WORLD METEOROLOGICAL ORGANIZATION

A brief survey of the activities of the WORLD METEOROLOGICAL ORGANIZATION relating to HUMAN ENVIRONMENT

JUNE 1970

Secretariat of the World Meteorological Organization · Geneva · Switzerland

NOTE

The designations employed and the presentation of the material in this publication do not imply the expression of any opinion whatsoever on the part of the Secretariat of the World Meteorological Organization concerning the legal status of any country or territory or of its authorities, or concerning the delimitation of its frontiers.

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INTRODUCTION

The human environment is a subject of much discussion at the present time, and, on the national level, many countries are giving great attention to environmental questions. It is, however, a multi-faceted subject and in some respects can only be treated in a satisfactory manner by an international approach.

It is therefore not surprising that the United Nations itself has decided to organize a world conference on "The Human Environment". This conference will take place in Stockholm in 1972.

The United Nations and some of its specialized agencies have long been active in programmes and projects which relate directly or indirectly to the human environment; among these is the World Meteorological Organization.

WMO's interest in the subject stems from the fact that, whatever definition one may give to the term "human environment" (and it is by no means easy to arrive at a satisfactory all-embracing definition), it is axiomatic that the atmosphere is an essential, if not the primary, element. Since the international aspects of the study of the atmosphere constitute the very *raison d'être* of WMO, it may be said that all of WMO's activities are environmental in character and that WMO is, as it were, an "environmental" organization.

Having regard to this general increase in world interest in the human environment and to the above-mentioned UN conference in particular, it seems desirable that information about existing and planned programmes in this field should be made readily available in a form suitable for specialists and non-specialists — and such is the purpose of this publication in so far as WMO is concerned. Information of this kind will, it is thought, assist in clarifying the present situation and in avoiding duplication of effort. In this connexion, the following quotation from the "Report of the Preparatory Committee for the United Nations Conference on the Human Environment" * is relevant:

> "It was the firm view of the Preparatory Committee that repetition or duplication of effort in dealing with technical environmental matters should be avoided. The 1972 Conference should make full use of work already going on or being planned in the various international organizations concerned. These activities could be taken account of in the preparations for the 1972 Conference in a way which would give them additional support, fresh impetus, common outlook and direction. This applied, for instance, to the atmospheric monitoring programmes of WMO, ..."

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* United Nations General Assembly Document A/CONF.48/PC/6, 6 April 1970.

A detailed description of WMO's activities in this field would, of course, involve an account of virtually the whole programme of WMO since, as already explained, WMO is an "environmental" organization. Such a description would therefore be long and, in the present context, unnecessarily complicated. This publication is therefore confined to a simplified general account of those aspects of the programme of the Organization which are likely to be of particular relevance to possible future discussions and decisions by national and international bodies on questions relating to the human environment.

It should be noted, however, that many of the constituent bodies of the Organization, as well as many of their subsidiary bodies, are actively pursuing programmes and projects directly related to the activities referred to in the following pages. Thus, further publications or documents on this subject will be issued as and when necessary.

It is, perhaps, hardly necessary to add in conclusion that supplementary information on present WMO activities in this field may readily be obtained from the Secretary-General of the World Meteorological Organization, on request.

MONITORING THE ATMOSPHERE

With the dangers of atmospheric pollution very much in mind, the need for the introduction of a global system of monitoring the state of the atmosphere now seems to be generally recognized. Under the aegis of WMO, the nations of the world have, in fact, established for meteorological purposes a system of monitoring the atmosphere — a system which has operated over a period of many years. A description of the main features of this system therefore seems appropriate.

As will be seen later, the system has a "built-in" flexibility which has enabled it in the past to be modified to meet changing requirements and which will permit of further additions or modifications in the future to meet further changing requirements and needs.

It was recognized about a century ago that if the science and practice of meteorology were to make significant progress, a network of observing stations would need to be established, covering as far as possible the whole surface of the globe. In addition, a means of exchanging the resultant observational data between countries and regions would be needed. For forecasting purposes and other immediate practical applications of the data, the exchanges would need to be effected promptly and at frequent intervals; for climatological purposes, the exchanges could be made less speedily. A further requirement of the system was that the observational data could be exchanged by countries using different languages, so a system of figure codes for different types of observations was necesssary. Evidently the data would need to be strictly comparable, so standardized methods and times of observation would need to be agreed upon internationally, while each station in the network would need to have an international index number to identify it in the coded messages.

