44. COMMISSION DES OBSERVATIONS ASTRONOMIQUES EN DEHORS DE L'ATMOSPHERE TERRESTRE

Compte rendu de la Séance, 23 août 1961

PRÉSIDENT: P. Swings.
SECRÉTAIRE: J.-C. Pecker.

1. La Commission discute de la composition du comité d'organisation. Il sera composé comme suit:

Président: L. Goldberg;
Vice-Président: A. G. Massevitch.

Membres du comité d'organisation: MM. J. E. Blamont, H. E. Butler, H. Kienle, P. Swings, H. C. van de Hulst.

2. Le *Draft Report* est ensuite approuvé. Le Président s'excuse de ne pas avoir exposé avec assez de détails, les travaux effectués au Jet Propulsion Laboratory (JPL) du California Institute of Technology; il n'avait guère reçu d'information à leur sujet.

JPL handles the American program for lunar and planetary exploration. It has taken an essential part in the launching of the U.S.A.'s first successful satellite (Explorer I, 31 January 1958), of several other satellites and of probes. It is now actively engaged in the preparation of the lunar program (rough-landing missions, 1962, and soft landings, 1963 to 1970) and of the planetary program (Venus, 1962–1971; Mars, 1964–1971; Mercury, 1968; Jupiter, 1970).

3. Le Professeur van de Hulst fait un exposé sur les activités du COSPAR. Il s'agit d'un comité inter-unions qui s'occupe de tous les problèmes associés à l'espace. En sont membres dix-huit nations (par leurs Académies des Sciences) et dix Unions Scientifiques. Son secrétariat permanent est à La Haye. Le COSPAR essaie d'éviter les responsabilités déjà assumées par d'autres organismes: les problèmes clairement astronomiques restent du domaine de l'UAI; au contraire les problèmes relatifs à la législation de l'espace sont du ressort du COSPAR. L'une des tâches du COSPAR est l'organisation de symposia.

Rapports scientifiques

L. Goldberg: The U.S. Space Program

Dr Leo Goldberg described some of the developments that have taken place in the U.S. Space Program since the publication of the *Draft Report*.

Rocket Experiments. A. Boggess* (NASA) has obtained absolute fluxes for a number of stars in wave-length bands centered at 2600 Å and 2200 Å with an accuracy of about 20 per cent. T. P. Stecher and J. E. Milligan* (NASA) have scanned the spectra of ten stars in the wave-length region 4000 Å – 1600 Å, including five stars of spectral classes O and B, one of class Fo and one of class WC7. The observed energy distribution for the Fo star (α Carinae) is in good agreement with theory. For the early spectral types, the observations agree with theory down to λ 2600, after which the observed curve becomes depressed and then declines steeply from 2400 Å to 2000 Å, where the discrepancy between theory and observation amounts to an order of magnitude.

* Paper reported at 108th meeting of American Astronomical Society, Nantucket, Massachusetts, 18-21 June 1961.

Excellent new photographs of the far ultra-violet solar spectrum in the spectral region 175 Å – 600 Å have been obtained with a grazing incidence spectrograph by R. Tousey of the Naval Research Laboratory. The emission lines below $\lambda 350$ are largely unidentified.

F. T. Haddock (Michigan) is planning a Journeyman-rocket shot late this year, which will carry three receivers at frequencies 0·7, 1·2 and 2·2 Mc. connected to a 40-foot dipole. The altitude of apogee should be 2 500 kilometers, or well above the critical level of the outer ionosphere.

Satellite Experiments. On 27 April 1961, NASA successfully launched its Gamma-ray astronomy satellite (S-15), the experiment being carried out under the direction of W. L. Kraushaar and G. W. Clark of Massachusetts Institute of Technology.

The *Draft Report* lists the experiments to be carried aboard the S-16, the first vehicle in the NASA program of orbiting solar observatories. This vehicle is scheduled for launching later in 1961. The second in the series, called the S-17, is planned for flight late in 1962 or early 1963.

The following experiments have been scheduled for inclusion in the stabilized section:

1. Scans of the solar spectrum in the range 1600 Å-75 Å, by Goldberg and Liller (Harvard).

2. A series of six experiments by Tousey and collaborators (NRL) including observation of the white light corona, scans of the disk in Lα, scans of the disk in 8-20 Å and 44-60 Å X-rays, measurement of X-ray emission in connection with surge prominences and with types III and IV radio emission.

