

INTERNATIONAL UNION OF GEODESY AND GEOPHYSICS  
XIVth GENERAL ASSEMBLY  
LUCERNE

SEPTEMBER - OCTOBER 1967

**INTERNATIONAL ASSOCIATION OF  
METEOROLOGY AND  
ATMOSPHERIC PHYSICS  
REPORT OF PROCEEDINGS**

Published by  
The International Association of Meteorology  
and Atmospheric Physics

TORONTO - APRIL 1968

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## FOREWORD

As for previous IAMAP Assemblies, this publication contains the abstracts of the scientific papers presented plus the proceedings of the plenary and commission sessions, together with reports on activities since the 1963 Berkeley Assembly. In addition, the full text of the Presidential Address has been included, as well as papers presented at the IUGG Symposium on International Cooperation in Meteorology - a part of the regular IAMAP program.

In many ways the 1967 Lucerne Assembly of IAMAP was at least as successful as any in the past, despite the fact that IUGG was itself spread out over four Swiss cities. The need for efficient and timely programming had led to the abandonment of general contributed sessions, but not of the inclusion of contributed papers in pre-organized sessions. It is unfortunate that some scientists were thereby unable to present papers at Lucerne, but both quantity and topic control are going to be increasingly necessary in the foreseeable future.

In both scientific and plenary sessions, plans for the Global Atmospheric Research Programme (GARP) attracted major attention at Lucerne, with the emphasis on a coordinated scientific programme to which both ICSU and WMO would contribute, in a joint manner. The full role of IAMAP was perhaps not clear, but it is hoped that IAMAP Commissions, Joint Committees and National Committees will give real consideration to this aspect of GARP, quite apart from their vigorous interaction with the developing international programme for which the new ICSU-WMO Joint Organizing Committee for GARP is the logical coordinating body.

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Secretary, IAMAP.

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## 1. EXECUTIVE COMMITTEE AND BUREAU

### 1.1 Bureau Report, 1963-67.

The following members, elected at the Berkeley General Assembly 1963, were still in office at the end of the period (the one-year extension necessitated by the postponement of the current General Assembly created no procedural difficulties):

President:	Prof. A. M. Oboukhov, U.S.S.R.
Vice-Presidents:	Dr. R. C. Sutcliffe, U.K. Dr. S. Fritz, U.S.A.
Secretary:	Dr. W. L. Godson, Canada.
Executive Members:	Dr. R. V. Garcia, Argentina. Prof. N. Koncek, Czechoslovakia. Prof. S. Syono, Japan.

During the entire period, Dr. R. E. Munn, Canada, served as the Assistant Secretary, on selection by the IAMAP Executive Committee. In addition to Dr. Godson and Dr. Munn, the Bureau Secretariat consisted of Mrs. N. J. Derco, Technical Assistant and Mrs. A. Martin, Secretary, both provided by courtesy of the Meteorological Service of Canada. The IAMAP Executive Committee wishes to express its gratitude and appreciation to the Meteorological Service of Canada, and in particular to its Director, Mr. J. R. H. Noble, for permitting the part-time participation in the Bureau Secretariat of the four individuals noted above and for providing all ancillary services, so that the Secretariat expenses to the Association were almost nil. It should be recorded that this indirect subsidy by the Canadian Government amounted to at least three times the IUGG allocation to IAMAP.

There was no meeting of the Executive Committee between the General Assemblies, and all formal business was conducted by correspondence. Members of the Bureau met, severally, at numerous scientific meetings and symposia during this period, however, and were able to discuss Association affairs at length. Such informal procedures are quite adequate, in general, since most problems that do arise require action in a short period of time and could not await even annual meetings of the Executive Committee or Bureau.

### 1.2 Lucerne Report, 1967

The Executive Committee met frequently during the Lucerne Assembly, before and/or after the plenary meetings of the Association. Decisions taken by the Executive Committee will be found in the Proceedings under the appropriate agenda item.

At its first plenary meeting, a Nominations Committee was established, consisting of:

Prof. J. Van Mieghem, Belgium - Chairman  
Dr. H. G. Houghton, U.S.A.  
Prof. A. Khrgian, U.S.S.R.  
Prof. K. R. Ramanathan, India.  
Dr. W. C. Swinbank, Australia.

