorrow with what you made necessary yesterday.

This gap must be closed—this disruptive and dangerous lag between scientific discovery and political adaptation to it. I suggest that the natural scientist and the political practitioner must enter into a new communion of early and constant intercommunication, so that the world's institutions can more nearly keep up with the incessant march of science. Unless this is done, the gap will surely widen, for there is no way to slow down the pace of scientific discovery even if we wanted to do it.

Today things move more swiftly. Within ten years after man set off his first atomic explosion, the leaders of all the great powers had acknowledged that a nuclear war between any nations would be a catastrophe for *all* nations. There is now an Atomic Energy Agency which is *international.* There are strenuous negotiations for a permanent, reliable, controlled ban on nuclear weapons tests by any nation. There is a groping determination to halt the further spread of nuclear weapons to any nation. Thus, no doubt the exploration of outer space will breach them further.

We can only guess at such possibilities. But there is no guessing any more as to whether man will undertake the adventure of space exploration. Yesterday's dreams are today's facts. Scientific instruments, then animals, then men, have been hurled into space. The splendid flight and safe landing of Major Titov, just nine days ago, marks one further stride in this progression. There is no turning back; as certainly as the oceans were conquered in the century of Columbus and Magellan, new realms of space will be conquered in our century.

These questions are beyond the scope of science—but all of us, as citizens, must help to answer them. If the scientist and the engineer can create a thrust strong enough to defeat the Earth's gravitation, and can plan to send groups of men into flight far beyond the Earth—

then it is up to us in government and diplomacy to develop a comparable "orbital velocity" of our own, great enough to lift *all* mankind beyond the dread gravitation of mistrust and war.

In the years ahead, then, international diplomacy must do far more than put out the recurrent fires of conflict. It must apply itself with massive energy to three great areas of creative effort: to disarmament, to the building of institutions to keep the peace, and to international cooperation for human progress.

After fifteen years' debate all the world agrees that the arms race, especially in nuclear weapons, is anarchic, wasteful, and deadly dangerous for humanity. So all agree that we must stop the race, reverse the process and disarm.

Yet it is not done. Why? Because of deep conflicts of purpose, and an even deeper mistrust. But it can be done. It involves principles which are familiar to you as scientists—freedom of investigation, freedom of inspection, and freedom of verification. There must be, in any disarmament program, adequate inspection and verification such that each side can be quite sure, at every stage, that the other is living up to its part of the bargain.

Disarmament has been misconstrued as if it were in some way the enemy of national defense. And the idea of inspection and verification has unfortunately been misconstrued in certain quarters, as if it were in some way the enemy of disarmament. It is not. It is a necessity. The acid test of sincerity is whether one agrees to fully adequate inspection and verification. Only with them can we know that, inside the box marked "Disarmament", we will really find the reality and a peaceful world, and not something ticking away to the destruction of all of us. The same, of course, applies to the banning of nuclear weapons tests, for no permanent ban is possible without adequate inspection and verification. In nearly three years of negotiations in Geneva that has always been the key issue. And it still is.

The next question is: Who is to do the inspection and verification? What sort of policeman can police the great powers?

Here we find that we cannot take even the first practical step toward general and complete disarmament and a peaceful world unless the nations are willing to build new world institutions which stand above the individual nations and act impartially for the entire human community. What is called for is an international organization within the framework of the United Nations which will see to it that no single nation fails to comply with agreed steps toward general and complete disarmament.

And if we look still further down the road, to the day when national armed forces will be done away with and only internal police units remain, then all the more will the world need institutions of international law and order. Then the United Nations will need its own United Nations Peace Force, capable of deterring or subduing the strongest combinations which might be raised against it.

That is the long-run need—but the short run makes similar demands on us. Events in the Congo have shown how vital it is that the United Nations retain and develop further the capacity to act for peace, to deploy military forces with speed and precision, and thus to uphold the integrity of vulnerable nations in emergencies where direct intervention by a great power would risk disaster. The United Nations is the world community's greatest instrument, and the world community must act now to uphold it, pay for it, invigorate it, and support its able and courageous Secretary General.

All these things are demanded of us to save mankind from violence and war. But the community of nations, as this meeting today so eloquently attests, should be bound together by more affirmative and creative purposes. More and more we must, as a world community,

learn to practise the arts of peace cooperatively and together. And, at this fateful moment in history, when man has, so to speak, one foot already in the heavens, surely we must find ways for the powers to cooperate rather than fight in the exploration of outer space.

And surely all the world would breathe easier if the conquest of space were looked on henceforward not as a means to the power and glory of particular nations or ideologies, but as one of the great adventures of the whole human race.

"Together let us explore the stars"—so said President Kennedy at his inauguration last January, appealing especially to the Soviet Union. A few days later he renewed this appeal in these words: "I now invite all nations—including the Soviet Union—to join with us in developing a weather prediction program, in a new communications satellite program, and in preparation for probing the distant planets of Mars and Venus."

Technology will not wait long for an answer. In just a few years there will be rocket boosters, in more than one country, big enough to launch whole teams of men on journeys to the nearest planets. Shall this too be a race for military or psychological advantage at huge and wasteful expense? Or shall it be the occasion for teamwork, ignoring ideological lines? We haven't much time left in which to decide—it is a fork in the road which will soon be passed.

We have many similar choices to make closer to home. The new nations, which have recently become independent, have an almost unlimited need for education, health, industrial development, agricultural improvement, communications, and exchanges in the fields of science and culture. Shall more fortunate nations exploit those needs by offering aid only in exchange for political influence? Or shall we help because it is right to help? And shall we prefer more and more the disinterested channels of the United Nations? The path to peace must lie increasingly in the multilateral direction of the United Nations, especially with all the self-restraint and mutual tolerance which it requires.