3. Measurement of the solar constant by the Goddard Space Flight Center.

Equipment has been developed by Haddock (Michigan) for a sweep-frequency receiver in the band 2-4 MHz. for solar burst observations from a satellite in an eccentric orbit in a flight planned for 1963.

The Goddard Space Flight Center is working on the design of an artificial comet to be launched in a high Earth orbit for the study of the effects of solar radiation on an icy conglomerate of known constitution.

H. Friedmann. Results with X-rays

Le Dr H. Friedmann rend compte des résultats obtenus dans le domaine des rayons X: image du soleil dans ce domaine, et enregistrement, pendant une éruption, du flux X très fortement affecté par l'éruption, au contraire du flux en Ly α, observé simultanément. Le Dr Friedmann expose quelques-uns des projets de son équipe.

A. G. Massevitch. Research in U.S.S.R.

Le Dr A. G. Massevitch expose certaines des recherches effectuées en U.R.S.S.

1. *Plasma investigations.* Ion traps for measuring positive ion concentrations in the ionosphere and interplanetary space were mounted on Sputnik III, several geophysical rockets and Soviet space probes. Most of the details are published in the Russian issue *Iskussvennie Sputniki Zemli*, 1958–1961. I shall only give a short survey of the results obtained.

Data on concentration of interplanetary ionized gas (particles with thermal energy), obtained by K. Gringauz and others during the flight of Lunik III (November 1959) at distances of about 150 000 km from the Earth, showed that the concentration does not exceed a few particles per cc. Positive ion currents of solar origin were registered in 1959 outside the magnetic

field of the Earth (at distances of about 100 000 km) by means of three electrode traps placed on space probes. Possibility of thermal energy particles interfering was excluded by applying high potentials on the outer grids. A rather good correlation between the intensity of the registered currents and the K-indices of geomagnetic variation was established. Similar traps oriented toward the Sun were mounted on the Venus probe launched 12 February 1961. One of these traps was specially designed for measuring the ionic component of the solar corpuscular radiation. During the last communication with the probe (17 February) a noticeable stream of corpuscules (of the order 10^9 particles/cm^3) was noted. That corresponds to an ionic concentration of the order of 20 cm^{-3}. Simultaneously, a geomagnetic storm was observed. At distances of about 50 000 to 75 000 km beyond the limits of the radiation belts streams of electrons with densities about 10^8 particles/cm^2 sec and energies exceeding 200 Ev have been detected (with the first cosmic rockets, January and October 1959). The energies of these electrons are too low to be measured by cosmic ray counters mounted on the same rockets which registered electrons of the outer radiation belt. These results lead K. Gringauz, J. Shklovsky and others to suspect the existence of an outer belt of electrons. Those conclusions are in agreement with Pioneer V measurements of the geomagnetic field obtained in March 1960 by Sonett and others.

So far all the devices applied in Soviet experiments allowed the detection of streams of ions in space and the confirmation that they did not consist of thermal-velocity ions. It has not yet been possible to measure the energy of the registered corpuscules. New devices, permitting measurements of the energy spectra of those streams, are now in preparation.

2. *Micro-meteorites.* Acoustical detection of small meteorites in space by geophysical rockets, satellites, and space probes has been carried out by J. N. Nazarova and others. The minimal mass of the micro-meteors measured was about 3×10^{-9} g to 3×10^{-8} g (for a velocity of about 15 km/s). For heights of about 100-300 km the impact rate is about $0{\cdot}1 - 1$ particle/m^2 sec; for 400 km up to an Earth's radius, of the order of 10^{-3} particles/m^2 sec.; for 10^5 km, 10^{-3} to 10^{-4} particles/m^2 sec.

