

ANNUAL REPORT 1963-64

Division of Meteorological Physics

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DIVISION OF METEOROLOGICAL PHYSICS

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I INTRODUCTION

A greater understanding of the fundamental processes of meteorology and the application of this knowledge to problems of economic importance to Australia constitute the Division's two main objectives. In the case of the former, the group working in Dynamic Meteorology, while directing its attention primarily to the basic problems of atmospheric mechanics, gives prominence to matters of particular interest to Australia. In Applied Meteorology the accent is on agriculture and the efficient use of water. It is in such spheres that many of the results and techniques which stem from the work of the Division's major field of interest, atmospheric turbulence and exchange processes, can be readily applied.

II DYNAMICAL METEOROLOGY AND THE GENERAL CIRCULATION

Fronts, Meso-scale Circulations and Jet Streams

Investigations of meso-scale disturbances in the wind field are being continued and the case of an ideal vortex embedded in a fluid subject to shearing flow examined. It is found that in some cases the relative streamlines which result are similar to those observed in the neighbourhood of atmospheric windshear lines. These systems decay under the influence of drag forces in a manner which depends upon the distribution of vorticity in the mass moving with the system, and in the case of a flattened vortex should be accompanied by a

deceleration. Examples of such regimes were detected recently by means of serial wind and temperature soundings made at Woomera in collaboration with the Weapons Research Establishment, the Bureau of Meteorology, and the University of Melbourne. At the same time further insight into the structure of winter depressions and frontal disturbances, both single and multiple, was obtained. The multiple system appears to consist of a leading baroclinic zone which precedes any immediate change at the surface, and could easily remain undetected by routine observations. Succeeding members of the system were geostrophically unbalanced, and had the characteristics of a squall line or surge, while total energy content decreased only gradually as the systems passed over. Relative streamlines, as in the model vortex, show a trajectory boundary between air that has ascended from lower levels and that which has descended from the upper troposphere. This explains the frequent occurrence of clear cut edges to frontal cloud bands.

Detailed measurements of the high level subtropical jet stream have revealed unexpected but systematic cross flow patterns; tentatively explicable in terms of shearing stresses. The magnitude of the stresses suggests a causative relation with clear air turbulence and this in fact has been observed at levels where the Richardson number was very small.

The low level nocturnal jet, a phenomenon of continent-wide occurrence, and hitherto neglected in Australia, was observed at Woomera last year and found to be a prevalent feature of airstreams with a continental fetch. Some peculiarities of its structure are still unexplained and require further investigation.

As an additional aid to the meso-scale work use is being made of the weather surveillance

radar - technical details of which appear elsewhere in this report. By means of this equipment the distribution, dimensions and velocity of rain echoes are being examined in an endeavour to locate preferred regions and determine the influence of the vertical wind shear on rain clouds. With further development of the radar it will be possible to measure the vertical as well as the horizontal extent of echoes, and with this in view ground instruments to record the relevant meteorological variables are being installed in the Melbourne area to augment the existing network.

Association between Rainfall and Sea Surface Temperatures

A proper understanding of many phenomena, such as trends, cycles and large scale anomalies in the weather elements must depend, particularly in the southern hemisphere, on a knowledge of the behaviour of sea surface temperatures. Although at present the latter data are rarely available in historical form, a series of sea temperature soundings obtained from the inshore waters of the New South Wales coast over a period of some fifteen years has permitted a limited pilot study to be made.

A definite correlation between sea surface temperature and coastal rainfall in this region has been established on a monthly basis. A detailed examination of the persistence properties of each series and of the lag correlations between them reveals evidence of two separate processes in operation. Air flowing over warmer water will be moister, or more likely to produce convective rainfall on reaching the coast: such a process has potential forecasting value, owing to the greater persistence of sea temperature. In addition, there is good reason to believe that had temperatures further out to sea been available (these would have been more representative of trajectories) even higher

correlations would have been found. The second process relates to the additional drift (or Ekman current) set in motion by onshore, rainbearing winds and tends to give rise to a correlation between rainfall and subsequent sea surface temperatures.