Such are the specific challenges which face international diplomacy today and which draw still greater urgency under the accelerating pressures of science and technology. Disarmament. The building of institutions to keep the peace, both now and in a future disarmed world. International cooperation in the creative arts of peace, to abolish poverty and backwardness.

We have no choice but to meet these challenges. And, in meeting them, we shall be building together a grand design of peace—a design whose keynote is world community.

If there can be said to be a way of the future for mankind, I believe it is in that principle of community. No one nation, no empire, no imposed system can dare to speak any more for mankind. All must be willing, if sovereignty is to make any sense in the thermo-nuclear age, to deny themselves some of the extravagant jungle habits which have accompanied it in times past—and to join their sovereign wills in community institutions, in common community action, and in common obedience to the community's rules.

The rules themselves already exist. They are proclaimed in one of the greatest creative acts of history, the United Nations Charter. We can attempt to restate some of them in the light of our experience since 1945, when that Charter was framed—on the other side of San Francisco Bay.

The Charter commands every nation not to use or threaten force against the territory or independence of another. But experience requires us to go further, for there are other means of conquest. We have seen nations and peoples subjugated by political subversion and guerrilla warfare. We have seen economic aid used as bait and club to impose political influence and subservience. We could well see the raising of new territorial claims, or even, claims of possession in outer space. To all these exaggerations of sovereignty we must say: no, no

nation, any more, by any means, direct or indirect, shall seek to extend its control at the expense of another. And we can say so with rising confidence now that the Republic of the Congo, which was mortally threatened with new conquest by outside powers, has with the massive help of the United Nations regained its unity and its hopes for the future. Long may it live! And long may the world remember the triumphant achievement of the United Nations!

A second provision of the United Nations Charter calls for international cooperation for human progress—economic, social, cultural, and in the field of human rights. Much has been accomplished along those lines, but how much more could be done, both on this earth and in the spaces beyond, if all the nations would willingly pool their capacities and their efforts! The wonderful techniques of material progress should not be perverted to satisfy political or ideological ambitions. The poor and the hungry and the diseased of this world do not ask for help in the name of one "system" or another. They ask for it in the name of humanity—of the community of mankind—and it is in that name only that they should receive it.

There is a third principle of the United Nations that needs reaffirmation. It is summed up in those splendid words of the Preamble—"to practice tolerance, and live together in peace with one another as good neighbors."

Tolerance is the key to peace, for there can be no peace unless there is mutual tolerance as between differing peoples and systems and cultures. Peaceful co-existence should not and cannot involve "burial" by any one of any other.

You men of science above all others should value and preach tolerance, for you have only to recall the blight that intolerance cast on Copernicus and Galileo, a blight that held back astronomy for generations, and you know only too well how the orthodoxy of one scientific era becomes the heterodoxy of the next.

The condition of tolerance is openness and the understanding that comes from openness. How can there be tolerance or understanding if great nations continue in secretive isolation from the rest of the world, in suspicion and fear of sinister foreigners, excluding outside information, periodicals, books, and broadcasts, restricting travel, and hiding great parts of their territory? Only in openness will that mistrust that poisons the world atmosphere today be dispelled, and only through open societies can there arise that tolerance that will permit all of us to live in confidence and peace with one another.

Amid the darkness of this noontime there are rays of hope that we *will* achieve an open world. It is happening, bit by bit. Just the other day, we read that next year there will be direct air service between New York and Moscow. We see it in the growing record of tourism and cultural and technical exchanges. Indeed, we see it in such great world-wide assemblies as this of the International Astronomical Union.

Just last week I was happy to read the remark of the eminent Soviet astronomer, Professor A. A. Mikhailov, at a meeting in Pasadena on the astronomy of the space age. "Science is international," said Professor Mikhailov. "My hope is for the United States and Russia to share in space projects and in many other fields of human endeavor."

I am glad Professor Mikhailov is here this morning, because I would like to tell him how much I agree with him!

Community, tolerance, openness—those are the words which I would leave with you. And if they are to be made real, we all have one more great duty: to support the United Nations, which is the community's greatest symbol and greatest instrument. It is the world center of tolerance and openness. It is, as long as men are free to differ—which I trust will be forever!—a center of disciplined disagreement. No one power can dominate it, or use it to drive another

to the wall. It is the greatest defense of the weak against the bullying of the strong. It is the lightning rod which prevents rampant nationalism from sparking war. And if the world is to be saved from disaster, the United Nations must be built into still more—an institution which can enforce the judgments of the world community against those who threaten or break the peace.

I hope I have not detained you too long. After this exposition of our terrestrial worries, I suspect you will all be glad to get back to the remotest celestial bodies!

Indeed, I rather wish that all of us who deal in human affairs could be astronomers for a while. Sir James Jeans called astronomy "the most poetic of the sciences." Perhaps if we all practiced it we would be filled with the wonder and excitement of discovery, with a sense of elemental majesty and beauty, with our little quarrels in better perspective, and would thus be purged of our pride and prejudice, and all the base motives which complicate and endanger our lives.

At all events, I devoutly hope that all of us in and out of the United Nations will make a new beginning; that we will dare to part with habits and institutions dangerously outworn; and that we will have the courage and determination to construct, soon enough to save mankind, a new world order more nearly worthy of the scientist and the poet, and of the best that man has in him.

The Chairman expressed the thanks of the gathering to Ambassador Stevenson for his inspiring address, and formally declared open the Eleventh General Assembly of the Union.