The need for the creation of an international body within which the nations of the world could reach agreed arrangements on these and similar questions was soon recognized. The first international Meteorological Congress was held in 1873 in Vienna, and this occasion may be said to have marked the beginning of the International Meteorological Organization and hence of organized international co-operation in meteorology.

As the science of meteorology developed and its practical applications assumed greater significance, and as improvements in observational techniques became available, so the global observing system developed and the methods and procedures of the international body became more refined and effective. In 1951 the non-governmental International Meteorological Organization was replaced by the governmental World Meteorological Organization, a specialized agency of the United Nations.

Thus, for purely meteorological purposes, over a period of about a century, a highly effective system has been devised and developed for monitoring the atmosphere on a global scale. Let us now examine in a little more detail what this involves at the present time.

The present system comprises the main part of the WMO programme called World Weather Watch; it involves three main elements:

Global Observing System;
Global Telecommunication System;
Global Data-processing System.

The first of these ensures that meteorological observations are made every few hours (generally every three or six hours) at fixed international times at a network of stations covering as far as possible the whole surface of the globe. At present, some 8,500 stations throughout the world comprise the synoptic network of land stations. The map (Annex I) attempts to show the distribution of these stations, but the density is so great as to make it virtually impossible to identify each station on a map of the size in question.

Full details of the stations in the network and the daily observational routine at each are published in WMO publications (see publications items 1 and 2, page 11), which are issued to all countries and are kept up to date by amendments or new editions. An indication of the type of information the publication quoted under item 1 contains may be obtained from Annex II, which reproduces the entry from just one station and explains each item of the entry. It will be seen from this annex that in addition to the normal routine of meteorological observations which each of the 8,500 stations makes, the publication indicates also the other meteorological or geophysical observations which each makes. A more extensive list of 44 additional types of observations is given in the same annex together with the number of stations at which each of these additional observations is made. By way of example, a few of these are quoted below:

984 stations transmit monthly climatological means of surface elements (CLIMAT (C));
1,117 stations make evaporation measurements (EVAP);
1,252 stations make special reports of sudden changes (M/B);
32 stations make ozone observations (OZONE);
252 stations make phenological observations (PH);
9 stations make rocket-sonde observations (ROCOB);
275 stations make state-of-sea observations (SEA);
175 stations make seismological observations (SEISMO);
792 stations make soil temperature measurements (SOILTEMP);
1,610 stations make sunshine duration measurements (SUNDUR);
92 stations make tide observations (TIDE).

Any amendment to the observational programme, or the addition of information on new types of observations, can readily be incorporated in the publication and hence disseminated to all countries.

In addition to the observations from land stations, the Global Observing System provides for data to be obtained from about 5,500 merchant ships at sea, from special ocean weather ships and, in recent years, from meteorological satellites on an operational basis. Special WMO publications deal with each of these (see publication item 3, page 11).

To be of value for synoptic purposes, all these observations have to be exchanged within a few hours on a regional, hemispheric and even a global scale for certain centres. Thus, a complex global telecommunication system has to be maintained under the WMO plan. Annex III shows a schematic diagram of the WMO Global Telecommunication System which will serve to give some indication of the main features of the system.

The vast quantity of observational data now available, as well as the development of new forecasting techniques, makes it necessary for many centres to be equipped with modern data-processing equipment, including high-speed electronic computers. The World Weather Watch therefore includes a co-ordinated data-processing system for world and regional centres. The World Meteorological Centres are based in Melbourne, Moscow and Washington, and all have extensive computer facilities; the 21 Regional Meteorological Centres are scattered throughout the world and most of these are, or will shortly be, computer-equipped. In addition, many national centres already have advanced data-processing facilities.

Thus, an extensive WMO programme for monitoring the atmosphere on a global scale for meteorological purposes is in routine operation. It is supported by extensive telecommunication and data-processing facilities. It is a programme which is based upon long experience in this field but which has, nevertheless, flexibility to adjust itself to meet changing requirements.

While the above remarks are devoted mainly to the programme for synoptic observations, it should be noted that a much closer network of stations is in operation for climatological observations. The need for rapid exchange of climatological data is not so great as for synoptic observations, but there is still a need for extensive data-processing and archiving facilities. Several WMO publications deal with this subject (see, for example, item 4, page 11).

ATMOSPHERIC POLLUTION

Conscious of the present dangers which arise from pollution of the atmosphere, WMO recently adopted a plan for establishing a network of "background" stations, and all countries of the world are now being encouraged to establish such stations. The full text of the WMO resolution approving this plan is given in Annex IV.