Large-scale Weather Relationships

It is of obvious importance to gain greater understanding of the processes which govern long term weather relationships both in space and time. The existence of relationships between various meteorological parameters in the Indian and Pacific Oceans has been recognised for a number of years in a phenomenon known as the "Southern Oscillation". Basically this appears to consist of a mass flow of air between the two oceans, high pressure in one region being associated with low pressure in the other. Further, within this oscillation there exists a complex of relationships, both lag and contemporaneous, between monthly and seasonal values of pressure, temperature and other meteorological parameters. Some of the relationships claimed have been re-examined using data from recent decades, the results confirming a tendency for pressure anomalies of opposite sign to occur at the same time over both oceans. It appears also that the North Pacific plays a less important role than was formerly supposed. While there has been a decline in persistence of anomalies and in some lag relationships, the important lag correlation between the South East Pacific and Indian Ocean pressures still holds. The changes observed are additional confirmation of a minor secular change or fluctuation commencing in the 1920s and referred to in a previous report.

From an examination of regression rather than correlation coefficients it has been found that the sub-tropics and lower middle latitudes of the

Indian Ocean-Australian region are at least as important as the tropics in the mass exchange. This raises important questions as to the physical processes determining the oscillation. Frequently the word "oscillation" has been taken to mean some regularity in the occurrence of anomalies, and various "periodicities" ranging usually from two to seven years have been proposed. However, significance tests coupled with analysis of subsequent data indicate there is not sufficient basis for these periodicities, their apparent existence probably being due to sampling fluctuations in random but often persistent series.

Further to the problem of long range weather relationships in the Southern Hemisphere, it is important to explore the processes and the mechanics of what is referred to as a "vacillation" in the strength of the hemispheric westerly winds. Although TIROS weather satellite observations are proving to be a valuable aid in analysis, the scarcity of conventional observations throughout much of the hemisphere hampers any systematic investigation of vacillation and associated phenomena. However, by making use of data from the International Antarctic Analysis Centre together with information collected during the International Geophysical Year it is feasible to study the heat and mass exchange over Antarctica and its surroundings. A re-examination of the various factors involved is also in progress.

Theoretical Studies

The effect of the earth's rotation on shallow water motions in other than axially symmetric containers has not received much attention, possibly because the general behaviour of the solutions to the equations for such systems are relatively difficult and not easily understood without resort to extensive numerical computations. Simple solutions however

have been found in the case of the elliptic paraboloid. A basin of this type is just as good an approximation to many naturally occurring bodies of water as is, for instance, a rectangle of constant depth (favoured by some earlier theorists). Furthermore, because of the absence of vertical boundaries in such a container, the theory can be extended to describe the behaviour of a dome of cold air in the atmosphere or "lenses" of warm water at the ocean surface. The gradual diminution of depth towards the periphery of the liquid produces dynamical effects similar to those due to the sphericity of the earth and certain solutions are closely akin to "planetary waves".

When the earth's rotation is neglected the modes of motion fall clearly into two classes. The first consists of oscillatory modes (gravitational oscillations) which leave the depth unchanged along a system of nodal lines, and the second consists of steady rotational modes which leave the depth unchanged everywhere. The most striking effect of the earth's rotation on the oscillatory modes is the disappearance of the nodal lines which, in general, are replaced by isolated "amphidromic" points where the depth is unchanged throughout the motion. On the other hand the earth's rotation converts the steady rotational modes to low frequency oscillatory motions that are akin to large scale motions in the atmosphere.

III GENERAL MICROMETEOROLOGY

Two further field expeditions were made during the year, one to the Division's former meteorological site at Kerang, N. Victoria, and the other to an improved location at Hay, N.S.W. Previous findings that the essential difference between the vertical transfer of heat and momentum is due to the discriminating effects of buoyancy were confirmed. However an attempt to determine the

relationship between the flux of water vapour and that of heat and momentum was less successful. The difficulty lies in the extreme accuracy of instrumentation required for the proper determination of the humidity profile. Improved equipment for this purpose is under construction and will be used on an expedition in the coming spring.

