XIVth General Assembly

Brighton, UK

1970

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Resolution No. 1
Proposed by the Executive Committee
Proposée par le Comité Exécutif

On Photographic Emulsions

The International Astronomical Union recommends that Adhering Organizations and/or National Committees of Astronomy use their influence to secure removal of all restrictions hindering the supply of photographic emulsions of interest to astronomers.

Sur les Émulsions Photographiques

L'Union Astronomique Internationale recommande aux Organisations Adhérentes et/ou aux Comités Nationaux d'Astronomie d'user de leur influence pour obtenir la suppression de toutes les restrictions qui gênent l'approvisionnement en émulsions photographiques d'intérêt astronomique.

Resolution No. 2
Proposed by the U.A.R. National Committee of Astronomy
Proposée par le Comité National dAstronomie de la R.A.U.

Sur la création d'une Commission pour les Échanges d'Équipement

La XIVème Assemblée Générale de l'Union Astronomique Internationale décide la création d'un Groupe de Travail Commun aux Commissions 9 et 46 pour les Échanges d'Equipement.

On the creation of a Commission for Exchange of Equipment

The XIVth General Assembly of the International Astronomical Union resolves to create a Joint Working Group of Commissions 9 and 46 for Exchange of Equipment.

Resolution No. 3
Proposed by the U.S.S.R. National Committee for Astronomy
Proposée par le Comité National dAstronomie de l'U.R.S.S.

On the proclamation of 1973 *the Year of Copernicus*

The International Astronomical Union recommends to proclaim the year 1973 the Year of Copernicus.

Sur la proclamation de 1973 *comme Année Copernic*

L'Union Astronomique Internationale recommande de proclamer l'année 1973 Année Copernic.

Resolution No. 4
Proposed by the U.S.S.R. National Committee for Astronomy
Proposée par le Comité National dAstronomie de l'U.R.S.S.

On less expensive IAU publications

The XIVth General Assembly of the International Astronomical Union instructs the Executive Committee to investigate the possibility of less expensive IAU publications.

Sur l'abaissement du prix des publications de l'UAI

La XIVème Assemblée Générale de l'Union Astronomique Internationale charge le Comité Exécutif d'étudier la possibilité d'abaisser le prix des publications de l'UAI.

Resolution No. 5
Proposed by the U.S.S.R. National Committee for Astronomy
Proposée par le Comité National dAstronomie de l'U.R.S.S.

On the creation within one of the IAU Commissions of a Sub-Commission on the Physics of Unstable Stars

The XIVth General Assembly of the International Astronomical Union requests the Executive Committee to encourage Commissions Nos. 27, 35 and 36 to organize special meetings for the discussion of the Physics of Unstable Stars, and to consider the desirability of creating a Working Group on this subject.

Sur la création au sein d'une des Commissions de l'UAI d'une Sous-Commission de la Physique des Étoiles Instables

La XIVème Assemblée Générale de l'Union Astronomique Internationale demande au Comité Exécutif d'inciter les Commissions Nos. 27, 35 et 36 à organiser des réunions spéciales pour discuter de la Physique des Étoiles Instables et pour envisager la création éventuelle d'un Groupe de Travail sur ce sujet.

Resolution No. 6
Proposed by IAU Commission 4 (Ephemerides)
Proposée par la Commission 4 de l'UAI (Ephémérides)

On Universal Time

The International Astronomical Union,

having noted the various proposals to modify the present basis of Co-ordinated Universal Time (UTC) and

wishing to emphasize that visual observers in astronomical and related fields require a knowledge of Universal Time (UT1) to a precision of the same order, namely $0^s.1$, as that of human time discrimination,

formally requests that the appropriate authorities ensure that adequate means have been provided of making UT1, or the difference UT1-UTC, available to such observers, and to such precision, before they permit UTC to depart from UT1 by more than about $0^s.1$.

Sur le Temps Universel

L'Union Astronomique Internationale,

ayant pris note des diverses propositions faites en vue de modifier la base actuelle du Temps Universel Coordonné (TUC) et

désirant insister sur le fait que les observateurs visuels dans les domaines astronomiques et voisins ont besoin de connaître le Temps Universel (TU1) avec la même précision, c'est-à-dire $0^s.1$, que celle définie par les possibilités sensorielles de l'homme,

demande instamment aux autorités compétentes de s'assurer que les moyens adéquats ont été utilisés pour que le temps TU1, ou la différence TU1-TUC, soit accessible à ces observateurs, et avec cette précision, avant de pouvoir permettre au TUC de différer du TU1 de plus de $0^s.1$.

Resolution No. 7
Proposed by the Working Group on Numerical Data
Proposée par le Groupe de Travail sur les Données Numériques

On the establishment of a Permanent Working Group on Numerical Data

The XIVth General Assembly of the International Astronomical Union resolves to establish a Permanent Working Group on Numerical Data.

Sur la création d'un Groupe de Travail Permanent sur les Données Numériques

La XIVème Assemblée Générale de l'Union Astronomique Internationale décide de créer un Groupe de Travail Permanent sur les Données Numériques.

Resolution No. 8
Proposed by IAU Commission 17 (The Moon)
Proposée par la Commission 17 de l'UAI (La Lune)

On the names of craters on the far side of the Moon

The International Astronomical Union accepts the approximately 500 names proposed by IAU Commission No. 17 on the Moon for designating the craters on the far side of the Moon.

Sur la dénomination des cratères de la face de la Lune opposée à la Terre

L'Union Astronomique Internationale accepte les quelques 500 noms proposés par la Commission 17 de l'UAI sur la Lune pour désigner les cratères de la face de la Lune opposée à la Terre.