It will be seen that the objectives of the network are to determine variations in concentrations of global atmospheric pollution and to compile atmospheric-pollution climatologies. Details of the density of the network, the siting of stations and the methods of observation are specified, while items to be measured are also given, namely: S, Cl^-, NO_3^-, NH_4^+, Na, K, Ca, Mg, pH in precipitation and SO_2, CO_2 and CO at selected stations. The content of particulate matter in the air is also to be observed.

Thus, a comprehensive WMO scheme for the measurement of the main atmospheric pollutants has already been approved, and steps are being taken to implement it. It could readily be adjusted if required.

Special mention should be made of the inclusion of CO_2 (carbon dioxide) and particulate matter in the list of substances to be measured. These are particularly important features in view of the possible effects of their variations on weather and climate. A persistent increase of CO_2 could result in a warming of the Earth's atmosphere, while an increase of particulate matter could have the opposite effect. In both cases, possible serious consequences to mankind could occur. It is important therefore that measurements of CO_2 and particulate matter be made at a network of stations and collected and analysed in a systematic manner. Such measurements are also of importance for research problems, such as the exchange of CO_2 between the atmosphere on the one hand, and the oceans and land masses on the other. It is relevant to mention in this connexion that at a later stage CO_2 measurements may be made by remote-sensing satellite instead of by ground stations.

WMO has also been co-operating with IAEA in the establishment of a global network to measure isotopes in precipitation. For the past seven years, more than 100 weather stations in 67 countries and territories have been collecting monthly precipitation samples for the WMO/IAEA Isotopes-in-Precipitation Network. Analyses of the oxygen and hydrogen isotope content from these samples have been used to answer successfully, and sometimes uniquely, questions and problems in the fields of meteorology, oceanography and hydrology. Isotope data have been used for such diverse purposes as study of the structure of hurricanes and for estimating the volume of the ground-water reservoir of a volcanic island.

As far as high-concentration air pollution in cities and industrialized areas is concerned, WMO is engaged in studies of the most suitable techniques for analysing the dispersion of pollutants over both short and long distances. A Technical Note is under preparation describing modern techniques and models applied in various countries for analysing dispersion over short distances. Examples of warning systems based on forecasting of air-pollution potential will also be described.

For reasons such as these, WMO has taken a great interest in the whole question of atmospheric pollution and has very recently published under the title *Meteorological Aspects of Air Pollution* a new WMO Technical Note containing papers by several acknowledged experts in this field (see item 5, page 11).

Many of the WMO constituent bodies have the subject under constant study. The WMO Executive Committee has appointed a group of experts to advise it on this subject.

The WMO Commission for Climatology has also given attention to pollution questions. The commission considers that there are climatological aspects to be taken into account in the handling of data on local air pollution and that in view of the facilities which national Meteorological Services have for data-processing, these same facilities might well be used for handling data on local air pollution. The commission also recommends that the collection of climatological data and the collection of data on atmospheric components be co-ordinated at the national level.

The same commission has endorsed the view that climatologists, by defining air-pollution potentials, have an important role to play in planning appropriate use of land. Many studies are under way on such subjects as the use of climatological data for assessing the probability of air pollution in connexion with land development.

Another WMO technical commission, dealing with instruments and methods of observation, is at present studying developments in the field of instrumentation for atmospheric pollution measurements. Another study by the same commission relates to requirements for low-level soundings of the atmosphere needed for the assessment and forecasting of air-pollution potential.

The WMO Commission for Agricultural Meteorology has studied the meteorological aspects of air-pollution damage to agricultural crops, and WMO has published the results in a Technical Note entitled *Air Pollutants, Meteorology, and Plant Injury* (see item 6, page 11).

In 1965, a WMO scientific advisory committee considered a report on possible atmospheric pollution at high levels by rocket effluents and by other experiments. It concluded that generally a world-wide change of the upper atmosphere is beyond man's capability in the foreseeable future. It was felt, however, that further studies were needed into the effects of such exotic pollutants as aluminium, zirconium and cobalt. Concern was also expressed that the lithium concentration may change to an extent which would preclude its use as a tracer in large-scale atmospheric circulation experiments. The committee considered that no special action by WMO was needed at that time but that the Organization should keep abreast of developments in this field. The subject is therefore under study by the Commission for Atmospheric Sciences.

Thus, in addition to the pollution-monitoring system referred to above, WMO is actively engaged in many other aspects of air pollution.