An analysis has been made of some wind profiles obtained from measurements made on a 1,200 ft. tower in Texas (U.S.A.), with the object of deriving information on the variation of turbulent shearing stress with height. Whilst this primary aim was not achieved, interesting results were obtained throwing some measure of doubt on the common assumption that the shearing stress is necessarily parallel to the velocity gradient. Further work to investigate this point is being planned and instrumentation developed to permit the direct measurement of shearing stress at heights greater than those so far employed.

A theoretical study of the time response characteristics of fine wire wet and dry bulb resistance thermometers has been made with particular reference to the use of these thermometers in psychrometry. With currently available methods of construction, wet bulb thermometers frequently have a much greater lag in response than the dry bulb thermometers with which they are coupled, and it has been shown that in the detection of moisture fluctuations at certain frequencies, very large phase lags (approaching 270°) can occur.

An improved version of the Spectrum Slicer, the instrument which, from an unsteady platform such as a ship, is capable of obtaining the vertical fluxes of heat and momentum in the air over the sea has been completed and field tested over land and from the end of a jetty in Port Phillip Bay. In an extensive series of tests at Kerang in October 1963 and at Hay in March 1964 flux

measurements obtained by the now standard techniques used for land surfaces were made simultaneously with observations from the Spectrum Slicer. These data were then used to relate flux values to the energy of the high frequency turbulence and the resulting empirical constant applied to the measurements made over the sea. The computed drag coefficients were in good agreement with the values published by workers who have used other methods in similar near shore situations. Since the motions of a ship are relatively low in frequency as compared with the frequencies under investigation, there is good reason to suppose that the method will give reliable flux values for open sea conditions - for which information is very scanty. Sea trials are expected to follow final tests on a field expedition in the early spring.

The Evapotron, the instrument which measures automatically the evaporation and sensible heat flux over natural surfaces, has now been brought to an advanced stage of development. It has been used in two recent field expeditions (results of which appear elsewhere in this report) and technicians from the Chemical Research Laboratories and the University of California have spent some months with us and constructed instruments to our design. A technical report of the instrument is in preparation.

IV AGRICULTURAL METEOROLOGY AND EVAPORATION

The Lysimeter Installation

The lysimeter installation described in previous annual reports and comprising twelve sunken soil containers, each weighing 6,000 kgm. and having a surface area of 2 sq. metres, has been used during the past year to study in detail the effect of soil moisture depletion on pasture evaporation. Two experiments have been conducted, one lasting three

weeks in mid-summer and the other lasting seven and a half weeks in the autumn. The irrigated pasture, a little more than one acre in area, was divided equally in two, the irrigation of one half being suddenly stopped, and that of the other half continued so as to maintain evaporation at the potential rate. Soil moisture changes at various depths in both sections of the experimental area as well as in some of the lysimeters were followed by means of tensiometers, Buoyoucos gypsum blocks and a neutron moisture meter.

In the first experiment, measurements in the frequently irrigated area showed that the soil moisture content was always at field capacity at all depths. In the drying area, this state was maintained to within 40 cm. of the surface, showing that there was no water removal by the grass roots below this depth. At the end of the trial, however, the total soil moisture in the upper 40 cm. had been depleted by about 40% whilst that of the top 20 cm. had reached the permanent wilting percentage. Considered on a daily basis the evaporation rates in the drying area started to differ significantly from the potential rate after 5 days, and by the end of the trial were less than 40% of the potential rate.

In the second trial later in the season, lower evaporation rates prevailed and potential evaporation was maintained in the drying area for about four weeks. By the end of the trial - terminated by heavy rain - it was still a little more than 50% of the potential rate, even though 25% more water had been extracted from the soil than in the first trial.

These trials support the opinion that a reduction in evaporation rate commences when the soil moisture content is still well above the wilting percentage, and that for a given moisture content, the reduction is more pronounced when the atmospheric demand on evaporation is greater.

It has become apparent that an inexpensive, robust and reliable form of lysimeter for use as a general field instrument rather than as a highly specialised research tool would be of considerable value in agro-meteorological investigations. With these points in mind a simple hydraulic system is being developed and the results to date are encouraging.