This Committee reported to the final plenary the following nominations:

President:	Dr. R. C. Sutcliffe, U.K.
Vice-Presidents:	Dr. S. Fritz, U.S.A. Dr. C. H. B. Priestley, Australia.
Secretary:	Dr. W. L. Godson, Canada.
Executive Members:	Dr. R. K. Berggren, Sweden. Dr. B. Dzerdzevsky, U.S.S.R. Dr. P. R. Pisharoty, India.

The above nominations were approved unanimously.

At a subsequent meeting, the IAMAP Executive Committee made the following appointment:

Assistant Secretary: Dr. R. E. Munn, Canada.

## 2. COMMISSIONS AND COMMITTEES OF THE ASSOCIATION; SYMPOSIA

### 2.1 Bureau Report, 1963-67

*Commissions and Committees of the Association; Symposia.*

Reports of the Commissions and Committees of the Association are included in this Bureau Report. As usual, these bodies have been active in the holding of symposia, and in international coordination of research and of research programmes within their respective fields. In summary, the present Commission and Committee Organization is as follows, with the place and year of their symposia in brackets:

- International Commission on Atmospheric Radiation (Leningrad, 1964)
- International Commission on Atmospheric Ozone (Albuquerque, 1964)
- International Commission on Atmospheric Chemistry and Radioactivity (Visby, Sweden, 1965)
- International Commission on Dynamic Meteorology (Boulder, 1963 and Moscow, 1965)
- International Commission on Meteorology of the Upper Atmosphere (Vienna, 1966)
- International Commission on Polar Meteorology (Geneva, 1966)
- Ad-Hoc Committee on Cloud Physics and Cloud Modification (Tokyo, 1965 and Albany, 1966)
- IAMAP/IAPO Joint Committee on Interaction between Atmosphere and Oceans (Tokyo, 1966 - Turbulence Symposium)
- Inter-Union Committee on Radiometeorology (Boulder, 1964 and Moscow, 1965)
- IAMAP/IAGA Joint Committee on Atmospheric Electricity (Tokyo, 1965 - Cloud Physics Symposium)
- IAGA/IAMAP Joint Committee on Lunar Variations
- IAMAP Advisory Group on Space Research

In addition to the above bodies, three which existed in 1963 have since been dissolved:

- IASH/IAMAP Joint Committee on Evaporation
- IASH/IAMAP Joint Committee on Precipitation
- Inter-Union Commission on Solar and Terrestrial Relationships (IUCSTR)



At Berkeley in 1963 an IAMAP/IASH Ad-Hoc Joint Committee on Precipitation and Evaporation was formed to consider the need for and functions of IAMAP/IASH Joint Committees. After exchange of views by correspondence, the Ad-Hoc Committee reported in August 1964 that the only possible need was for symposia and that these could easily be arranged by the Association Secretariats. Subsequently, the Bureaux of both IAMAP and IASH accepted these views and the Joint Committees were not re-established. IUCSTR was dissolved by ICSU and replaced by an Inter-Union Commission on Solar - Terrestrial Physics (IUCSTP), on which there is at present no formal IAMAP representation.

During the four-year period the following WMO Symposia were co-sponsored by IAMAP:

Tropical Meteorology, Rotorua, New Zealand, Nov. 1963.

Long-Range Forecasting, Boulder, U.S.A., June/July 1964.

Meteorological Data Processing, Uccle, Belgium, July 1965.

In addition, there was a symposium on Noctilucent Clouds in Tallin, U.S.S.R., in March 1966, jointly sponsored by IAMAP, WMO and the IQSY Committee, and a symposium on Turbulence and Boundary-Layer Effects in Kyoto, in September 1966, sponsored by IUGG (IAMAP and IAPO) and IUTAM.

## 2.2 Lucerne Report, 1967

No new commissions or joint committees were established at the Lucerne Assembly, although the Ad-Hoc Committee on Cloud Physics and Cloud Modification was transformed into a full commission. There was further discussion of a possible commission on turbulence and/or air pollution, but it was found preferable to enlarge the membership of the Commissions on Dynamic Meteorology and on Atmospheric Chemistry and Radioactivity in order to ensure that these topics were covered adequately within the IAMAP structure.

The following list, in quasi-chronological order, of scientific meetings for the period 1968-69 has been abstracted from Lucerne reports of commissions, primarily. The listings are, in some cases, rather tentative, but will provide a basis for advance planning.

May 1968, Tokyo (during COSPAR Assembly).

Special Session on Structure of Winter Atmosphere from Stratosphere to Turbopause.