URBAN CLIMATOLOGY

The process of urbanization, now taking place in almost all countries, gives rise to local modifications in the weather and climatic conditions. These consequences of urbanization fall within a relatively new field of study called "urban climatology". The heat generated in an urban area and the influence on incoming and outgoing radiation caused by the local pollution it creates may result in important temperature and wind-field changes. It is possible also that precipitation may increase due to the increase of condensation nuclei.

Closely related to this field of study is that known as building climatology, in which climatological knowledge and methods are applied to assist in solving problems of the planning of new urban areas and the design of buildings, having regard to the factors of economy and comfort.

WMO has had these subjects under discussion and has just published the proceedings of a symposium on Urban Climate and Building Climatology which was held jointly with the World Health Organization in Brussels in 1968 (see items 7 and 8, page 11).

Another related subject is that of the management of water supplies for urban and agricultural areas. The WMO Commission for Hydrometeorology has, for instance, given guidance in questions related to potable water supplies, the building of hydro-power schemes, the fostering of more rational systems of irrigation, the provision of flood-forecasting procedures and sounder design criteria for hydraulic structures.

A related subject is that of the effects or influences of weather and climate on the health of the human race. WMO is, of course, not competent to discuss medical questions although some joint projects have been held with the World Health Organization; one of these is mentioned above. Reference should, however, be made to an important and substantial survey of human biometeorology recently carried out by WMO and published as a WMO Technical Note bearing that title (see item 9, page 11).

WEATHER AND CLIMATE MODIFICATION

WMO has had the subject of weather and climate modification (whether by intention or inadvertently) under consideration for many years. As regards weather modification, a recent important contribution to the literature on this subject is a WMO Technical Note entitled *Artificial Modification of Clouds and Precipitation* (see item 10, page 11). This Note includes a review of the present situation as regards the possibilities of efficient control of precipitation, fog dissipation and hail prevention. There are, however, other aspects of this subject which need further study — such as the possibility of changing the energy of hurricanes by cloud seeding or altering the paths of tornadoes. The reduction of evaporation losses and the local increase of cloudiness due to condensation trails of high-flying aircraft are other examples of problems requiring further study. WMO is keeping itself abreast of developments.

Turning now to climate changes, it is well known that climate, locally and over large areas of the earth, fluctuates both from natural causes built into the sun/atmosphere/ocean system and from influences caused by man. Such fluctuations may have important environmental repercussions, as they may cause changes in the basic conditions for many vital human activities — such as agriculture, water-resource development, industry, etc. WMO is interested in promoting increased understanding of the fundamental mechanisms which cause these fluctuations, in order, hopefully, to achieve in due course methods for forecasting them. In this context, it is particularly important to investigate to what extent a change of climate of a certain area of the globe is due either to natural conditions or to influence of human activities, or both. The continuous expansion of arid and semi-arid conditions in some areas of the globe on marginal desert regions is an example of a climatic change where man's influence (for instance, by bad land-management) must be considered in relation to a possible natural change of climate. A WMO Technical Note on this problem is under preparation. Other influences by man, having similar consequences, have been mentioned above in connexion with air pollution and urbanization.

This whole problem is under continuous study by the WMO Commissions for Climatology and Atmospheric Sciences. A special working group was recently established by the Commission for Climatology to study the problem of climatic changes and its practical consequences to man.

POLLUTION OF THE OCEANS

Another environmental problem which is now of great significance is the pollution of the oceans. Meteorology is making a considerable contribution to the methods being developed to minimize the consequences of such pollution. This is because conditions at and near the sea surface are greatly influenced by weather conditions and *vice versa*. Indeed, the subjects of meteorology and physical oceanography are so close in some respects that it is difficult to draw a line of distinction between them.

Forecasts are made when necessary in order to determine the dispersion and transport of surface pollutants by natural physical processes. The movement and behaviour of pollutants, the densities of which are less than that of water (such as oil), are significantly affected by surface wind and waves. Methods of forecasting of these environmental parameters have therefore been developed by the meteorologist, using conventional and computer techniques.

By introducing other factors (ocean currents, upwelling, etc.) which require close co-ordination between the meteorologist and oceanographer, the assessment of the dispersal of pollutants can be made much more effective. To this end, an expanded synoptic observational system is being considered within the framework of the World Weather Watch and the Integrated Global Ocean Station System.