Other Evaporation Studies

There is observational evidence that open water surfaces frequently have a thin thermal boundary layer, the water right at the surface being cooler than that just below by up to 1°C . Since current methods of evaluating lake evaporation require measurement of the true surface temperature, whereas in practice the temperature is measured just below the surface, a correction for the presence of the skin should strictly speaking be made. Fortunately, the effect on overall evaporation is likely to be small, since the surface cooling is smallest when the wind is strongest, which is generally when the evaporation is greatest. Knowledge of the skin effect is not yet sufficient to allow an accurate correction to be made; as a guide however an elementary theory is now being completed which will provide an estimate of the thickness of the layer (generally 1 to 2 mm.) and the temperature difference across it, in terms of the meteorological conditions.

Last year's report referred to a new procedure for the assessment of lake evaporation from pan observations together with measurements of atmospheric humidity and lake temperature. This method has now been tested using published data from the well known Lake Hefner (U.S.A.) investigation of 1950/51, and the results compared with those obtained independently by the American workers using the heat budget method. Data were available for

eight periods totalling 76 days. Comparison between the two sets of values for the individual periods (mostly 8 or 9 days) shows a standard deviation of 11 per cent; over the whole 76 day period the total evaporation using the new method agrees with that obtained by the heat budget technique to well within the estimated standard error of 4%. It is therefore expected that from high quality daily pan observations this new approach will provide values of monthly lake evaporation correct to within 10 or 15%.

Blue Mould in Tobacco

Protective fungicidal sprays are now being used to an increasing extent to control the spread of blue mould in tobacco. Normally these are applied as a weekly cover spray, but it is patently uneconomic in terms of both material and manpower to spray when meteorological conditions are unfavourable for the production of spores.

With financial assistance from the Central Tobacco Advisory Committee and in co-operation with the Tobacco Research Station of the Victorian Department of Agriculture a test programme was instituted in 1962. In this experiment daily weather forecasts provided by the Weather Bureau were used to control the application of fungicide to a test crop. The results obtained were sufficiently encouraging to warrant continuing the trial during the 1963/64 season: unfortunately no blue mould at all was experienced during this season, so no positive results were obtained. The experiment continues during the coming season.

V RADIATION

To obtain information on radiation quantities over varying types of terrain and under differing conditions of cloud and elevation of the

sun, a survey has been commenced using radiometers mounted on an aircraft. The quantities being measured are net radiation and the upward and downward components of short wave radiation. The records are being correlated with the photographs obtained from two vertically pointing cameras (one upward, one downward) mounted on the aeroplane. To date, through the ready co-operation of the R.A.A.F., records have been secured on three flights and further flights are planned.

A polythene shielded black disc temperature element has been developed for attaching to the standard Australian radio-sonde. At night this will give observations from which the radiative temperature of the earth, atmosphere and clouds may be deduced. It has been possible to devise a system whereby the signal from the temperature element may be transmitted to the ground recorder without interfering with the normal operation of the radio-sonde. In this way and in conjunction with the Commonwealth Meteorological Bureau, it is hoped to secure observations from a number of radio-sonde stations and so make feasible the study of outgoing terrestrial radiation on a synoptic basis. Some proving flights have already been made and successful recordings obtained.

A new form of net-radiometer has also been devised which can be carried aloft by the standard German radio-sonde. This will enable the variation of net-radiation with height to be studied on selected occasions.

Measurements of the long wave radiation from clear skies were made at Hay under conditions of high temperature and very low humidity (dew point approximately 0°C). The results obtained are in very good agreement with the empirical formula proposed earlier relating incoming radiation to 6th power of the low level (screen) air temperature alone.

Radiative flux divergence measurements at three heights in the lowest 15 metres of the atmosphere during clear nights have been continued, with some refinement of measuring and recording equipment. Radiation ground temperatures are now being obtained with improved accuracy, and measurements of temperature gradient have been extended to a height of 32 metres.