Resolution No. 9

Proposed by IAU Commission 33 (Structure and Dynamics of the Galactic System)
Proposée par la Commission 33 de l'UAI (Structure et Dynamique du Système Galactique)

On the superscript of the new Galactic Co-ordinates

The XIVth General Assembly of the International Astronomical Union resolves that the superscript II be omitted from the new galactic co-ordinates: henceforth it will simply be *l, b*; the old co-ordinates retain the superscript I. It is desirable that authors indicate in their papers that *l, b* refer to the new galactic co-ordinates.

Sur l'indexation supérieure des nouvelles Coordonnées Galactiques

La XIV^{ème} Assemblée Générale de l'Union Astronomique Internationale décide de supprimer l'indexation supérieure II des nouvelles coordonnées galactiques qui, en conséquence, seront simplement désignées par *l, b*; les vieilles coordonnées conservent l'indexation supérieure I. Il serait bon que les auteurs précisent dans leurs articles que *l, b* se rapporte aux nouvelles coordonnées galactiques.

Resolution No. 10

Proposed by IAU Commission 40 (Radio Astronomy)
Proposée par la Commission 40 de l'UAI (Radio-Astronomie)

On the uses of space for scientific and other purposes

Having regard to the continued and increased uses of space for scientific and other purposes the International Astronomical Union wishes to draw attention to the 'Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and other Celestial Bodies' of 27 January 1967, in particular to the Articles IV and IX of that Treaty, and to re-affirm its own Resolution No. 1 of the XI General Assembly, 1961, the final paragraph of which reads:

'The International Astronomical Union... appeals to all Governments concerned with launching space experiments which could possibly affect astronomical research to consult with the International Astronomical Union before undertaking such experiments and to refrain from launching until it is established beyond doubt that no damage will be done to astronomical research.'

Sur l'utilisation de l'espace dans des buts scientifiques et autres

Tenant compte du fait que l'espace est utilisé d'une façon continue et croissante dans des buts scientifiques et autres, l'Union Astronomique Internationale désire attirer l'attention sur le 'Traité sur les Principes régissant les activités des États en matière d'exploration et d'utilisation de l'espace extra-atmosphérique, y compris la Lune et les autres corps célestes', en date du 27 janvier 1967, en particulier sur les Articles IV et IX de ce Traité, et réitère sa propre Résolution No. 1 adoptée en 1961 par la XI^{ème} Assemblée Générale et dont le dernier paragraphe est le suivant:

'L'Union Astronomique Internationale... demande instamment à tous les gouvernements engagés dans des expériences spatiales qui pourraient affecter la recherche astronomique, de prendre l'avis de l'Union Astronomique Internationale avant d'entreprendre de telles expériences, et de ne procéder à aucun lancement sans qu'il soit établi d'une manière irréfutable qu'aucun dommage ne peut en résulter pour la recherche astronomique.'

Resolution No. 11
Proposed by IAU Commission 40 (Radio Astronomy)
Proposée par la Commission 40 de l'UAI (Radio-Astronomie)

On Radio Transmission

The International Astronomical Union
considering that

(*a*) Radio Astronomy observations are made with receivers having great sensitivity,

(*b*) under normal earth surface conditions some protection from neighbouring transmitters is effected by earth curvature and terrain effects

(*c*) transmitters in space vehicles are exposed to radio astronomy antennae under line of sight conditions

(*d*) due to the high sensitivity of radio astronomy receivers interfering signals are received from transmitters operating outside the assigned radio astronomy bands due to modulation spillover and to harmonics of the carrier frequency

(*e*) there is to be a World Administrative Radio Conference (WARC), under the International Telecommunication Union (ITU), in the year 1971 whose agenda includes matters dealing with 'Space and Radio Astronomy'

(*f*) the International Council of Scientific Unions (ICSU) established the Inter-Union Committee on the Allocation of Frequencies (IUCAF) to speak for it in matters pertaining to the use of the radio frequency spectrum,

recommends that

(1) The IUCAF take urgent steps to ask the WARC to impose stringent regulations on transmitters located in space vehicles to insure that emissions from the space vehicles outside the assigned space frequency bands will be reduced to an extent greatly in excess of that presently required by ITU regulations for ground based transmitters;

(2) The IUCAF determine the limits on out of band transmissions by space transmitters to be recommended to the WARC;

(3) The IUCAF urge that a continuing program be undertaken by the ITU to further reduce out of band transmissions of all transmitters both earth and space bound;

(4) The IUCAF urge that transmissions from satellites in those bands allocated to Radio-Astronomy on shared basis be discouraged.

Sur les Emissions Radio

L'Union Astronomique Internationale
considérant

(*a*) que les observations radioastronomiques sont faites au moyen de récepteurs d'une grande sensibilité,

(*b*) que, dans des conditions normales à la surface de la Terre, une certaine protection contre les émetteurs voisins est réalisée grâce à la courbure de la Terre et aux inégalités de terrain,

(*c*) que, en revanche, les engins spatiaux émettent vers les antennes de radio-astronomie par une transmission en ligne droite,

(*d*) qu'en raison de la haute sensibilité des récepteurs radioastronomiques, de l'étalement de modulation et des harmoniques de la fréquence porteuse, des interférences proviennent d'émetteurs opérant en dehors des bandes allouées à la radioastronomie,

(*e*) qu'une Conférence Mondiale Administrative Radio (WARC: World Administrative Radio Conference) doit avoir lieu en 1971 sous les auspices de l'Union Internationale des Télécommunications (UIT) et que son ordre du jour comprend l'étude des problèmes relevant de la Radioastronomie et de l'Astronomie Spatiale,

(*f*) que le Conseil International des Unions Scientifiques (CIUS) a créé le Comité Inter-Union pour les Allocations de Fréquence (IUCAF) afin de traiter en son nom les problèmes concernant l'utilisation du spectre des fréquences radio,

recommande que

(1) l'IUCAF fasse une démarche urgente auprès de la WARC pour lui demander d'imposer des règles strictes à l'emploi des émetteurs situés à bord des engins spatiaux, afin de réduire les émissions faites à partir de ces engins en dehors des bandes de fréquence allouées à la recherche spatiale, et ce d'une façon dépassant largement ce qui est exigé actuellement par les règlements de l'UIT pour les émetteurs au sol;

(2) l'IUCAF fixe les limites des émissions issues des émetteurs spatiaux en dehors des bandes allouées, en vue d'en faire la recommandation à la WARC;

(3) l'IUCAF insiste pour qu'un programme suivi soit entrepris par l'UIT afin de réduire encore plus les émissions de tous les émetteurs spatiaux et au sol en dehors des bandes allouées;

(4) l'IUCAF insiste pour que l'on décourage les émissions provenant des satellites dans celles des bandes allouées à la Radioastronomie sur la base d'un partage.