Research is also taking place into the transport and deposit of pollutants through the atmosphere into the oceans through the effect of high-level winds and rain. Reasonable estimates can be made of the life history of impurities released from industrial or other man-made pollutants with the aid of surface and upper-air charts. In order to ensure that the capabilities of the meteorologist in this field are adequately utilized, WMO has become co-sponsor of a joint IMCO/FAO/Unesco/WMO Group of Experts on the Scientific Aspects of Marine Pollution. In April 1969, WMO, through its Advisory Group on Oceanic Research, took part in a joint working party, together with committees from FAO and ICSU, in preparing a report on "Global Ocean Research". This report served as a recommended basis for the scientific content of the "Long-term and Expanded Programme of Ocean Exploration and Research", in which the study of marine pollution problems is an important objective.

RELEVANT WMO DOCUMENTS AND PUBLICATIONS

As indicated in the text the following information is included as annexes:

Annex I — Map showing WMO global network of surface synoptic stations;
Annex II — Selected information on the WMO global monitoring system;
Annex III — Schematic diagram of the WMO Global Telecommunication System;
Annex IV — Resolution 11 (EC-XXI) — Establishment of a network of stations to measure background pollution.

For convenience, the few publications which have been referred to in the text as being directly relevant to the discussion are listed below:

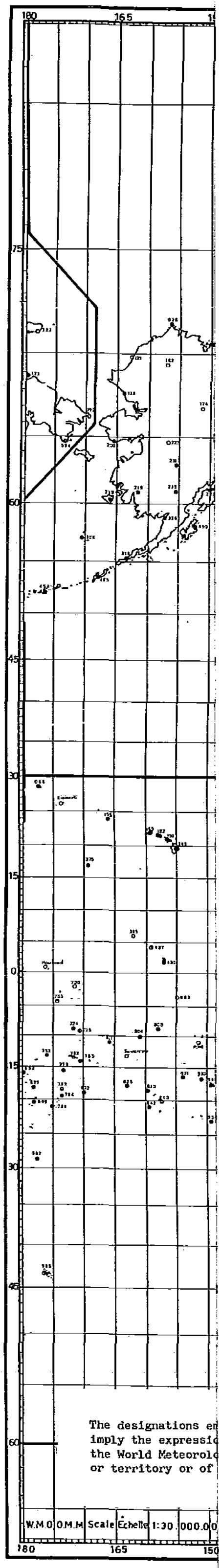
1. Weather Reporting: Stations, Codes and Transmissions (WMO – No. 9.TP. 4)
   Volume A — Observing Stations
   Volume B — Codes
   Volume C — Transmissions
   Volume D — Information for Shipping
   Coastal radio stations accepting ships' weather reports
   (reprinted from WMO Publication No. 9. TP. 4, Volume D, Part B)
2. Basic synoptic networks of observing stations (WMO – No. 217. TP. 113)
3. International list of selected and supplementary ships (WMO – No. 47. TP. 18)
4. Data processing for climatological purposes (Technical Note No. 100, WMO – No. 242. TP. 132)
5. Meteorological aspects of air pollution (Technical Note No. 106, WMO – No. 251. TP. 139)
6. Air pollutants, meteorology, and plant injury (Technical Note No. 96, WMO – No. 234. TP. 127)
7. Urban climates (Technical Note No. 108, WMO – No. 254. TP. 141)
8. Building climatology (Technical Note No. 109, WMO – No. 255. TP. 142)
9. A survey of human biometeorology (Technical Note No. 65, WMO – No. 160. TP. 78)
10. Artificial modification of clouds and precipitation (Technical Note No. 105, WMO – No. 249. TP. 137)

The above list is, of course, only a very small extract from the full list of WMO publications.

CONCLUSION

As explained in the introduction, this short publication is intended only as a brief review of the activities of WMO in certain fields related to the human environment. It is in no way a comprehensive account, its aim being to produce a short and easily readable account of this facet of WMO's programme. To those who are not familiar with WMO's activities, the publication may be informative and instructive; to others it may serve as a means of presenting known information in a somewhat different light.

The general interest in the subject of the human environment is so great that it may confidently be predicted that the WMO programme in this field will develop still further. It is fortunate that the next quadrennial session of the WMO Congress will be held in 1971, since it will give the opportunity for the highest body to review the whole policy and programme of the Organization in the very near future.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ANNEX II

SELECTED INFORMATION ON THE WMO GLOBAL MONITORING SYSTEM

Note: This information is a small extract from WMO Publication No. 9.TP.4 referred to in item 1, page 11.

The type of information contained in the above publication, for the 8,500 land stations which operate within the WMO system, is demonstrated by the accompanying extract for just one station.

