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THIRTY-FIFTH CONGRESS OF A. N. Z. A. A. S. BRISBANE 29 MAY TO 2 JUNE 1961

The Thirty-fifth Congress of A. N. Z. A. A. S. was held in Brisbane from 29 May to 2 June 1961.

This year, under the chairmanship of Mr. A. J. Shields, Deputy Director, Queensland Divisional Office, four papers were delivered in the Meteorology session under the Astronomy, Mathematics and Physics Section of A. N. Z. A. A. S. The papers were all well balanced expositions which combined scientific and popular approaches so as to hold the attention of all listeners, whether meteorologists, other scientists or laymen. Papers and authors were:

1. The heat budget of the atmosphere - F. Loewe
2. Long range weather forecasting - C. H. B. Priestley
3. Extreme wind gusts in the Australian region - H. E. Whittingham
4. Satellites and Meteorology - G. T. Rutherford

The Bureau of Meteorology contributed other papers to the Conference also. An extended air conditioning symposium was held all day Tuesday, 30th May, and Friday, 2nd June. It was conducted under the following headings:

Physiological and sociological aspects;

Climatological and meteorological aspects;

Engineering aspects; and

Architectural aspects.

The Bureau paper by H. T. Ashton presented the basis for, and a station sample of, temperature and humidity tabulations in the forms satisfying the varying requirements of engineers and architects.

In the session on Electrical Engineering, under the chairmanship of Professor S. A. Prentice who has for many years collaborated closely with the Bureau on thunderstorm research, A. T. Brunt of the Queensland Divisional Office contributed a paper. He prepared and presented Part I of "A Study of Thunderstorms in Southeast Queensland" dealing with meteorological aspects. Part II covered electrical aspects and was given by D. Mackerras of the University of Queensland.

It is worthy of note that a number of speakers in various sections expressed appreciation for assistance and data supplied by the Bureau of Meteorology.

Papers by A. T. Brunt and G. T. Rutherford are published in full in this copy of Australian Meteorological Magazine; papers by F. Loewe, H. E. Whittingham and H. T. Ashton are to be published elsewhere. *

Following are abstracts of the papers of meteorological interest.

1. The Heat Budget of the Atmosphere

by F. Loewe

University of Melbourne

The different components of the atmospheric heat budget are surveyed, with special emphasis on aspects in need of further study or of improved data. These include absorption processes in oceanic regions and in clouds, reflection from water waves, and long-wave radiation fluxes in the free atmosphere. The atmosphere's net heat loss by radiation amounts to 10^{14} h.p. and exceeds in two seconds all the energy produced by man in a year; it occurs in the main at the upper surfaces of clouds and is balanced by vertical and horizontal heat transports. The overall radiation deficit amounts to 24 per cent and is shared between latent heat (20 per cent) and sensible heat (4 per cent).

A detailed study of the transient gains and losses of heat in the atmosphere is becoming possible with the improved understanding of the physical processes involved in the heat budget of the atmosphere and the wealth of new data available; such a study may be important for forecasting the tendencies of the weather for periods of weeks ahead.

2. Long Range Forecasting

by C. H. B. Priestley

Division of Meteorological Physics, C. S. I. R. O, Melbourne

Three methods of approach to the problem of long range forecasting are discussed. These are:

(a) the physical;

the approach here is through the laws of physics, culminating in the technique of numerical forecasting, but limited in effectiveness by the complexity of detail;

(b) the analogue;

* The paper by Loewe is to be published by Meteorology Department, University of Melbourne. Papers by Whittingham and Ashton are to be published as separate studies by the Bureau of Meteorology.

experience of past situations used against a background of physical laws is employed to determine the relative chances of the various alternative developments from a given situation;

(c) the statistical;

the approach here is entirely factual and the method consists in statistical correlations between quantities with varying separations in space and time, and the analysis of data to establish periodicities and trends.

The normal technique of "extended period" or 5 day forecasting is briefly discussed as a method based on the prediction of movement and development of individual large scale eddies such as cyclones and depressions. This is essentially restricted to the period of the life cycle of these eddies and a natural barrier exists at the end of the extended forecasting beyond which substantially different techniques are required.

The semi-permanent highs and lows or centres of action are indicated as potential tangible aids which may be invoked on the other side of the 5 day barrier. Abnormalities of these features display a certain inertia which may be retained for several weeks and lend themselves to correlation with particular weather types for prolonged periods in various localities. These centres of action themselves undergo displacement or even exhibit life cycles on the seasonal scale and thus another barrier is encountered such that techniques of monthly forecasting may have little application to seasonal forecasting and beyond.