Resolution No. 12
Proposed by the Resolutions Committee
Proposée par le Comité des Résolutions

On the resolutions adopted by Commissions

Considering the impracticability of giving individual attention to every resolution adopted by each of its 39 Commissions, and having full confidence in its Commissions, this General Assembly wishes to give its endorsement to the Resolutions adopted by its individual Commissions, and recommends that astronomers give effect to these Resolutions in so far as they are able.

As to the remaining proposals for resolutions, it is recommended to refer them to the appropriate Commissions. In the form of Resolutions of Commissions they will be supported by the 'blanket' resolution, as proposed above.

J. H. OORT
Chairman, Resolutions Committee

Sur les résolutions adoptées par les Commissions

Considérant qu'il lui est pratiquement impossible d'accorder une attention particulière à chaque résolution adoptée par chacune de ses 39 Commissions et ayant une confiance entière en ses Commissions, cette Assemblée Générale désire exprimer son approbation des Résolutions adoptées par ses différentes Commissions et recommande aux astronomes de les appliquer dans toute la mesure du possible.

Quant aux autres propositions de résolutions, il est recommandé de les soumettre aux Commissions compétentes. Si elles sont adoptées en tant que Résolutions de Commissions, elles seront appuyées par la résolution 'générale' proposée ci-dessus.

Commission 4 (Ephemerides/Ephémérides)

IAU SYSTEM OF ASTRONOMICAL CONSTANTS AND RELATED MATTERS

The President gave a brief account of the background to the resolutions that had been adopted at *IAU Colloquium* No. 9, which had been held at Heidelberg during the previous week. (It is hoped that the proceedings and papers will be published in a separate issue of *Celestial Mechanics* early in 1971). The resolutions were then discussed in turn.

"1. Considers that any changes in the precessional constants and in the system of planetary masses be introduced into the national and international almanacs together, at a time that is closely linked with the introduction of the next fundamental star catalogue."

This is to avoid having two separate discontinuities in the basis of the planetary ephemerides and to ensure that the apparent places of the planets and of the fundamental stars are on the same system.

"2. Recommends that a Working Group be set up to report, in time for consideration in 1973, on the consequences of changes in the precessional constants and on the procedure for the introduction of new values at a later date. The Group should feel free to discuss actual values, if it wishes."

Although many participants in the Colloquium had been doubtful about the desirability of attempting to adopt new values of the precessional constants in 1973, the final consensus of opinion had been that the Working Group should not be inhibited from recommending new values if the evidence were considered to be sufficiently strong. *J. Kovalevsky* emphasized the importance of investigating and publicizing the full consequences of any changes in the precessional constants before such changes were adopted. *K. C. Blackwell* considered that for those engaged on the determination of proper motions it would be preferable to leave the precessional constant unchanged.

"3. Considers that no changes be made in the series for nutation until a decision is made about the precessional constants, but considers that a new theory of nutation be developed, based upon a more realistic model of the Earth and consistent with recent developments of the tidal potential."

P. J. Melchior drew attention to the possible derivation by a simple arithmetical process of a series for the nutation from a harmonic development (such as that by A. T. Doodson) of the tidal potential. Recent work on the tides took account of the nonrigid structure of the Earth and led to results that are in closer accord with observation than the adopted series for the nutation. A new and extensive development of the tidal potential by D. E. Cartwright would provide a suitable basis for the nutation.

"4. Recommends that no changes in the basis of the ephemerides published in the national almanacs be made before 1980."

This delay before the possible introduction of new constants is required to allow adequate time for the preparation of new fundamental catalogues and ephemerides, for the subsequent preparation of derived data and explanatory material for publication, and for their printing, proofreading and distribution well in advance of the year to which the data refer. It seems unlikely that the preparation, at the Astronomisches Rechen-Institut, of a new fundamental catalogue will require the use of final constants until 1976, and so publication will not take place until 1978. In normal circumstances the almanacs for 1980 would be scheduled for publication not later than the end of 1978, although the distribution of the data for the first part of the *Astronomical Ephemeris* would take place in 1975 or 1976. *R. L. Duncombe*, in a reply to a question by *D. H. Sadler*, confirmed that the resolution implied no change in the theories to be used and, in particular, that a new theory for Mars should not be introduced before 1980.

"5. Recognizes the need for ephemerides of higher precision for use in many applications and recommends that Commission 4 seeks ways by which a standard set of such ephemerides may be made available in machine-readable form as often as is practicable, together with adequate documentation."

D. H. Sadler drew attention to the likelihood that the ephemerides printed in the almanacs would not be used for the comparison with observations once ephemerides of higher precision were available and that this would lead to confusion. (This can be largely avoided if the new ephemerides are only used where the additional precision is *necessary* for the proper interpretation of the observations as, for example, when looking for variations in the periods of pulsars.) *R. L. Duncombe* considered that the Directors of the national ephemeris offices should propose, after consultation with other interested organizations, how best to implement this resolution.

"6. Recommends that a Working Group be set up to specify, in time for consideration in 1973, the basis for the planetary ephemerides to be published in the almanacs for 1980 onwards, and suggests that ephemerides on this basis be made available in machine-readable form at the earliest opportunity."