1	2	3	3	4	4	5	6								7	8				9
INDEX NUMBER	NAME	LAT.	LONG.	ELEVATION		PRESSURE LEVEL	SURFACE OBSERVATIONS								OBS.H OBS.S	UPPER-AIR				OTHER OBSERV. AND REMARKS
				HP	H/HA		00	03	06	09	12	15	18	21		00	06	12	18	
43149	P VISHAKHAPATNAM	17 43N	83 16E	3	3		X	X	X	X	X	X	X	X	H2230-1130 S06,07,08	RW	P	RW	P	WT;A;C;CLIMAT(CT);EVAP;M/B;NEPH;NOCTRA;SEA;SEISMO;SUNDUR;TIDE;TOTRA

The explanation of the entry in each column is as follows:

Column 1: *Index number.* — The WMO index number permits the identification of the station at which the observation has been made.

Column 2: *Name.* — The name of the station is included under this heading.

Column 3: *Latitude and longitude.* — The latitude and the longitude are given in degrees and minutes.

Column 4: *Elevation.* — This column indicates:
HP: The elevation of the station in metres (level of barometer). H or HA in metres: H, elevation of the ground (average level of terrain in immediate vicinity of station); HA, official altitude of the aerodrome.

Column 8: *Upper-air observations.* — RW indicates radiosonde/radiowind observations; i.e., observation of atmospheric pressure, temperature and humidity in the upper air, as well as of upper wind, obtained by electronic means. P indicates pilot-balloon observations; i.e., observations of upper wind obtained by optical tracking of a free balloon. Hours are given in GMT.

Column 9: *Other observations and remarks.* — This column provides information on additional observations taken at the station in question. In the example chosen, the additional observations or remarks are as follows:

WT:	Upper-wind observations made by radiotheodolite
A:	Aerodrome
C:	Coastal station

Column 5: *Pressure level.* — This column indicates the level to which the pressure readings are reduced. No entry (as in the case shown) means that the pressure is reduced to sea-level.

Column 6: *Synoptic surface observations.* — The symbol X means that surface observations are made regularly at the time indicated; hours are given in GMT.

Column 7: *Hourly observations (H) — Half-hourly observations (S).* — This column indicates the hourly and half-hourly observations made at the station. Hourly observations are shown by the letter H, followed by the period of the day during which they are made. Similarly, half-hourly observations are shown by the letter S, followed by the period of the day during which they are made.

CLIMAT (CT):	Station for which monthly climatological means of both surface and upper-air elements are transmitted
EVAP:	Evaporation measurements
M/B:	Station making reports of sudden changes
NEPH:	Nephoscope observations
NOCTRA:	Nocturnal radiation measurements
SEA:	State of sea observations
SEISMO:	Seismological observations
SUNDUR:	Sunshine duration measurements
TIDE:	Tide observations
TOTRA:	Total radiation measurements