3. *Heavy nuclei in cosmic rays.* On the three spaceships (1–2 December 1960) with an integral Tsherenkov counter (measuring nuclei $Z \geqslant 5$; $Z \geqslant 13 - 14$; $Z \geqslant 31 - 32$ and $Z \geqslant 34 - 37$) an increase of the intensity of heavy nuclei was noted (1 December 1960, at 11^h20^m U.T., lasting about 12 min.). The intensity of the nuclei with $Z \geqslant 13 - 14$ increased $2{\cdot}8 \pm 1{\cdot}4$ times (as compared to the mean intensity for geomagnetic latitudes $50° - 70°$, where the spaceship at that time was travelling). No definite increase was noted for $Z \geqslant 5$. Simultaneously, only one nucleus (during the whole experiment) with $Z \geqslant 31 - 34$ was observed. The differential Tsherenkov counters noted at the same time an increase of α-particles (from 11^h20^m to 11^h26^m) ($2{\cdot}7 \pm 1{\cdot}3$ times) and no increase for $Z \geqslant 5$. The energy of the measured particles exceeded $1{\cdot}4$ to $1{\cdot}5$ Bev/nucleus. This increase can be correlated with a chromospheric flare (1+) that started at 11^h24^m and had its maximum at 11^h35^m. A simultaneous radio-burst at 208 MHz. was observed. L. V. Kurnosova, L. A. Razorenov, M. J. Fradkin (*Iskusstvennie Sputniki Zemli*, in press, Moscow 1961) conclude that the observed heavy nuclei are of solar origin.

4. *Magnetic field measurements.* Magnetic field measurements in interplanetary space were carried out by Dolgintsov, Pushkov and others on Sputnik III (1958), Luniks I and II (1959) and the Venus probe (1961). Most of these results have been presented by E. Mustel at the meeting of Commission 43 and I would rather not repeat them. Perhaps a few words should be said about the new results obtained with the Venus probe. Though the information obtained is rather limited (as measurements could be made only during 57 minutes), they confirm the fact established by Sonett and others, namely that in some cases magnetic fields frozen in corpuscular streams may be not very high, of the order of 10^{-5} gauss.

A. Severny. X-Ray and Lα experiments

Le Professeur A. Severny complète l'exposé précédent par les considérations suivantes, relatives à:

X-Ray and Lα experiments carried out at Korabl-Sputniks II and III. Efremov used the rotating disk with the set of filters transmitting the spectral regions 1·4 – 3 Å (lead), 1 – 12 Å (Ber.), 8 – 20 Å (Al), and 44 – 100 Å (CH), and Lα (LiF-CaF). For quiet Sun, he found $\lambda_{max} = 32$ Å, and $T = 0{\cdot}9 \times 10^6$ degrees, but at the onset of a flare 2+, 19 August 1960, the flux in Be-filter increased 7 times and in Al-filter 3·3 times, which leads to a temperature $T = 6{\cdot}5 \times 10^6$ degrees and $\lambda_{max} = 6$ Å. The Lα-flux remained essentially unchanged (or decreased a little) during this flare event. Mandelstam and others obtained nearly the same values for the quiet Sun during the same flight. Prokoviev and Bruns who use a grazing incidence spectrometer with a photo-multiplier for scanning the He II line $\lambda = 304$ Å, obtained the total flux in this line $\approx 0{\cdot}5$ ergs/cm². sec at the mean height 210 km, from Korabl-Sputnik III, December 1959.

Une discussion s'engage au cours de laquelle le Dr Friedmann attire l'attention sur le danger que courent les fenêtres métalliques (Al par exemple), en raison du flux de météorites; il faut remarquer que la durée de vie de ces fenêtres a été plus grande que prévue, le flux de météorites ayant été surestimé.

H. A. Brück. British Space Experiments

Le Professeur H. A. Brück présente ensuite les expériences astronomiques effectuées, ou devant être effectuées en Grande-Bretagne:

In this brief report I want to confine myself to mentioning a few astronomical experiments which have either been successfully carried out, or are about to be carried out, or are definitely planned for the reasonably near future.

All the work so far has been based on the use of vertical sounding rockets, in particular of "Skylark", a rocket which had been developed for the IGY and with which payloads of the order of a hundredweight can be carried up to altitudes of the order of 200 kilometres. Some recent experiments have also made use of the high-altitude rocket "Black Knight".

There does not exist yet a British satellite, but in view of the fact that in due course Britain is likely either alone, or more probably in collaboration with other countries, to launch satellites, a fair amount of work has been done on a detailed design study for a satellite to be used for astronomical spectroscopy.

Plans are far advanced for the launching of some U.S.-U.K. satellites in the case of which the vehicle, its launching, and the telemetry will be the responsibility of NASA, whereas the actual experiments and the design of the necessary instrumentation will be the responsibility of British scientists. Definite programmes exist at present for the launching of two such "Scout" satellites.