D. H. Sadler considered that the resolution would permit the introduction of the new ephemerides before they had been considered by the Commission in 1973. The President stated that this was certainly not the intention; it was merely hoped to shorten the period for which the special ephemerides referred to in the previous resolutions would be required.

"7. Considers that further changes in the values of the primary constants adopted in 1964 should not be made at the Brighton meeting, and endorses the values of the secondary constants compiled by IAG in 'Geodetic Reference System 1967' (special publication of *Bulletin Geodesique*, 1970)."

The new values of the constants adopted in the 1964 appeared to be of adequate accuracy for the purposes for which the system is used, although there had been some criticism of the choice of primary constants. *J. Kovalevsky* explained that the second part of the resolution had been included to meet the wishes of the International Association of Geodesy that only one set of extra figures for the secondary geodetic constants be recognized.

"8. Recommends that a Working Group be set up to review the definition of ephemeris time, its relation to other time scales, and the possible effects of changes in the primary constants on its definition and determination."

In addition to investigating the full effects on astronomical time-scales of the earlier change in the constant of aberration and of any future changes in the precessional constants and planetary masses, it is desirable that the Group consider carefully the extent to which the ephemeris time-scale should be more closely related to the atomic time-scale. *T. C. Van Flandern* drew attention to the results of an analysis of occultation observations which suggested that the currently adopted values of the secular accelerations of the Sun and Moon would lead to a large acceleration of ephemeris time, as determined from the Moon, with respect to atomic time. (See also report of Joint Meeting of Commission 4 and 31 on p. 198.)

"9. Recommends that the next standard equinox be that of 2000.0 and that it be introduced in the next fundamental catalogue."

Although *A. M. Sinzi* argued that the next standard epoch should be that of 2050.0, there appeared to be general agreement with the recommendation, which leaves unspecified the frequency of subsequent changes.

"10. Recommends that the Working Group on Precessional Constants should also consider the desirability of changing the mean places of stars by the effects of the E-terms of aberration when the next new fundamental catalogue is produced."

The wording of the resolution was criticized on the grounds that the nature of the change was not precisely specified; the President stated that this had been done deliberately as this was a matter for the Group to consider very carefully. Any change from the current practice would lead to a change in the mean place of each star, but should greatly simplify the theory and practice of aberration corrections.

"11. Urges that the observational data of the International Latitude Service be made available on a uniform system in machine-readable form as soon as is practicable, for use in the determination of nutations."

"12. Urges that the promising techniques of radio interferometry and laser ranging be developed for astrometric purposes, that regular observations by radar of the positions of planets be made to help resolve the uncertainties in the orbits and masses of the planets, and that the observational data be made available to the scientific community as soon as possible."

"13. Urges that all significant observational data be preserved in machine-readable form, in as raw a state as is practicable."

The President pointed out that these resolutions went well beyond the field of responsibility of Commission 4, but they had arisen naturally from the discussions at the Colloquium. *D. H. Sadler* considered that such resolutions were not helpful to committees responsible for the allocation of funds to different projects as they did not take account of relative values and costs. *P. J. Melchior* stated that Commission 19 had set up a working group to implement resolution 11.

At the final meeting the President suggested that the Commission should endorse the resolutions of Colloquium No. 9 as a whole, on the understanding that this did not imply complete acceptance of all details. This was agreed without objection. In order to avoid administrative complications it was agreed that the Commission should be responsible for the three working groups suggested in resolutions 2, 6 and 8, but that the members of the groups need not be members of Commission 4 since it is hoped to cover the interests of other commissions. The terms of reference of each group would be drawn up so as to include the related problems that had arisen during the meetings of the Commission. It was agreed that the convenors of the three groups should be as follows:

Working Group on Precessional Constants: W. Fricke

Working Group on Planetary Ephemerides: R. L. Duncombe

Working Group on Units and Time-Scales: G. A. Wilkins

Further, the membership of the groups should be decided by the new President (J. Kovalevsky), who will be an ex-officio member of the three groups, and the respective convenors. It is intended that all three groups should endeavour to publish reports by the end of 1972 in ample time for consideration before the IAU General Assembly in 1973.

Resolutions

16. Consideration of the Resolutions

At the end of the session on Thursday afternoon, a Resolutions Committee was appointed. The members were Kovalevsky, Lederle, Lieske, Vicente and Wilkins (Chairman). The drafts of the resolutions were distributed at the beginning of the session on Friday afternoon for individual study before they were discussed. After an unsuccessful attempt to dispose of the 'non-controversial' items, the resolutions were taken in the sequence of the draft. In this report the original draft form is given together with the principal arguments that led to the adoption of the final resolutions that are listed on page 147.

"Considers that it would be premature to adopt in 1973 new conventional values for the precessional constants."

Even though many felt that this resolution was realistic as far as our present knowledge is concerned, it was rejected by a large majority on the grounds that new data may become available or fresh arguments may be put forward to justify making changes in 1973.

"Considers that any changes in the precessional constants and in the system of planetary masses should be introduced into the national almanacs together at a time that is closely linked to the production of the next fundamental star catalogue."

After minor amendments this resolution was adopted nem con (i.e. without any objection) and is given as resolution No. 1 on page 147.

"Recommends that a Working Group be set up to report in 1973 on the consequences of changes in the precessional constants and on the procedures for the introduction of new values at a later date."

This was amended to make it clear that the report of the Working Group should be published well before the General Assembly in 1973, so that the recommendations can be subjected to a wide and detailed examination before any decision is taken. The Colloquium also felt that the Group should not be inhibited from putting forward definite proposals for changes in constants. The amended resolution was then adopted nem con as resolution No. 2.

"Considers that no changes should be made in the series for the nutation until a decision is made about the precessional constants, but considers that a new theory of nutation, based upon a more realistic model of the Earth, should be developed."