Jointly sponsored by ICMUA and COSPAR Working Group II.

May 1968, Tokyo (during COSPAR Assembly).

Session on Noctilucent Clouds and Particles in Upper Atmosphere.

Unofficial participation by ICMUA Working Group on Noctilucent Clouds.

May 1968, Tokyo.

International Symposium on Universal Aspects of Atmospheric Electricity.

Sponsored by IAMAP/IAGA Joint Committee on Atmospheric Electricity.

August 1968, Bergen.

International Symposium on Radiation including Satellite Techniques.

Jointly sponsored by IAMAP (Radiation Commission) and WMO.

August 1968, Toronto.

International Conference on Cloud Physics.

Sponsored by IAMAP (Cloud Physics Commission), co-sponsored by WMO.

September 1968, Marseilles.

International Symposium on Atmospheric Ozone.

Sponsored by IAMAP (Ozone Commission), co-sponsored by WMO.

October or November or December 1968, Tokyo.

International Symposium on Numerical Weather Prediction.

Sponsored by WMO, co-sponsored by IAMAP (Dynamic Meteorology Commission)

August or September 1969, Heidelberg.

International Symposium on Atmospheric Chemistry.

Sponsored by IAMAP (ICACR), perhaps co-sponsored by WMO.

1969, Prague or Vienna.

International Symposium on Nucleation.

Sponsored by IAMAP (Cloud Physics Commission).

1969, Rome.

International Symposium on Air-Sea Interaction.

Sponsored by IAPSO and IAMAP (Joint Committee on Atmosphere-Ocean Interaction).

June 1969, Stockholm or Slough.

Specialized Colloquium on Spectra of Meteorological Variables.

Sponsored by Inter-Union Commission on Radio Meteorology.

Additional symposia are planned for 1970 and 1971, as can be seen in reports from IAMAP's constituent bodies, but the plans are too indefinite to merit collection in an overall program of symposia.

### 3. COMMISSION ON ATMOSPHERIC RADIATION

#### 3.1 Commission Report, 1963-67

##### 3.1.1 Membership

The following officers and members of the Commission were elected at the Berkeley Meeting in August 1963. There was no change in Membership during the subsequent period and as of 31 December 1966 the commission membership was as follows:

Prof. F. Möller, Germany, GFR - President  
Dr. A. Ångström, Sweden - Hon. Vice-President  
Dr. W. Mörikofer, Switzerland - Hon. Vice-President  
Prof. J. London, U.S.A. - Secretary

Prof. M. I. Budyko, U.S.S.R.  
 Dr. Inge Dirmhirn, U.S.A.  
 Mr. R. Dogniaux, Belgium.  
 Dr. H. Hinzpeter, Germany, GFR.  
 Dr. J. I. Houghton, U.K.  
 Prof. K. Ya. Kondratiev, U.S.S.R.  
 Dr. J. Lenoble, France.  
 Prof. Z. Sekera, U.S.A.  
 Dr. D. Q. Wark, U.S.A.  
 Prof. G. Yamamoto, Japan.

As the result of a discussion held at the Berkeley meeting, it was decided that commission members with nine or more years of service should not in general be re-appointed to the commission for the period 1963-1966. It was agreed that this decision was not to be used as precedent for future Commission membership.

### 3.1.2 Financial Statement

On 12 November 1963, the commission account was transferred from an English bank to one in Boulder, Colorado. An audited statement has been submitted to the secretary of IAMAP. The following is a summary of this statement. (All amounts are given in U.S. dollars.)

	<u>IUGG</u>
Cash in hand and in bank, 1 January 1963	\$ 975.00
Receipts	<u>2,000.00</u>
Total	\$ 2,975.00

#### Expenditures:

Administration (supplies and equipment)	\$ 288.82	
Symposia (organization)	94.69	
Symposia (travel)	<u>1,000.00</u>	
Total Expenditures	\$ 1,383.51	<u>1,383.51</u>
Cash in hand and in bank, 31 December 1966		<u>\$ 1,591.49</u>

The above statement does not reflect the income and expenditures related to the radiometersonde intercomparison held in the U.S.A. during Spring 1965 and the subsequent conference to discuss the results held in Munich during June 1966. Supporting funds for the intercomparison and subsequent conference came from the WMO, IAMAP, the University of Wisconsin and the DVL Institute of Physics of the Atmosphere at Munich.