Periods of long range forecasting are thus classified as of the order of 5 days, monthly, and seasonal, and each of the three forecast types presents separate problems.

Monthly forecasting (meaning periods of the order of one week to six weeks) is discussed under the analogue method and it is concluded that monthly mean circulation charts are in general related to weather anomalies and also that they undergo an orderly evolution capable within limits of being rationalised by the use of physical principles.

Seasonal or longer term forecasting cannot be treated adequately by any analogue approach. Reference is made to the absence of any notable influence of moon or planets on terrestrial weather which is subject rather to the external influences of the daily cycle, annual cycle and sunspot cycle only.

In association with the sunspot cycle it is considered that there are also a number of natural oscillation periods which are explainable in terms of internal physical processes. An example of this is the Southern Oscillation arising from abnormality of the "high" centre of action near Easter Island and of the "low" centre of action in the Borneo - New Guinea - Indonesia - Darwin region. This gives rise to a flow of colder water via the Humbolt current to the Borneo - Darwin region and a pressure rise.

The period of travel leads to a periodicity of this oscillation of about 2 1/3 years. A wide range of periods may arise from this 2 1/3 year internal and the 11 year external sunspot cycle. Similar periodicities may be conceived as originating in the other main oceans.

It is concluded that while long range forecasting is unlikely to achieve the accuracy of short period forecasts, a systematic attack on the problem could achieve worthwhile results. This attack would however involve a research effort on a scale comparable with that of the present defence or space research programme.

3. Extreme Wind Gusts in the Australian Region

by H. E. Whittingham

Bureau of Meteorology, Brisbane

The pressure on an object due to the wind is given by $p = 0.00294\ k\ V^2$, where p is in lb/sq. ft. and V in knots. This paper attempts to provide design values of V. Gusts are caused chiefly by the growth of eddies, local pressure differences, deflection around objects, vertical thermodynamic interchange, and by combinations of these causes. Anemometers vary in their response to applied wind pressures and the characteristics of the Dines anemometer, which is the standard installation in Australia, are briefly discussed. The first instrument was installed at Sydney in 1937 and now over 60 stations are equipped with Dines. 100 kt gusts or over have been recorded at Willis, Onslow, Forrest, Yampi and Bowen. In general it is found that the maximum annual gust along the southern littoral is produced by major extra-tropical depressions or their associated sharp troughs. Along the tropical coasts of Queensland and North and West Australia the annual maximum gust is often cyclonic in origin. Over the remainder of the country the annual maxima are due to a variety of causes, one of the more important being the downdraught from thunderstorms. The difference between typical gusts of the various types is illustrated by slides. A record from Cairns illustrates the effect of mechanical turbulence produced over nearby mountain ranges. The records from all anemometers in the Australian region have been analyzed using Gumbel's extreme value theory and maps of modal gust and isopleths of slope of the Gumbel line produced. From these two maps it is possible to derive by graphical addition maps showing the gusts corresponding to any desired return period.

4. Meteorological Data for Air Conditioning in Australia

by H. T. Ashton

Bureau of Meteorology, Melbourne

The complex interaction of factors related to assessment or measurement of human reactions and environmental conditions compels a limited approach to meteorological data in this field.

Air temperature and humidity tabulations are almost invariably sought when air conditioning of buildings is being considered, wet bulb temperatures in association with dry bulb being equivalent to humidity information. Dry and wet bulb thermometers are exposed in a louvred screen where they are sheltered from radiation.

Concepts using temperatures have been introduced, to help simplify the expression of a relation between man's comfort and environmental conditions. These include effective temperature and a number of comfort indices.

Wind and radiation data are not considered in this paper although they, like structure design, have important effects on indoor climate and devices can be employed to vary their impact. The devices, however, do not involve substantial running costs in themselves.

Variability of human reactions to climate because of race, activity, and seasonal acclimatisation, makes postulation of a universal comfortable climate impossible. At the same time variability of meteorological conditions over an area must be realised, and the error in assuming data for a point as precisely representative of any other point recognised. Figures are given to demonstrate this.

Temperature (including wet bulb) data sought by operators are then considered and an assessment is made on the basis of need and practicability. Subsequently, from study of climatic data over wide areas, and bearing in mind earlier discussion, two proposed actions are outlined. The first is a series of tables of meteorological data which are considered adequate, and the second a break up of Australia into areas over which climatic data for a single station may be regarded as representative for application to air conditioning.