On the suggestion of Melchior, this resolution was amended without objection so as

to emphasise the desirability of connecting the astronomical theory of nutation and the geophysical study of body tides. The resolution was adopted nem con as resolution No. 3.

"Recommends that no changes in the bases of the ephemerides published in the nautical almanacs should be made before 1980."

The Chairman pointed out that this date was consistent with the earliest likely introduction of FK5 in 1978 as the almanacs are published one year in advance of the date to which they refer. The resolution was adopted nem con without amendment as resolution No. 4.

"Recognises the need for ephemerides of higher precision for use for certain specialised applications and recommends that Commission 4 should seek ways by which a standard set of such ephemerides may be made available with adequate documentation."

This resolution was amended on the suggestion of Shapiro, who considered that there is a greater need for high precision ephemerides than is implied in the original wording, and that the main requirement is ephemerides in a form suitable for use with computers. There was some division of opinion about the frequency with which it would be practicable or desirable to produce improved ephemerides but the amended resolution was carried by a large majority as resolution No. 5.

"Recommends that a Working Group should be set up to specify in time for consideration in 1973 the bases for the planetary ephemerides to be published in the almanacs for 1980 onwards, and suggests that ephemerides on this basis be made available in machine-readable form at the earliest opportunity."

This resolution was adopted with one verbal amendment as resolution No. 6.

"Considers that further changes in the values of the primary constants adopted in 1964 should not be made, and endorses the values of the secondary constants compiled by IAG in 'Geodetic Reference System 1967' (special publication of the Bulletin Géodésique, 1970)."

This resolution was amended to make it clear that the first clause refers only to the forthcoming IAU General Assembly at Brighton. It was then adopted without objection as resolution No. 7.

"Recommends that a Working Group should be set up to review the definition of ephemeris time, its relation to other time scales, and the possible effects of changes in the primary constants on its determination."

In view of the possibility that a change in the primary constants might affect the definition as well as the determination of ET, the resolution was agreed, and it was then adopted, with one objection, as resolution No. 8.

"Makes no recommendation about the time of introduction of the standard equinox of 2000.0."

During the discussion, it became clear that the Resolutions Committee had misjudged the feeling of the meeting, and so a positive recommendation was proposed and then adopted, with one objection, as resolution No. 9.

"Recommends that the Working Group on precessional constants should also consider the desirability of amending the mean places of stars by the effects of the *E*-terms of aberration when the next new fundamental catalogue is produced."

With one verbal amendment, the resolution was adopted nem con as resolution No. 10.

"Makes no recommendation on the specification of the IAU system of astronomical constants."

Although Herrick suggested that the distinction between primary and secondary constants be abolished, it was agreed that no resolution was required.

"Makes no recommendation about the form of presentation of the series for the nutation."

It was agreed that no resolution was required, although Melchior's point about the notation for, and sequence of, the nutation terms was pathetically noted.

"Considers that the observational data of the International Latitude Service should be made available on a uniform system and in machine-readable form as soon as is practicable."

This was amended to strengthen its tone and to indicate why the data are relevant to the system of astronomical constants. It was then adopted nem con as resolution No. 11.

"Considers that the promising techniques for long baseline radio interferometry should be developed for astrometric purposes and that the regular observation by radar of the positions of planets would help to resolve the present uncertainties in the masses and orbital elements of the system of planets."
"Urges that observational data obtained by radio and radar techniques should be made available to the scientific community."

These two resolutions were eventually combined and widened to give resolution No. 12, which was then adopted nem con.

Shapiro then proposed a further resolution recommending the preservation of raw observational data in machine-readable form. After discussion resolution No. 13 was adopted nem con.

Herrick made the suggestion that there should be a resolution recommending publication only of standard errors rather than of probable or mean errors. Although this was sympathetically received, it was agreed not to proceed to a formal resolution.

17. Concluding Remarks

There being no further business, Clemence proposed a vote of appreciation to the Local Organising Committee and helpers for the efficient and thoughtful way in which they had made all the arrangements for the Colloquium. He also congratulated the Chairman on bringing the Colloquium to a successful conclusion without the necessity for the additional meeting that had been contemplated in the provisional programme. Finally, it was unanimously agreed that best wishes for a full and speedy recovery should be sent to Professor Fricke, the absent host.

18. Resolutions Adopted at the IAU Colloquium No. 9 on the System of Astronomical Constants

IAU Colloquium No. 9:

(1) Considers that any changes in the precessional constants and in the system of planetary masses be introduced into the national and international almanacs together, at a time that is closely linked with the introduction of the next fundamental star catalogue.

(2) Recommends that a Working Group be set up to report, in time for consideration in 1973, on the consequences of changes in the precessional constants and on the procedure for the introduction of new values at a later date. The Group should feel free to discuss actual values, if it wishes.

(3) Considers that no changes be made in the series for nutation until a decision is made about the precessional constants, but considers that a new theory of nutation be developed, based upon a more realistic model of the Earth and consistent with recent developments of the tidal potential.

(4) Recommends that no changes in the basis of the ephemerides, published in the nautical almanacs, be made before 1980.

(5) Recognises the need for ephemerides of higher precision for use in many applications and recommends that Commission 4 seek ways by which a standard set of such ephemerides may be made available in machine-readable form as often as is practicable, together with adequate documentation.

(6) Recommends that a Working Group be set up to specify, in time for consideration in 1973, the basis for the planetary ephemerides to be published in the almanacs for 1980 onwards, and suggests that ephemerides on this basis be made available in machine-readable form at the earliest opportunity.

(7) Considers that further changes in the values of the primary constants adopted in 1964 should not be made at the Brighton meeting, and endorses the values of the secondary constants compiled by IAG in 'Geodetic Reference System 1967' (special publication of the Bulletin Géodésique, 1970).

(8) Recommends that a Working Group be set up to review the definition of ephemeris time, its relation to other time scales, and the possible effects of changes in the primary constants on its definition and determination.