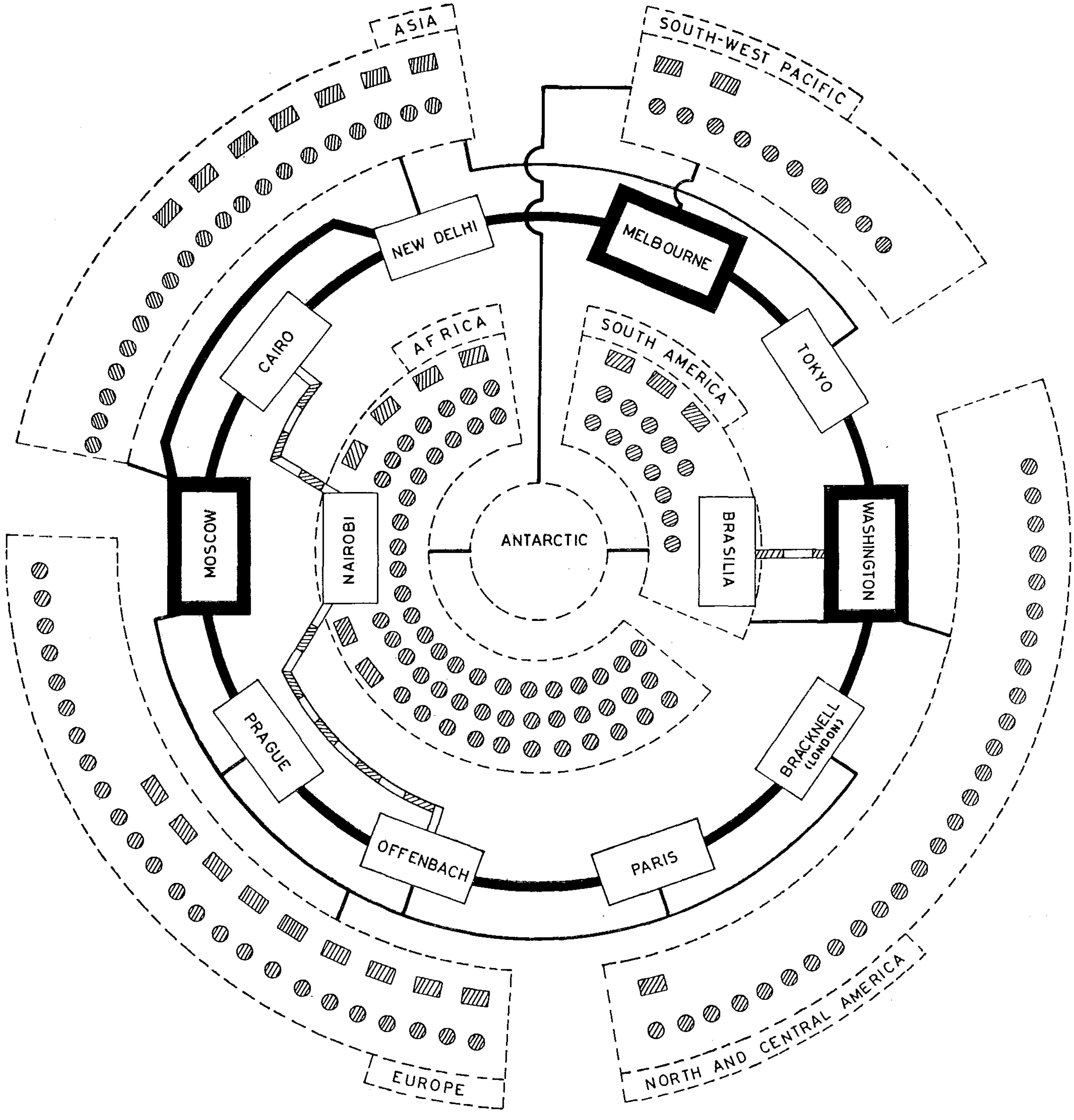
The full list of additional observations is, however, much longer than the list given above and more complete information is provided on the next page. The number of stations at which each particular type of observation is taken is also shown.

Abbreviation or symbol	*Meaning*	*Number of stations*
AGRIMET	Agrometeorological station	55
ATMEL	Atmospheric electricity measurements	15
ATMOS	Atmospherics location by narrow-sector direction-finder	7
AUT	Automatic station or observation made by automatic equipment	13
AUR	Visual aurora	43
CLIMAT (C)	Station for which monthly climatological means of surface elements are transmitted	984
CLIMAT (T)	Station for which monthly climatological means of upper-air elements are transmitted	93
CLIMAT (CT)	Station for which monthly climatological means of both surface and upper-air elements are transmitted	306
EVAP	Evaporation measurements	1,117
H	Hourly observations	The letters are followed by figures showing the hours during which the observations are made (e.g. H 00-24 or S 0630-1830)	3,275
S	Half-hourly observations	
HU/FC	Hurricane, tropical cyclone or typhoon forecast centre	21
ICE	Ice observations	79
IONOS	Ionospheric observations	7
LIT	Lightning counter	18
MAGNET	Magnetic observations	17
METAR	Aviation routine weather report	105
M/B	Station making reports of sudden changes	1,252
MONT	Observations of cloud below the level of the station	92
NEPH	Nephoscope observations	414
NLC	Noctilucent cloud	58
NOCTRA	Nocturnal radiation measurements	10
OZONE	Ozone observations	32
PH	Phenological observations	252
RAD	Radiation measurements	52
RAREP	Weather radar report	9
RECCO	Aircraft reconnaissance flights	6
ROCOB	Rocket-sonde observations	9
RSD	Radar storm and meteorological phenomena detection	234
SEA	State-of-sea observations	275
SEA/SWELL	Sea and swell observations	75
SEATEMP	Sea temperature measurements	106
SEISMO	Seismological observations	175
SFERIC	Atmospherics detection by cathode-ray direction-finder	29
SKYRA	Sky radiation measurements	48

Abbreviation or symbol	*Meaning*	*Number of stations*
SNOW	Snow survey	105
SOILTEMP	Soil temperature measurements	792
SOLRA	Solar radiation measurements	231
SPECI	Aviation selected special weather reports	193
SUNDUR	Sunshine duration measurements	1,610
SWELL	Swell observations	8
TIDE	Tide observations	92
TI/WA/FC	Tidal wave forecast centre	7
TOTRA	Total radiation measurements	211

ANNEX III

SCHEMATIC DIAGRAM OF THE WMO GLOBAL TELECOMMUNICATION SYSTEM



The diagram shows the centres on the Main Trunk Circuit, which circles the Earth.