5. Solar Radiation records in Australia and their presentation

by C. M. Sapsford

Department of Mechanical Engineering, University of New South Wales, Sydney

The records of solar radiation made in Australia in the past and present are reviewed and suggestions made for improved coverage in the future. Details are given of the type of records available from various centres in Australia, and methods of presentation discussed.

Examples are given of graphical plots to show

(a) Isopleths of diurnal and annual variations.

(b) Frequency distribution of the daily summations for each month.

(c) Sequences of above average and below average radiation.

Investigations show that it should be possible to design solar operated equipment for heating purposes, without using standby heating, by making suitable provision for short term storage and by utilising a calculable proportion of the useful energy collection expected on an average day. A reasonable period of solar radiation observations must, however, be available to apply the method.

6. Climatic Regions of Australia and their influence on human discomfort

by F. Wickham

Commonwealth Department of Works, Melbourne

Various studies of the subject of human discomfort are discussed in which the variables dry bulb, wet bulb, air velocity, clothing and rate of work are used, leading to the concepts of Effective Temperature and comfort charts which are now generally accepted.

Mention is made of the factors which combine in the relation between conditions experienced by a person in a house and the outdoor conditions as recorded in a standard meteorological "screen". These are chiefly,

(a) insulation, mass and orientation,

(b) infiltration of outside air and internal heat loads,

(c) rate of change of outside temperature.

It is assumed that a difference of 2 deg. F Effective Temperature between outside and inside a house is reasonable and the occurrence of an Effective Temperature of 80°F (at 3 p. m) outside is adopted to indicate that uncomfortable conditions will exist in the house during most of a day.

A frequency of 25 or more occurrences of 80°F per year is assumed to warrant the use of mechanical air treatment and appropriate tables are presented for the main population centres on this basis.

7. Studies in the preferred thermal environment

by R. K. MacPherson

School of Public Health and Tropical Medicine,
University of New South Wales

The preferred thermal environment is discussed for various localities and it is demonstrated that this cannot be predicted with certainty from a result of studies elsewhere.

It is shown that effective temperature is not necessarily a better indicator than air temperature in assessing environmental stress indoors.

The effects of clothing and of acclimatization are also discussed.

8. Control burning in Eucalypt Forests
The Problem of excessive fuel accumulation

by A. G. McArthur

Forestry and Timber Bureau, Canberra

The majority of eucalypt forests in Australia have developed over the centuries in an environment subject to frequent fires. Before white settlement, such fires resulted from aboriginal activity and lightning. Lightning fires have caused extensive damage in both forests and grasslands over the last decade, despite the activities of relatively efficient fire suppression organisations. It is estimated that lightning fires alone have burnt over an area exceeding 10, 000, 000 acres in the period 1951-1961.

The incidence of high intensity forest fires has increased markedly over the last 30 to 40 years, due to a combination of factors which have resulted in a marked increase in the amount of fuel on the ground and in the tree canopies, as open virgin stands are replaced by heavily stocked younger stands.

Fuel quantity, or the amount of fuel available for combustion, has a profound effect on all aspects of fire behaviour.

(i) Rate of forward spread of a fire will vary directly with the amount of fuel available for combustion, providing meteorological conditions and slope remain constant.

(ii) Besides affecting rate of spread, fuel quantity also significantly affects fire intensity. As fuel quantity doubles, fire intensity is increased four-fold.

(iii) Increased fire intensity also vitally affects two other vital factors affecting fire behaviour. These are the "spotting potential" and "crown fire development".

The process of fine litter accumulation under eucalypt forests shows that there is a linear relationship between the logarithm of fuel quantity and the logarithm of time, according to canopy cover.

Control burning guides exist, which allow estimates to be made of rate of spread, fire intensity and possible damage under most combinations of fuel and weather.

The loss from multiple fires in periods of extreme fire danger can be significantly lessened only by systematic control burning.