(9) Recommends that the next standard equinox be that of 2000.0 and that it be introduced in the next fundamental catalogue.

(10) Recommends that the Working Group on precessional constants should also consider the desirability of changing the mean places of stars by the effects of the *E*-terms of aberration when the next new fundamental catalogue is produced.

(11) Urges that the observational data of the International Latitude Service be made available on a uniform system in machine-readable form as soon as is practicable, for use in the determination of nutations.

(12) Urges that the promising techniques of radio interferometry and laser ranging be developed for astrometric purposes, that regular observation by radar of the positions of planets be made to help resolve the uncertainties in the orbits and masses of the planets, and that the observational data be made available to the scientific community as soon as possible.

(13) Urges that all significant observational data be preserved in machine-readable form, in as raw a state as is practicable.

Commission 16 (Physical Study of the Planets/L'Etude Physiques des Planètes et des Satellites)

RESOLUTION ON NEW PLANETOGRAPHIC COORDINATE SYSTEMS

A. *Guiding Principles*

1. The rotational pole of a planet or satellite which lies on the north side of the invariable plane shall be called north, and northern latitudes shall be designated as positive.

2. The planetographic longitude of the central meridian, as observed from a direction fixed with respect to an inertial coordinate system, shall increase with time. The range of longitudes shall extend from 0° to 360°.

B. *Definitions and Numerical Values for Mercury and Venus*

1. For Mercury (having a direct rotation) the origin of planetographic longitudes is defined by the meridian containing the subsolar point at the first perihelion passage of 1950 (J.D. 2433292.63). The rotational axis shall be provisionally defined as perpendicular to the orbital plane of Mercury (1950). For purposes of obtaining longitude at earlier or later time, a provisional value for the sidereal rotational period of $58^{d}.6462$ is adopted.

2. For Venus (having a retrograde rotation), the origin of planetographic longitudes is defined such that the central meridian of Venus as observed from the center of the Earth is 320°.0 at 0^{h} on 20 June, 1964 (J.D. 2438566.5). The rotational axis shall be provisionally defined as having a north pole direction of $\alpha = 273°.0$, $\delta = +66°.0$ (1950.0). For the purposes of obtaining longitude at earlier or later time, a provisional value for the sidereal rotational period of $243^{d}.0$ is adopted.

RESOLUTION ON MAKING JUPITER INFORMATION MORE READILY AVAILABLE

In order to place on a systematic basis the collection, reduction and reporting of the rotation periods of Jupiter's radio sources and visible features (e.g. Great Red Spot), together with related information such as the appearance, position, and dimensions of the feature observed, Commission 16 recommends:

1. that a comprehensive bibliography be compiled without delay;

2. that copies of reports in preprint or reprint form be sent by authors to a 'central office' for inclusion in supplements to the bibliography;

3. that the bibliography supplements and summaries of the rotation periods, presented with error estimates, be published annually in one of the regular international journals (e.g. *Icarus*);

4. that the President and Organizing Committee be invited to implement these proposals.

RESOLUTION DE LA COMMISSION 17 APPUYEE PAR LA COMMISSION 4 PROPOSEE POUR LE COMITE EXECUTIF

"L'Union Astronomique Internationale,

consciente que l'importance scientifique des déterminations de distance de la Lune par laser se trouverait grandement valorisée par une collaboration internationale concernant les observations et les développements théoriques ainsi que par des échanges rapides des données à réaliser entre les différentes équipes engagées dans ce domaine,

et *considérant* qu'un groupe a été constitué par le COSPAR (décision No. 7, 1970) dans le but d'assurer cette coordination,

estime appropriée la formation de ce groupe.

Afin de renforcer la coopération internationale et la liaison entre les unions scientifique l'UAI *propose* que des représentants des commissions suivantes:

4 (Ephémérides)
7 (Mécanique Céleste)
9 (Instruments Astronomiques)
17 (La Lune)
19 (Rotation de la Terre)
31 (Temps)

soient nommés dans ce groupe et qu'ils rendent compte de ses travaux à l'UAI."

RESOLUTION FROM COMMISSION 17 SUPPORTED BY COMMISSION 4 PREPARED FOR THE EXECUTIVE COMMITTEE

"The International Astronomical Union,

Realizing that the potential scientific value of lunar laser ranging experiments would be highly enhanced if international cooperation in the observations and theoretical developments, as well as prompt data exchange are achieved by all groups active in the field,

and *noting* that a working party was appointed by COSPAR (decision No. 7, 1970) in order to initiate such coordination.

welcomes the formation of this working party.

In order to strengthen international and interunion cooperation,

IAU *suggests* that representatives of the following commissions:

4 (Ephemerides)
7 (Celestial Mechanics)
9 (Astronomical Instruments)
17 (The Moon)
19 (Rotation of the Earth) and
31 (Time)

be appointed to the working party and report about its activity to IAU."

Commission 17: *RESOLUTION*

"The IAU expresses its conviction of the great scientific importance of the preliminary physical measurements made in the environment of the Moon and on its surface, and of the collection and analysis of samples returned from the surface, especially in relation to the advance of our knowledge of the origin and evolution of the Earth, the Moon and the whole Solar System.

The IAU strongly hopes that continued programmes will be developed in which a sufficient minimum of sampling sites are included so that conclusions can be drawn about the Moon as a whole. In particular, the IAU stresses the importance of sampling the highlands, and of some special areas which are critical for the understanding of the processes which have shaped the Moon and even the Solar System as a whole.

The IAU recognizes the value to member states of contributions to the scientific exploration of the Moon made from the international scientific community, and expresses the hope that international cooperation in this field will continue to expand."

Commission 19 (Variation of Latitude/Variation des Latitudes)

ANNEXE II. RESOLUTIONS

1. Considering that the basic observational data concerning the physics of the Earth, namely its rotation and polar motion, needed for space research, geophysics, and geodesy, are provided by astronomical observations:

Commission 19 recommends that:

(a) The precise astronomical determinations of time and latitude be continued, and

(b) New chains on the same parallel of latitude be formed, in accordance with the resolutions adopted at Prague in 1967.