Administrative and other expenses associated with the Radiation Symposium in Leningrad in August 1964, were largely borne by the Main Geophysical Observatory, U.S.S.R. The National Center for Atmospheric Research, U.S.A. shared some administrative cost. WMO co-sponsored this symposium and paid for the travel of some of the participants.

### 3.1.3 Business Meetings

Business meetings of the Commission were held in Berkeley, California, on 19th, 22nd and 29th August 1963, and in Leningrad on 8th August 1964.

The following administrative actions were taken at the commission meetings. Recommendations and resolutions of the Berkeley meeting were published in the Report of Proceedings IAMAP, Publication No. 13.

#### 3.1.3.1 Berkeley Meetings

a) The Commission noted with satisfaction that a comparison of balancemeters was in progress in various parts of the world and stressed the importance of the proposed comparison of balancemeters under tropical conditions in India.

b) The successful conclusion of the comparison of pyrheliometers at Davos in 1959 was welcomed. The proposal made within WMO for regional and inter-regional sub-standard pyrheliometers was noted and endorsed. (A further international comparison of standard pyrheliometers was held at the Davos Observatory in August/September 1964, under the direction of WMO-CIMO.)

c) IQSY- The Commission endorsed a set of recommendations on activities to be included in the IQSY scientific program as adopted at its Vienna meeting (1961) and submitted through IAMAP to the appropriate organizations.

d) A recommendation was drafted endorsing a program of international comparison of radiation-sondes (radiometer-sondes). (See discussion of appropriate action below.)

e) The invitation to hold a Symposium on Radiation Processes in the Atmosphere in Leningrad during August 1964, was accepted.

f) The report of the sub-commission on instrumentation (Mr. A. Drummond - Chairman) was accepted. The work of the sub-commission was well done and there was no need for its re-appointment. The report of the sub-commission is appended.

#### 3.1.3.2 Leningrad Meeting

a) Dr. Peter Kuhn, U.S.A. was asked to contact all interested persons who might wish to participate in an international radiometer-sonde comparison program. A working group (Dr. P. Kuhn - Chairman) was appointed to coordinate this program and to report back the results to the Radiation Commission (see summary below).

b) The commission noted favorably the plans for continued comparison of balancemeters under the direction of Miss A. Mani, India, with WMO sponsorship.

c) It was proposed that a review of the results of commission suggested activities under IQSY be held at the next commission meeting.

d) Dr. T. G. Berlyand, U.S.S.R. gave a report of the plans for the Hydrometeorological Service of U.S.S.R. to act as the World Data Center for the collection and publication of selected radiation data for the IQSY and subsequent periods. Solar radiation data will include:

1. Daily and monthly totals of global solar radiation flux.
2. Hourly, daily and monthly totals of net radiative flux.
3. Monthly means of hourly data of global solar radiation and net radiation flux.

It was proposed that the Radiation Commission should sponsor a one day session on general radiation problems at the next General Assembly of IAMAP, Switzerland, 1967.

It was also proposed that the next International Radiation Symposium be held one year following the IAMAP General Assembly.

#### 3.1.4 Scientific Symposia

##### 3.1.4.1 Berkeley Symposium

The program and abstracts of the Berkeley Symposium on upper Atmosphere Radiation were published in the IAMAP Proceedings, December 1963.

##### 3.1.4.2 Karlsruhe Symposium

A one day conference on "Measurements of the Radiation Balance in Polar Regions" was held on 9 October 1963, in connection with a meeting on Polar Research in Karlsruhe, Germany.

Ten scientists took part in the discussion of the different instruments used and the results obtained in measuring radiation balance under cold climatic conditions.

##### 3.1.4.3 Leningrad Symposium

An international symposium on Radiation Processes in the Atmosphere was held in Leningrad, 5-12 August 1964, under the co-sponsorship of the Radiation Commission (IAMAP) and WMO, and the cooperation of COSPAR and the Commission on Dynamic Meteorology (IAMAP).

There were 239 registered participants (from 29 different countries) and 139 invited and contributed scientific papers, including two special lectures. This was the largest symposium ever held by the Radiation Commission.

The program of the Symposium was as follows:

- |                     |  |
|---------------------|--|
| <u>Session I:</u>   | Theory of Radiative Transfer in Planetary Atmospheres.<br>Convenor: Prof. Z. Sekera. |
| <u>Session II:</u>  | Improved Spectroscopy of the Atmosphere.<br>Convenor: Dr. J. N. Howard.              |
| <u>Session III:</u> | Radiation Climatology.<br>Convenor: Prof. M. I. Budyko.                              |

Session IV: Radiation Processes as related to Atmospheric Dynamics and the General Circulation.  
Convenor: Prof. R. M. Goody.