While accurate short wave calibration of radiation instruments by solar beam requires approximately two hours of clear sky at mid-day, records taken at Aspendale show that on an average there are only 10 such working days per year. This is insufficient for calibrating the increasing numbers of instruments being submitted for N.A.T.A. certification, and accordingly a method of calibration in the laboratory using a high intensity artificial light source is being developed. To provide a working area over which the intensity of illumination is uniform an oscillating mirror is used. Results so far are encouraging and the work continues.

An improved form of the equipment for measuring the radiative heat exchange of biological subjects has been constructed and is at present on loan to the School of Public Health and Tropical Medicine, Sydney University, where studies of the heat balance of human beings are being carried out.

As part of the Division's contribution to the International Indian Ocean Expedition, equipment for recording and integrating various radiation quantities has been provided for Cocos Island. After installation it was adjusted and checked by a member of the Division who broke his journey while en route to Europe.

VI OZONE AND UPPER ATMOSPHERE STUDIES

Observations of the total amount of ozone and calculations of its distribution in the atmosphere by the "umkehr" method, using Dobson spectrophotometers, are continuing at Aspendale and, in collaboration with the Bureau of Meteorology and the Australian National Antarctic Research Expedition respectively, at Brisbane and Macquarie Island.

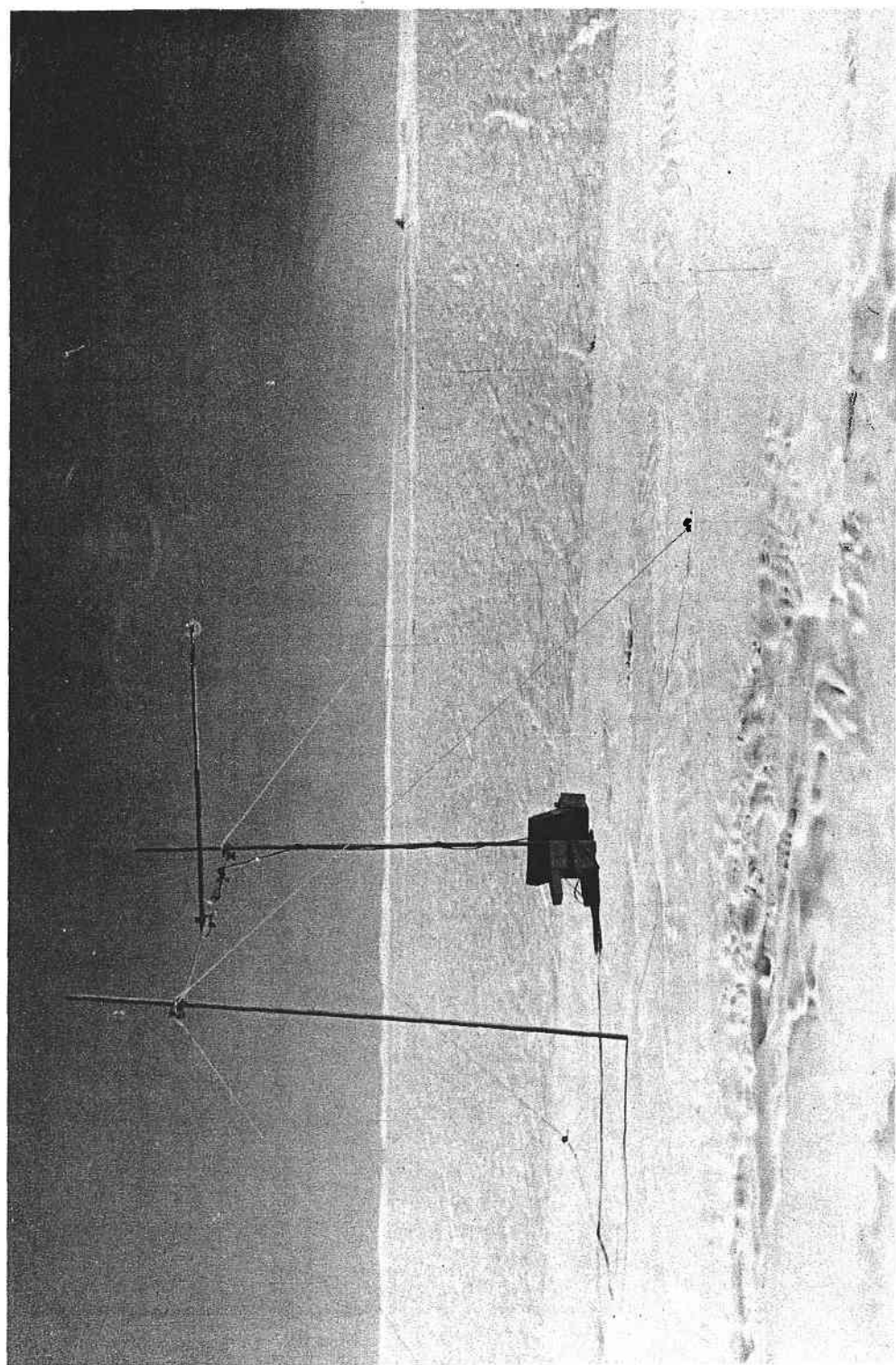
A programme of ozone sounding using a Brewer type bubbler is being initiated. Ground ozone measurements by means of chemical analysis have been commenced at Aspendale. While the average ozone content at ground level is of the order of $40 \mu\text{gm}/\text{m}^3$, there is evidence of a well defined diurnal variation with maximum ozone occurring about midday.