The three centres denoted by the symbol [symbol] are the World Meteorological Centres while those denoted by the symbol [symbol] are Regional Telecommunication Hubs on the Main Trunk Circuit and on its branches.

The telecommunication links between these centres and also the links to the respective regions are shown. In the space representing each region the Regional Telecommunication Hubs are shown by the symbol [symbol] and the National Meteorological Centres by the symbol [symbol], the number of symbols in each representing the number of centres in that region.

The designations employed and the presentation of the material on this map do not imply the expression of any opinion whatsoever on the part of the Secretariat of the World Meteorological Organization concerning the legal status of any country or territory or of its authorities, or concerning the delimitation of its frontiers.

ANNEX IV

RESOLUTION 11 (EC-XXI)

ESTABLISHMENT OF A NETWORK OF STATIONS TO MEASURE BACKGROUND POLLUTION

THE EXECUTIVE COMMITTEE,

NOTING:

(1) Resolution 31 (EC–XVIII),

(2) Paragraph 9.11.1 of the General Summary of CAe–IV,

(3) Recommendation 21 (69–CAS),

CONSIDERING:

(1) The increase of air pollution on a global scale,

(2) The need for making measurements of pollution concentration levels in areas of relatively clear air, commonly called "background" pollution measurements,

(3) That although some regional networks of background stations have been operating since the International Geophysical Year, these are inadequate to solve the global problem,

RECOMMENDS that each Member establish one or more stations to measure background pollution in accordance with the programme as outlined in the annex to this resolution;

DIRECTS the Secretary-General:

(1) To find Permanent Representatives of Members willing to accept responsibility for the central collection and publication of the data from the network, under WMO sponsorship, and to conclude suitable agreements with them as soon as possible;

(2) To provide advice, as required, to Members which accept such responsibility in initiating and carrying out the work;

(3) To assist Members lacking adequate laboratories in finding facilities in other countries to analyse their samples;

(4) To inform Members of any additional procedures to be followed in implementing this resolution as soon as any further negotiations have been satisfactorily completed;

INVITES the president of CIMO to study the instrumental aspects of the observations listed under IV.3 of the annex to this resolution and submit a report to the next session of the Executive Committee.

ANNEX TO RESOLUTION 11 (EC-XXI)

ESTABLISHMENT OF A NETWORK OF STATIONS TO MEASURE BACKGROUND POLLUTION

PROGRAMME

I. *Objectives of the network*

1. To determine variations in concentrations of global atmospheric pollution.
2. To compile atmospheric pollution climatologies.

II. *Siting of stations*

1. Background stations should *not* be established in or near cities or industrial areas. They should be located in rural surroundings sufficiently far away from built-up areas to be uninfluenced by local fluctuations in pollution concentrations.
2. A background station should be located at or near a principal climatological station.

III. *Density of network*

It is proposed that each Member establish at least one station. A minimum density of one station per 500,000 km^2 is recommended. Where a country has several climatic regions a higher density would be necessary. Stations should be distributed in such a way that observations from each climatic region are available.

IV. *Methods of observation*

1. A background station should make the following observations:
   (*a*) Monthly samples of precipitation;
   (*b*) Measurements of the turbidity of the atmosphere (preferably three times daily).
2. These observations should be supplemented by:
   (*a*) Climatological observations;
   (*b*) Measurements of solar radiation (selectively in the ultra-violet and visible region).
3. When possible, other types of observations should be made as follows:
   (*a*) Monthly samples of dry deposition;
   (*b*) Weekly average concentrations of SO_2 and CO_2 in air;
   (*c*) Observations of selected gases in the atmosphere, for example CO and oxides of nitrogen;
   (*d*) Observations of pollutants by indirect techniques such as lasers;
   (*e*) Observations of the earth's albedo from meteorological satellites;
   (*f*) Observations of pollutants from mountain stations and aircraft.

V. *Analysis of samples*

Precipitation and dry deposition samples should be analysed for S, Cl^-, NO_3, NH_4, Na, K, Ca, Mg, pH, alkalinity or acidity and electrical conductivity.

VI. *Central collection and publication of the data*

Members should send their data regularly to a central data centre in accordance with the procedures established by the Secretary-General.