Session V: Surface and Network Instrumentation.  
Co-Covenors: Drs. A. J. Drummond and  
Yu. D. Yanishevsky.

Session VI: Experimental Investigations of the Radiation Field in the Free Atmosphere.  
Co-Convenors: Prof. K. Ya. Kondratiev and  
Dr. D. Q. Wark.

Special Lecture I: The space Dust Cloud around the Earth and its penetration into the Lower Atmospheric Layers.  
Prof. V. G. Fessenkov.

Special Lecture II: The changing aspect of weather and climate and the prospects for large scale control of weather. Dr. W. O. Roberts.

The program and the local arrangements were under the direction of Prof. Budyko (Main Geophysical Observatory - U.S.S.R.) who was responsible in many ways for the success of the symposium. All scientific sessions were held in the council halls of the Tawrichesky Palace and simultaneous translations were provided in Russian or English as the need arose. The participants were grateful for the large number of available interpreters so that scientific discussions - of basic importance to such symposia - could be conducted among the participants.

The full program and all available abstracts of papers presented in Leningrad were published as IUGG Monograph Nr.28.

### 3.1.5 Scientific Activities

3.1.5.1 The Radiation Commission (through its President) strongly endorsed the recommendation of the International Commission on Dynamic Meteorology (IAMAP) to WMO for establishment of a permanent global network of net radiation measurements. The recommendations especially emphasized the need for such measurements for large-scale dynamics and for extension of detailed forecasts beyond the present time scale of the order of 2 days. At the same time the Radiation Commission urged the establishment of a network of radiometersondes to measure directly the time and space variations of radiative losses (or gains) within the free atmosphere.

3.1.5.2 The President of the Commission was elected rapporteur on radiation in the Commission of Aerology of WMO at its Brussels Meeting in July 1965.

#### 3.1.5.3 Intercomparison of Radiometersondes

At the suggestion and under the direction of the Radiation Commission a series of international intercomparisons of radiometersondes was made during the last three years. Much of the impetus for these intercomparisons came from Prof. V. Suomi and Dr. P. Kuhn, U.S.A. and Dr. H. G. Müller, Germany. The first of

these comparisons was made in Munich, Germany, during December 1963, and the second was made at two locations in U.S.A. during March-April 1965. The second set of ascents involved intercomparisons of four radiometersondes developed by Kuhn, U.S.A.; Müller and Fimpel, Germany; Shlyakhov and Kostyanoy, U.S.S.R.; and Yata, Sekiguchi and Kuwara, Japan.

The results of the intercomparisons were discussed by the participating group at a special conference held in Munich in June 1966. The conclusions of the conference participants are summarized in the following comments:

- a) Each instrument has been improved as a result of the experience gained in the intercomparison program.
- b) The absolute radiation flux values at pressures greater than 100 mb gave an average difference among the different instruments of 0.04 ly/min for downward radiation. At lower pressures the average difference was somewhat higher. The average difference of the flux divergence was found to be about 0.010 ly/min/100 mb at pressures higher than 100 mb and again slightly higher (about 0.020) at lower pressures.
- c) It is probable that with use of the improved instruments and better transmitting and receiving arrangements, greater homogeneity of the results can be obtained.

It was suggested that:

- a) Additional intercomparisons be planned over
  - 1) large homogeneous surface areas (e.g., the open seas)
  - 2) different climatic zones - particularly in polar regions,
- b) The group have close contact with scientists working in theoretical radiative transfer to facilitate comparison of experimental and theoretical results.

The full report by the intercomparison working group has been submitted to WMO and IAMAP.

### 3.1.6 Response to Resolutions

At its Vienna meeting (1961) the Radiation Commission adopted three resolutions (these were endorsed at its Berkeley meeting in 1963), dealing with

- a) comparison of methods of measuring radiation in the free atmosphere
- b) publication of radiation data
- c) radiation measurements by satellites and other means during the International Quiet Sun Year.

As noted above, positive action has been taken in response to resolutions 1 and 2. As far as is known, however, no program has

been developed in support of resolution 3. In particular, no observations were made during the IQSY to monitor, by rockets or satellites, measurement of the entire spectrum of solar radiation reaching the earth.