Most of the British space research has been carried on under the guidance of Professor Sir Harrie Massey of University College, London. In London Dr Boyd has either carried through or planned the following experiments:

1. Measurements of the solar X-ray emission between 8 Å and 16 Å. A figure of 2 to 3×10^{-2} erg cm^{-2} sec^{-1} has been determined for the total energy.

2. Measurements of the intensity distribution within the same range of wave-lengths. This experiment is about to be flown.

3. Study of the Sun with an X-ray scanning spectroheliograph. This experiment is now being prepared.

4. Measurement of the Lyman-alpha flux of the Sun. A figure of 4 erg cm^{-2} sec^{-1} has been found.

5. A sky scan at 1700Å with a set of photo-multipliers with peak sensitivity at 1700Å. This experiment was flown on 1 May of this year, and preliminary analysis seems to show traces of certain O- and B-stars of the southern sky. (Like other rockets, this one was flown from Woomera, Australia).

6. Sky photography at 1700Å with a camera containing a fused quartz lens focussed for 1700Å.

Mention might also be made of plans which are to be undertaken in due course by a group at Harwell under Dr Wilson. This group which studies, in the laboratory, the physics of plasmas through spectroscopy in the vacuum ultra-violet, intends—in collaboration with Professor Allen of London—to study the spectrum of the solar chromosphere and corona between 400Å and 3000Å.

As regards satellites, I should like to mention the design study for an astronomical satellite carried out at Farnborough under Dr Lines. The satellite is to carry a Cassegrain telescope of about 20 inches in diameter and a spectrograph with which spectra of individual stars are to be obtained within the range from about 1000Å to 3000Å with a resolution of about 1Å.

Finally I should like to mention the two Scout satellites for which the necessary instrumentation has been agreed on between NASA and the British Space Research Committee. Scout I, which is to be flown in 6 months' time, will contain two astronomical experiments, both due to Dr Boyd, and both extensions of his rocket work, namely measurement of solar X-rays between 3 and 20Å, and determination of the Lyman-alpha flux.

Scout II, which will only be flown in two years' time, contains two experiments of direct astronomical interest. The first of these, due to Dr Graham Smith of the Mullard Radio Observatory, Cambridge, aims at extending ground measurements of galactic radio noise to the lowest possible frequency, and in particular to the range between 0·75 and 3 MHz. A test launch of the equipment has been made with Black Knight.

The second astronomical experiment in Scout II is due to Dr Jennison of the Nuffield Radio Laboratory at Jodrell Bank. Dr Jennison intends to measure numbers and sizes of micrometeorites encountered by the satellite during its flight. The sensitivity of the relatively simple equipment is such that it should be possible to detect meteorites down to a diameter of one micron.

There are other groups in Britain just about to start work in this field, and there is, of course, a fair amount of both optical and radio/tracking work carried out, but it is too early to talk about the first, and not quite the place here to talk about the second.

Z. Suemoto. Space Research in Japan

Le Dr Z. Suemoto expose ensuite les réalisations japonaises. Elles comportent les principaux points suivants:

1. *Observations made so far by means of rockets.*
   - (*a*) Cosmic rays: thin walled Geiger-Müller counter.
   - (*b*) Positive ions: spherical probe coated by gold. Photo-emission.
   - (*c*) Electron density and electron temperature. Resonance probe.
   - (*d*) Solar spectrography (gratings, 600 lines/mm) has been a failure due to recovery problems.

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2. *Observations in preparation.*

(*a*) Night Airglow: photo-multipliers, used with filters (red, green, IR).
(*b*) Geomagnetism: fluxgate magnetometer.
(*c*) Energy spectrum of electrons and ions.
(*d*) Soft X-ray: gas-filled GM counter; photo-multiplier.
(*e*) Video Frequency Wave.

3. The *rockets* developed in Japan are as follows:

Name	Length	Diameter of section	Weight	Obtainable altitude	Payload
	m	cm	tons	km	kg
Kappa-8	10·95	42	1·5	200-220	35
Kappa-9L	12·50	42	1·5	350	35

A new series of rockets, the Lambda's, will then be developed. Their characteristics would enable them to carry 30 kg to 600 km or 3 kg to 1000 km.

4. The *launching sites* are Akita (West Coast, facing the Japan Sea, in Northern Japan) and Kajoshima (Southern Coast, facing the Pacific Ocean, in the Southern part of Kyûshû-Osami Peninsula).