2. The fundamental importance of the ILS northern chain in providing a long, consistent series of data is recognized by astronomers and geophysicists and the continuation of the visual observations at Mizusawa, Kitab, Carloforte (Cagliari), Gaithersburg and Ukiah is considered of paramount importance.

3. The importance is stressed of planning for the installation of PZT's at Gaithersburg and Ukiah, by the U.S. Coast and Geodetic Survey, to form a complete ILS chain.

(Note; Present status: Mizusawa, in operation; Kitab, being installed; Cagliari, planned).

4. Recognizing the urgent need to provide the best possible polar coordinates from all available observational data, commission 19 recommends that a program of investigation be conducted in several stages. The objectives are:

4.1. Determination of the appropriate frame of reference.

4.2. Anew, homogeneous reduction of the ILS visual results.

4.3. Determination of the best possible polar coordinates from all observations.

To initiate the first stage, Commission 19 requests the Scientific Council of the IPMS to establish a small working group to re-reduce the northern ILS visual observations on a homogeneous basis.

5. The importance of the program for the homogeneous determination of the polar motion and UT from both time and latitude observations made since 1955 is recognized and the BIH is urged to complete this work.

6. Noting the increasing difficulties of obtaining observing staff for Carloforte and noting the importance of obtaining continuous observations, Commission 19 concurs in the proposal of the Italian Geodetic Commission to move the VZT of the ILS station at Carloforte to Cagliari, provided that:

6.1. The systematic difference of the two sites shall be determined by conducting concurrent observations at the two sites with the use of auxilliary VZT.

6.2. The auxilliary VZT must be of the same accuracy as the one now existing at Carloforte.

6.3. Skilled observers will be maintained at both sites.

6.4. The observing program at each site will be that of the normal ILS station.

6.5. The duration of the concurrent observations will be 6 years.

6.6. Steps shall be taken so that observations with a VZT can be resumed at the present location at Carloforte, if so desired, after completion of the 6-year program.

6.7. The Scientific Council of IPMS will advise on the carrying out of this program.

7. Commission 19 notes with satisfaction that the definitive ILS results for 1949,0–1962,0 have been completed. However, it expresses concern that the origin of the pole used is not the Convential International Origin (CIO) adopted by both the IAU and the IUGG in 1967.

Commission 19 recommends that the Executive Committee of the IAU grant a subsidy to aid publication of the 1949,0–1962,0 results, providing that the results are referred solely to the CIO.

(Note: Use of CIO solely will avoid confusion of multiple systems).

8. Commission 19 welcomes the introduction of new techniques which may be used to study the rotation of the Earth and polar motion, such as artificial satellites via Doppler and laser measurements, lunar laser ranging, and radio interferometry, and urges that regular programs of extensive observations be established.

9. Recognizing that modifications in the surrounding areas of observatories affect the precise measurement of time and latitude, Commission 19 recommends that local authorities concerned aid in preserving suitable observing conditions in the vicinity of observatories.

Commission 20 (Minor Planets, Comets and Satellites/Petites Planètes, Comètes et Satellites)

RESOLUTIONS

A. *Minor Planets*

1. Observations are encouraged for objects of special interest or unusual circumstances, such as the Earth-approaching asteroids, asteroids with cometary orbits, and librating asteroids. There will always be an enduring interest in fast-moving objects which are found on any plates.

2. Observations are encouraged for those numbered planets whose ephemerides do not yield reasonably small residuals, say less than $1^m.0$ and $15'$.

3. It must be reiterated to the observers that positive identification of a moving object is impossible unless there are confirming observations from two to four weeks later.

4. Observations of selected minor planets for the purpose of establishing the equinox, and equator and systematic corrections to star catalogues are encouraged until these programmes are completed.

5. Any systematic observing programme, especially with meridian circles, of the bright minor planets for the purpose of supplementing the observations of the Sun, Moon, and major planets should be encouraged.

6. Observers with sufficiently powerful telescopes are urged to further observe the two 'clouds' of Trojans associated with the Lagrangian points L4 and L5.

7. Determination of approximate positions of minor planets has generally lost its importance. It is sufficient to give the approximate position only if there is a reasonable expectation that accurate measures can be provided to satisfy the request of any orbit computer in the years to come.

8. The accurate measures of moving objects should be reduced with AGK3 comparison stars or corrected to the FK4 system whenever possible, and this should be clearly stated.

9. The changes in the form of the *Ephemerides of Minor Planets* published in Leningrad, in particular the extension of the ephemeris intervals around the opposition, are accepted with satisfaction. The recent practice of including extended ephemerides for Earth-approaching asteroids is much to be encouraged. It is hoped that the number of planets given this special treatment will be increased so that the list includes eventually all those with highly eccentric orbits and not necessarily best observable around opposition.

10. As the very limited field of large reflectors imposes strict requirements on the accuracy of the ephemerides of the minor planet, it is desirable to print with each ephemeris a reference to the elements on which the ephemeris is based, or at least the year of the 'Ephemerides' in which the elements were introduced.

11. The present photometric system of asteroids should be revised to conform with the UBV photometric system. The new values are 0.10 magnitude fainter, nearly the same difference for all asteroids; a new list of photoelectric magnitudes referred to the UBV system has been prepared by T. Gehrels (list published in *Surfaces and Interiors of Planets and Satellites*, A. Dollfus, ed., Academic Press, 1970).

B. *Comets*

12. Recognizing that the most important function of large telescopes is the observation of very faint objects, Commission 20 calls attention to the astrophysical importance of observing faint comets. Directors of observatories with large telescopes are urged to include the observation of faint comets in their assignments of telescope time.