These resolutions were adopted as proposals for future scientific activities at the 3rd IQSY meeting in Madrid in March 1965. It is hoped that they will be actively considered.

### 3.1.7 Future Meetings

An invitation to hold the next International Radiation Symposium (1968) in Bergen, Norway, has been received from the Geophysical Institute, University of Bergen. This kind offer will be considered by the Commission at the IAMAP General Assembly

### 3.1.8 Appendix

#### Sub-commission on Instrumentation, August 1961 - August 1963

The following is a summary of the principal activities of the Sub-commission during the period since the Vienna meeting of the Commission.

#### a) Standards of Radiometry

The relationship between the International Pyrheliometric Scale and that maintained in the U.S. National Bureau of Standards is under investigation at the Eppley Laboratory (in close collaboration with the N.B.S.) where, to date, about 50 comparisons have been made.

A comparison undertaken in March 1963, at Davos, between the primary working standard pyrheliometers of Davos and Newport indicated agreement to within 0.1 per cent of the relationship established in August 1959. These centres have been responsible for the transference of the I.P.S. to a very large number of secondary instruments during this period.

#### b) Optical Properties of Materials

The Satellite Laboratory of the U.S. National Weather Satellite Center, Washington, D.C., has investigated the reflectance of Parsons Optical Black Lacquer (at 30° incidence) over the wavelength range 1-40 $\mu$  and has found no significant variation from the data established elsewhere to 25 $\mu$ .

A start has been made at Newport with the investigation of the transmission properties of polyethylene and KRS-5 out to 40 $\mu$ , especially with regard to weather effects and as influenced by material temperature.

### 3.2 Lucerne Report, 1967

3.2.1 All members of the Radiation Commission were re-elected for the next term of 4 years.



3.2.2 The following scientists are newly elected members:

Dr. Anna Mani, India.  
Prof. L. Foitzik, G.D.R.  
Prof. M. Migeotte, Belgium.  
Prof. G. V. Rozenberg, U.S.S.R.  
Prof. V. E. Suomi, U.S.A.

3.2.3 Professor Möller retired from his office as President. Professor K. Ya. Kondratyev, Leningrad, was elected the new President, Professor Möller was elected Vice-President, Professor London will stay in his office as secretary for another term of 4 years according to the by-laws of the Association. Dr. Ångström and Dr. Moriköfer will stay Honorary Vice-Presidents.

3.2.4 The Working Group on Radiometersonde Intercomparisons was re-established with Dr. P. Kuhn as chairman. The Working Group was asked to contact a Radiation theoretician in the evaluation of their measurements. Proposal: Dr. W. C. Rodgers, Dr. Kuhn is kindly requested to inform the other members of the Working Group.

3.2.5 Miss Mani is requested to report to the Radiation Commission at its Symposium in Bergen 1968, about the results of the various inter-comparisons of the different surface radiation instruments.

3.2.6 The Commission was requested to elect a representative of IUGG to COSPAR Working Group VI, Panel 2. Professor Möller was elected for this office.

3.2.7 The Radiation Commission accepted the invitation of the University of Bergen, Norway, and its Institute of Geophysics to hold a Radiation Symposium in Bergen, 22 - 28 August 1968, WMO offered to join in the organization of that Symposium with the intention to have the Symposium extended to the topic of satellite technology. The Meeting will therefore be held under the title IUGG/WMO-Symposium on Radiation including Satellite Technique.

3.2.8 RESOLUTIONS OF THE RADIATION COMMISSION  
adopted at its meetings of Sept. 27 and  
29, 1967, in Lucerne.

(1) The Radiation Commission supports those recommendations of the Global Atmospheric Research Program (GARP) which are concerned with radiation investigations.

(2) In order to check the internal consistency and accuracy of laboratory experiments, radiation theory, and free air observations it is essential that a program of carefully calibrated observations of infrared radiation fluxes in the free atmosphere be made in different particular spectral regions. It is necessary that accurate vertical distributions of all essential atmospheric parameters, such as: temperature, water vapour, cloudiness (including water content and drop size distribution), ozone, dust, etc., be determined at the time of the radiation observations. The Radiation Commission recommends that this program should be pursued as completely as possible.

(3) The Radiation Commission recommends that special attention should be placed on experimental studies (including free air observations) and basic theoretical research of the problem of transfer of