Japan is taking an active part in international satellite collaboration, through the Baker-Nunn camera at the Tokyo Astronomical Observatory, and through the telemetering of satellite data, at Radio Research Laboratories.

Recherche française et italienne

Les chercheurs français et italiens, estimant que rien n'a été fait, en matière de recherche astronomique spatiale, en plus des recherches déjà mentionnées dans le *Draft Report*, renoncent à leur intervention.

R. Lüst. European collaboration

Le Dr R. Lüst fait ensuite l'exposé suivant sur la collaboration européenne en recherche spatiale:

I would like to report very briefly on plans for European collaboration in space research. These plans go back to some unofficial preparations and planning during the past year. At the end of last year eleven European countries (Norway, Sweden, Denmark, The Netherlands, Belgium, United Kingdom, France, Germany, Switzerland, Italy and Spain) signed an agreement for establishing a preparatory commission. This preparatory commission (COPERS) has the task of proposing the plans and drafting a convention for a European Space Research Organization (ESRO). The President of this preparatory commission is Sir Harrie Massey and one of the Vice-Presidents is Professor van de Hulst. Its Executive Secretary is Professor Auger. The plans for this organization have been worked out by a scientific and technical working group, and quite a number of astronomers actively participated in this planning stage.

In general terms, the purpose of the planned organization shall be to provide for and promote collaboration among European states in space research and technology. In doing this, the organization may operate facilities to design and construct payloads for sounding rockets, satellites and space probes. Furthermore, this organization shall provide launching vehicles, including their launching, and provide means for the reception, collection, reduction and analysis of data.

This scientific programme should start with research by making use of sounding rockets. The upper atmosphere will be studied, particularly in the auroral zone, and also astronomical investigations will be carried out. In the fourth year after establishing the organization the first small satellites and space probes shall be launched, carrying payloads of about 200 kg. A number of astronomical studies have been proposed, including those for studying the interplanetary medium and the comets. In the sixth year a first astronomical satellite with a stabilized platform should be launched, carrying a telescope of about 20 inches. The following is an indication of how large the effort may finally become when the ESRO is running at full activity: about 65 sounding rockets, 6 small satellites and space probes, and one large satellite should be launched each year.

The scientific instruments for the different payloads shall in general be developed and built by the universities and research units of the member states, as far as the launching vehicles, the small satellites and the space probes are concerned. The design and the construction of the payloads as a whole and of the whole satellites will be done by a European space technology centre. In this centre also applied research in the field of space technology will be done. Locally connected with this centre will be a smaller research laboratory to provide opportunities for original research in space science beyond those which exist in the individual countries.

Furthermore, it is intended that a number of radio tracking and telemetry stations be set up and also optical tracking stations. Our hope is to have close co-operation with all existing networks, and that these planned stations should complement the existing world-wide networks.

The data received from these stations will be collected together with data from solar and geophysical observatories by a European space data centre. At this centre there will be facilities to reduce and analyze the data. Also, it is intended that at this place research will be done on the analysis of solar and geophysical events. To fulfill this task effectively, it is sought to set up a fast communications system, not only with tracking and telemetry stations with launching ranges, but also with European geophysical and astronomical observatories and other organizations.

Finally, I should say that it is our hope to establish a launching range for sounding rockets in the auroral zone, very probably in the northern part of Sweden at Kiruna. A number of other launching ranges for sounding rockets exist already in some European countries. The kind of vehicles to be used is still under discussion. The United Kingdom made the proposal to finish development of the so-called "Blue Streak", a vehicle comparable in performance to the Atlas vehicle. The outcome of these discussions might be that there will be a second European organization for the development, construction and building of launching vehicles.

These are the plans at the moment. The governments have not, as yet, come to an agreement, but I think that there is good hope that the convention might soon be signed, and that the planned organization will start its activity in the near future.