Mean meridional distributions of ozone with height have been constructed for the southern hemisphere for the spring and summer seasons using all available data, the purpose being to relate the results obtained with the hemispherical stratospheric circulation. There is some evidence to suggest that the 24-26 month cycle in ozone variations observed in the middle latitudes of the southern hemisphere takes place above 24 km. It has also been observed that at Macquarie Island at heights above 60 mbs the temperature oscillates with a periodicity of about 24-26 months.

The Division continues to act informally as a calibrating centre for the Dobson spectrophotometer, the instrument used to measure total ozone in the upper atmosphere. Currently one such instrument belonging to New Zealand and another to the U.S. Weather Bureau (used at Wilkes, Antarctic) are being checked and intercompared with our own instrument at Aspendale. A third instrument in use by the Weapons Research Establishment, Salisbury, is arriving shortly for calibration.



Macquarie Island - Using a Dobson Spectrophotometer to measure ozone in the upper atmosphere.



A net radiometer at Mawson, Antarctic. (ANARE photograph by J. Bechervaise).

Measurements of the total β -activity occurring in rainfall at Aspendale following atomic bomb tests have continued, the results obtained since 1958 clearly indicating a seasonal effect with a maximum in late spring and early summer. It has further been observed that this maximum is preceded by one in total ozone by some two months, the lag appearing to be associated with stratospheric/tropospheric interaction. In an attempt to clarify the nature of this link equipment is being set up to determine the amount of Be^7 present in air samples taken at the ground. This element is produced almost wholly in the stratosphere and its presence at low levels can be related quantitatively to stratosphere troposphere interchange.

Following Operation "Dominic", the 1962 series of atomic tests near Christmas Island, a fallout pattern similar to that which resulted from the 1958 series has been observed. It is now clearly evident that the time taken for a homogeneous distribution of fission debris to be achieved in the stratosphere is greatly in excess of the six months formerly supposed. This discrete nature of the atomic clouds enables the transit time from the equator to 38°S to be estimated, the result being a poleward motion in the stratosphere of the order of 1 m/sec. Alternatively, if eddy diffusion is regarded as the transport mechanism a horizontal transfer coefficient of the order of $5 \times 10^9 \text{ cm}^2 \text{ sec}^{-1}$ is obtained. Both values are reasonable when compared with the results of allied investigations elsewhere.

To assist in resolving the problem - which basically is one of global circulations - humidity measurements in the upper atmosphere are being contemplated. Similar observations in the northern hemisphere provided the first clear evidence of a meridional circulation.

Use is also being made of the radio activity measurements to carry out a detailed analysis of the fallout accompanying individual storms.