13. Further experiments to investigate appropriate methods for allowing for nongravitational effects in the computation of the orbits of comets (particularly short-period comets) are encouraged.

14. It is recommended that, whenever perturbations are taken into account, the published osculating elements of a comet should be referred, in general, to the 40-day standard Julian date nearest the time of perihelion passage.

15. In order to ensure reliable predictions on the observability of comets in different types of telescopes, it is recommended that the notation m_1 be used for the 'total' magnitude of a comet and m_2 for the 'nuclear' magnitude in the publication of both observations and ephemerides. The subscripts are consistent with the code used for the telegraphic reporting of observations.

Commission 26 (Double Stars/Etoiles Doubles)

RESOLUTIONS ADOPTED

1. Commission 26 realizes the necessity in the near future to compile homogeneous data for visual double stars for which the following information is known: all orbital elements, photometric, spectroscopic and astrometric; this data will serve as a basis for research on mass-luminosity relation on stellar evolution and related problems. (This was first proposed at *IAU Colloquium* No. 5 on Visual Double Stars at the Nice Observatory September 1969.)

2. Commission 26, facing similar problems for publishing double star observations as Commission 42, supports its resolution concerning the desirability for editors of all journals to accept and even request for publication complete lists of double star observations.

Commission 27 (Variable Stars/Etoiles Variables)

The Commission unanimously endorsed this resolution.

The President brought to the attention of the Commission the following requests:

1. *Van Herk* reported experiencing difficulties in a program for improving proper motions of long period variables, due to poor photometric elements. *Mrs Mayall* was requested to send to the *Information Bulletin* for rapid circulation any new photometric data on these stars.

2. *Van Hoof* requested that cooperative observing programs on β CMa stars be carried out at observatories situated in different longitudes, especially in the southern hemisphere.

3. *Cesevich* requested simultaneous photometric and spectroscopic observations of two RW Aurigae-type stars, FG and FH Aql.

4. *Opolski* requested simultaneous UBV and velocity measures of δ Cephei-type variables, and urged those who plan to make velocity measures to circulate their plans as early as possible via the *Information Bulletin*, so that photometric observers can arrange to observe at the same time.

5. *Mumford* requested finding charts for old novae, and the Commission expressed its approval of the work on the preparation of finding charts which is being carried out by Dr. Bertaud.

A letter from the late Dr A. V. Nielsen was read by the President. Dr Nielsen had requested Commission 27 to publish the long series of observations of southern variables by the late A. W. Roberts. *Detre* will publish in the Information Bulletin the list of stars observed by Roberts. *Feast* suggested that photocopies of the observations be made available to interested workers.

The President reopened a proposal initiated by W. J. Miller at the Prague meeting, to the effect that a new scheme be devised for the rapid naming of newly discovered variables. After a short discussion in which *Herbig* stated that he and Kukarkin opposed any present change, the proposal was tabled.

In conclusion, the President proposed and the Commission approved that names of new officers of Commission 27 be forwarded to the Executive Committee of the Union.

Commission 31 (Time/L'Heure)

RESOLUTION ADOPTED BY COMMISSION 31

Commission 31 *makes the following recommendations*:

1. That the frequency offset of UTC be made zero, effective 0^h, 1 January 1972.

2. That *step adjustments* shall be exactly 1^s. When a step adjustment is made it shall be at 0^h on the first day of a month with preference for 1 January or 1 July. These step adjustments will be decided upon and announced as early as possible by the BIH.

3. The maximum difference UT1–UTC will be less than $0^s.7$ unless there are exceptional variations in the rotation of the Earth.

4. *Special adjustment*. The BIH will also announce a unique fraction of a second adjustment to be made at 0^h 1 January 1972, so that UTC and the International Atomic Time Scale (IAT, in French TAI) will differ by an integral number of seconds.

5. The *emission times* of time signals from co-ordinated stations shall be kept as close to UTC (BIH) as feasible with a maximum tolerance of 1 ms.

6. *Nomenclature*

6.1. Clocks in common use will indicate the minutes, seconds and fractions of UTC (French: TUC).

6.2. The terms 'G.M.T.' and 'Z' are accepted as the general equivalents of UTC in navigation and communications.

7. The term ΔUT is defined by: $\Delta\text{UT} = \text{UT1}-\text{UTC}$. Extrapolated and final values of ΔUT will be issued by astronomical observatories and the BIH, and will be given the widest possible distribution.

8. All standard time signal emissions must include information which will enable a user to obtain UT1 with a precision of at least $0^s.1$.

9. *Designation of the epoch of steps in UTC*

9.1. If UTC is to be advanced, then second 00 will follow $23^h\ 59^m\ 58^s$ of the previous day.

9.2. If UTC is to be retarded, then the second of the previous day $23^h\ 59^m\ 58^s$ will be followed by the next second $0^h\ 00^m\ 00^s$ of the first day of the month.

9.3. The stepped second will be commonly referred to as a "leap" second (in French: intercalaire).

9.4. The time of an event given in the old scale, before the leap second, will be given as a date in the previous month, exceeding 24^h if necessary. The time of an event given in the scale after the step will be given as a date in the new month, with a negative time, if necessary.

Note: Commission 31, taking into account the conflicting requirements of the various users of UTC, including the large number of those requiring immediate knowledge of hour angle, considers that the above represents the optimum solution.

Commission 36 (Stellar Atmospheres/Theorie des Atmospheres Stellaires)

Therefore, Commission 36 proposes to implement the following policy and it recommends and invites other Commissions of the IAU to join it:

(a) to encourage the Organizing Committee and the Editor of the Proceedings of each symposium and colloquium to utilize the staff and secretarial facilities of their institution to prepare quickly camera copy of the major summary papers and discussions for photo-offset reproduction. Paper quality and artistic appearance are negligible considerations;

(b) to encourage collaborative efforts between governmental and institutional publication offices to publish simultaneous English and Russian language editions at a price such that each student can afford to purchase his own working copy.