L. Biermann. Space Research in Germany

Le Professeur Biermann expose l'état de la recherche spatiale astronomique en Allemagne, dans les termes suivants:

Space Research is being planned or pursued in Germany, first of all at several University Observatories, such as those at Bonn, Heidelberg, Tübingen, and at the Schaunsland Observatory. Since Dr Siedentopf is among us, I presume that he will be willing to say a few words about the activities at these places, and particularly his own. I, myself, will describe in some detail the work which is being done in the framework of the Astrophysics Institute of the Max Planck Institut für Physik und Astrophysik. There will probably soon be a special division

for space research in the Astrophysics Institute, the responsibility for which lies, at this stage, with Dr Lüst. The group will consist of a number of scientists and engineers and a somewhat larger number of technicians. It will be established at Garching, about seven miles north of the Max Planck Institut on the same site as the Institute for Plasma Physics.

The experiments to be prepared first will aim at producing artificial plasma clouds at a distance of some 100 000 km from the Earth, outside the reach of the Earth's magnetic field. Work, which is in course of publication in the *Zeit. f. Astrophysik*, has shown that quantities of the order of 1 kg of the earth-alkali metals calcium, strontium, or barium are sufficient to produce clouds which should be visible without difficulty. The matter can be emitted as a neutral gas, since the ionization by solar light is fast enough. The comparison between the behaviour of these different elements should give information about the mechanism which couples such plasma clouds with the solar corpuscular radiation; also the direction of the velocity of the solar corpuscular radiation could be directly observed. In case of the higher particle flux from the Sun which presumably is characteristic for magnetic storms, it appears that also carbon monoxide could be used, which then should become ionized by charge transfer with a cross section known from laboratory experiments. In this way a direct measurement of the solar particle flux could be obtained which might be of interest in view of the very great experimental difficulties of all existing methods of measurements usable from space probes.

Other experiments which are planned or at least discussed among our group are related to the measurement of cosmic radiation, specifically the component which originates in the Sun, of high-energy electrons and of the magnetic fields in interplanetary space and their relations to the ordinary solar corpuscular radiation.

In conclusion, I would like to mention that the Max Planck-Garching group co-operates closely with space research going on in the Max Planck Institutes for Ionospheric Research and for Physics of the Stratosphere and for Nuclear Physics in Lindau/Northeim and in Heidelberg.

H. Siedentopf. Work at Tübingen

Le Professeur Siedentopf complète cet exposé par quelques précisions sur les travaux poursuivis sous sa direction à Tübingen, relatifs au suivage et à la télémétrie des satellites, d'une part, et, d'autre part, à l'étude de la partie intérieure de la lumière zodiacale (5-25° du soleil).

G. Newkirk. Observations from balloons

L'exposé suivant dû au Dr G. Newkirk, traite des observations en ballon:

Results of some astronomical observations from a balloon. In the fall of 1960, the High Altitude Observatory flew an externally occulted coronagraph to an altitude of 22 km to observe:

1. the angular distribution of skylight at scattering angles from 2° to 60° from the Sun;

2. the spectral energy distribution at a scattering angle of 2°·4 over the wave-length range $\lambda \sim 3650$–8000Å. The coronagraph used was originally designed by J. W. Evans and was found to introduce instrumentally scattered light of a brightness less than 10^{-8} of the brightness of the solar disk into the field.

The instrument was oriented toward the Sun with an accuracy ± 1 minute of arc by means of the pointing control which was developed for M. Schwarzschild for project Stratoscope I.

From the measurements and the theory of scattering of light in the atmosphere it is possible to determine the size distribution of aerosols suspended in the atmosphere above the point of observations. A preliminary estimate of the *upper limit* of micro-meteoritic influx of 100 particles per m² per second in the radius range $0{\cdot}1\mu$ to 1μ is obtained.

Cet exposé est suivi, en fin de séance, de la projection d'un beau film de Gordon Newkirk relatif aux expériences en ballon ci-dessus décrites.

H. Friedmann. UV stellar radiation

Enfin, le Dr H. Friedmann présente quelques remarques sur le rayonnement UV des étoiles et discute l'origine du rayonnement observé sous forme de nébulosité autour des étoiles très chaudes.

RESOLUTION

La fin de la séance est consacrée à la discussion d'une résolution relative à l'étude des comètes par engins extraterrestres. La discussion, à laquelle participent MM. Davis, Gold, Goldberg, Muller, Swings, Whipple et Miss Roman, aboutit à la rédaction de la recommandation ci-après:

Commission 44 recommends that, in addition to the plans for astronomical space experiments of high scientific interest which have been already planned, consideration be given to the launching of a space probe into the close vicinity of a comet.

Le Président lève la séance à $12^{h}00^{m}$.

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