VII MISCELLANEOUS

The small data processing group has continued to make use of the digital computers CRL Elliott 803 and CSIRAC. The Division has its own facilities for converting data which are initially in analogue form, e.g. pen recorder traces, to the required digital form. Investigations for which this group has carried out computations include upper-wind stress and profile relationships, investigation of non-stationary meteorological time series, correlations of rainfall and sea surface temperatures, tabulation of functions for estimating the modification of air passing from a dry to a saturated surface, lake evaporation investigations, and statistical calculations on the turbulence records obtained at Hay.

A number of modifications have been carried out to the Division's 10 cm weather surveillance radar, and its performance is being steadily improved. A transmitting power of 500 kW is now available and precipitation of average intensity can be detected at a distance of 90 miles, while heavy storms have been observed at a range of 140 miles.

To improve the resolution of the equipment and to extend the range, a new 12 ft. antenna is being fabricated in the Division's workshop. Its installation in the near future coupled with the increased power from the transmitter will provide the Division with a highly specialised research tool.

An improved design of contact cup anemometer has been developed, a provisional patent obtained and a licensee selected to manufacture the instrument on a commercial scale. The anemometer which is capable of operating in wind speeds of up to 150 m.p.h. has a streamlined axially symmetric casing and, unlike other instruments of this type, is so designed as to overcome the spurious counts which can result from an unsteady support.

During the year a new model (Mk. II) Sumner Long Term Recorder has been developed and a prototype instrument accepted from the licensee. The instrument incorporates a number of improved features found desirable following four years' experience with the Mk. I model. A further application of this recorder is under development to permit the measurement of radiation (outgoing as well as incoming) at remote sites.

A mast-mounted long term recorder has been developed to record mean wind speed and direction in a form suitable for automatic processing by a computer. The instrument is currently being operated on an experimental basis by the Department of Civil Aviation at Tullamarine Airport and, it is hoped, will be of considerable assistance in determining runway orientation at future airports.

The Division's laboratory, registered for a number of years by the National Association of Testing Authorities as an accredited testing authority in the fields of low-speed anemometry and atmospheric radiation instruments, has continued to provide this service. A similar service is provided in respect of heat flux plates.

The Victorian State Department of Agriculture is currently carrying out a programme of research into Facial Eczema in sheep. Calibration facilities together with equipment for the measurement and recording of temperature, humidity

and wind speed have been made available for use at the Department's Gippsland Experimental Site.

In collaboration with the Irrigation Research Laboratory, Griffith, the Division has set up instruments in the Coleambally area to measure the effects of irrigation on climate.

Consultation with the Snowy Mountains Hydro Electrical Authority on the assessment of evaporation from water storages continues.

From a draft design submitted by the Division of Plant Industry, a drag plate for measuring the horizontal component of the force exerted by the wind on a natural surface has been constructed. Following tests on a field expedition two such instruments have been made available to that Division.

VIII ACTIVITIES AND PERSONALIA

It is with great regret that we have to record the death of Dr. J. P. Funk on June 7th, 1964, in Munich, whilst en route to an International Comparison of Radiometers at Leningrad.

Meteorology, always recognised as an international science, continues to grow in this respect. During the year members of the Division have continued their associations with the various national and international organisations which have been established to deal with problems of Antarctic Research, Dynamic Meteorology, Ozone, Evaporation, Hydrology, Special Radiation Instruments and Observations, Plant Injury and Air Pollutants, Oceanic Research and Space Research.

Dr. C.H.B. Priestley, Chief of the Division, has been appointed to the newly formed Advisory Committee of the World Meteorological Organization.

The purpose of this Committee is to provide WMO with advice on the principal research problems and the co-ordination of scientific activities in the atmospheric sciences (particularly with reference to meteorological satellites), and also all major operational problems as well as overall policies and plans for training and education.

Mr. W. C. Swinbank is a member of the recently formed Site Testing Sub-Committee of the Australian Academy of Science's Standing Committee on a Large Optical Telescope. The purpose of this sub-committee is to assess sites for the proposed U.K./Australian 150" telescope.

At the invitation of the Institute of Advanced Studies, the Australian National University, Mr. F. K. Ball has accepted a temporary appointment as an Honorary Research Fellow in the Department of Mathematics. Mr. Ball's twelve months will be spent on theoretical work in fluid mechanics.

For a period of eight months Dr. F. A. Berson has been attached to the International Antarctic Analysis Centre where he was engaged partly on synoptic analysis and partly on an investigation into the quasi-periodical changes in the zonal circulation and their link with the heat balance of the Antarctic atmosphere.

Dr. D. E. Angus has again given the postgraduate course in Micrometeorology in the Meteorology Department, Melbourne University, and the undergraduate course for Forestry students in the Forestry Department, Melbourne University.

As part of the Division's contribution to the 1962/65 International Indian Ocean Expedition, a member of the Division has taken part during the past year in two cruises of the Frigate H.M.A.S. "Diamantina". Each cruise was from Freemantle to Singapore and return in the vicinity

of the 110°E meridian. Data were obtained on the radiation income of the sea and these will be related to cloud amount as recorded by an automatic all-sky camera. The information so obtained coupled with existing statistics on cloudiness along shipping lanes and the vast amount of data emanating from the TIROS weather satellites will very considerably improve existing knowledge of the heat economy of the Indian Ocean.

Overseas Visits

Early in the year Dr. Priestley left Australia for a three months' overseas visit. He attended the 13th General Assembly of the International Union of Geodesy and Geophysics (IUGG) in Berkeley, California, and an International Symposium on the Dynamics of Large-Scale Atmospheric Processes organised by the International Commission for Dynamic Meteorology. Whilst in North America the opportunity was taken to renew contact with professional colleagues at a number of institutions. The return journey was made via Europe and some time spent at the new headquarters of the British Meteorological Office as well as other centres of interest in the United Kingdom.

Later, Dr. Priestley visited Geneva to attend the first meeting of the newly formed WMO Advisory Committee, details of which appear elsewhere in this report.

Early in 1964 Mr. I. C. McIlroy commenced a twelve months' temporary appointment with the United States Water Conservation Laboratory, Tempe, Arizona. He is working in the agro-meteorological sphere with special reference to problems of evaporation from various crops.

In August, Mr. F. K. Ball spent four weeks in the U.S.A. At the invitation of the International Committee on Dynamic Meteorology and aided by a grant from the U.S. National Committee for Geodesy

and Geophysics, he presented a paper at a specialist seminar sponsored by the IUGG at Berkeley, California. He also attended the International Symposium on the Dynamics of Large-Scale Atmospheric Processes at Boulder, Colorado.

Mr. R. J. Taylor has returned from the U.S.A. where, at the invitation of the U.S.A.F. Geophysics Research Directorate, Bedford, Massachusetts, he has been working on turbulence in the lower atmosphere and in the relatively new field of sonic anemometry. During this time Mr. Taylor attended the International Symposium on Humidity and Moisture in Washington and also the 13th General Assembly of the IUGG.

Early in the year Mr. F.R.E. de Silva returned from a twelve months' tour of duty at Macquarie Island where he was responsible for the routine ozone observations. He was succeeded by Mr. G. Grauze who spent three months on the island training his successor, a member of the Antarctic Division, and participating in the measurement of cosmic rays using balloon borne equipment.

From Overseas

Mr. A. B. Bernstein of the United States Weather Bureau has recently completed a twelve months' attachment to the Division working on the structure of the boundary layer and problems of turbulent transfer.

In August Dr. Paul Frenzen, from the Argonne National Laboratory, Illinois, returned to the U.S.A. following ten months' work with the Division on the measurement of the vertical flux of momentum by reference to the inertial subrange of the turbulence spectrum.

Mr. W. B. Goddard, an electronics engineer from the University of California, spent six months

with the Division constructing an Evapotron for subsequent use in the U.S.A.

Mr. T. Kamiko, from the Japanese Meteorological Agency, and a Fellow of the Australian International Award Scheme, has returned to Japan following an extended visit of fourteen months, during which time he investigated synoptic sequences with special reference to frontal structure, in the Australian sub-tropics.

Also a Fellow under the Australian International Award Scheme and on the staff of the Japanese Meteorological Agency, Mr. M. Okamoto has completed an extended visit of seventeen months. His work was on problems of turbulent exchange under very stable conditions.

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