9. A phytogeographical comparison of Eastern Brazil and Eastern Australia

by L. J. Webb

Division of Plant Industry, Canberra

Eastern Australian rain forests are classified as follows:-

	Frost and Snow	Mean Air Temp. (°F)	Mean Temp. Coldest Month (°F)	Latitude Range (deg. S)
Tropical	NIL	75	70	11-19
Subtropical	Occasional light frosts	70	59	16-26
Subtropical warm temperate transition	Some heavy frosts	62	51	17-36
Warm temperate	Frequent heavy frosts	51	41	37-
Cool temperate	Snow	-	-	-

Brazilian tropical forests extend to 26 deg. S and subtropical to 30 S. Temperatures for the tropical forests are 68°F and 58°F compared with 75 and 70 in Australia, and for the subtropical forests 64°F and 57°F as against 70 and 59 in Australia. There is not the same development in tree height in Brazil as occurs in North Queensland (tropical forest) and around Dorrigo, N. S. W. (subtropical/warm temperate transition). The dry tropical inland of Brazil with its deciduous trees, vine scrubs and cacti contrasts with North Queensland's open savannah grasslands.

A noticeable feature of the Brazilian tropical rain forest was the lack of the cyclone damage which is such a feature of North Queensland forests.

10. The application of Thornthwaite's Concept of Potential Evapotranspiration in the Wheat Belt of New South Wales

by P. G. Irwin

Newcastle Teachers' College

Reference is made to the principal points of criticism of Thornthwaite's work, viz. the formula for determining water need, and the use of four inches as the figure for soil moisture storage.

An experiment is discussed which tests the above points and it is found that the Thornthwaite method for determining both the duration and intensity of a drought is valid for the climatic and soil conditions in the wheat belt of N. S. W. It is found also that the use of four inches as the amount of available moisture within the root zone of wheat gives satisfactory results for the soil types of this area.

11. Antarctic ice-thickness measurements

by M. J. Goodspeed

Bureau of Mineral Resources

Field parties from several countries carried out extensive traverses in Antarctica during the I. G. Y. Results of measurements of ice thickness, ice surface altitude and gravity anomaly along the traverses are now beginning to allow an overall picture of the subglacial land surface and its relation to ice surface topography to be built up.

A clear distinction has been established between two areas of Antarctica, tentatively named "Greater Antarctica" and "Lesser Antarctica". The boundary between these runs close to the eastern and southern limits of the Ross Ice Shelf, then just to the north of the Horlick Mountains (centred at 86°S 112°W), then close to the western limit of the Filchner Ice Shelf. "Greater Antarctica" includes approximately two thirds of the continent and in this area ice surface and rock surface elevations are considerably higher than in "Lesser Antarctica". The

boundary appears to represent the edge of a Pre-Cambrian shield forming "Greater Antarctica", the rocks of "Lesser Antarctica" consisting of younger formations.

Traverses in "Lesser Antarctica", almost entirely by U. S. parties, have shown that:-

(i) a rock surface trough between the Ross Ice Shelf and the Bellingshausen Sea is some 1000 m or more below sea level along its axis;

(ii) no major trough connects the Ross and Weddell Seas;

(iii) the mountains of Grahame Land (Palmer Peninsula) appear to continue under the ice to a point just north of the Horlick Mountains;

(iv) two ice surface elevation maxima, overlying rock surface elevation maxima, are located respectively in the area of the Executive Committee Range (77°S 122°W) and at 81°S 105°W.

Traverses in "Greater Antarctica" by U. S. S. R., British Commonwealth, French and Australian parties have shown that:-

(i) it is likely that a single ice surface elevation maximum of just over 4000 m is located at 82°S 75°E, close to the geographical centre of the area;

(ii) a broad plateau covering about one third of "Greater Antarctica" exists in the centre of the area, with ice elevation nowhere less than 3000 m;

(iii) corresponding to this ice surface plateau, an elevated rock plateau with elevation between 2000 and 3000 m for several hundred kilometres was crossed by U. S. S. R. and British Commonwealth parties in the central regions;

(iv) the Amery Ice Shelf is the expression at coastal latitude of a major depression which continues south to about latitude 80°S.

Evidence from rock topography, gravity anomalies and seismic observations strongly suggests that Antarctica is a single continent (in the geophysical sense).

12. The Conservation of Soil Resources in Queensland

by J. E. Ladewig

Department of Agriculture and Stock, Queensland

The large areas of summer crops grown in Queensland result in the exposure of vulnerable fallows to high intensity storms which occur more frequently than in the southern States. Other special difficulties applicable to Queensland are the predominance of clay soils, which have low infiltration rates when moist, and the absence of suitable economic pasture phases in the crop rotation programmes.

Although agronomic aspects will determine the success of soil conservation programmes in the long term, the immediate need is the application of engineering practices to arrest the major soil losses. This involves the integration and stabilisation of water disposal systems as a first step and for this reason virtually all soil conservation plans are developed on a catchment basis.

There appears to be a need in the future to expand the rate of soil conservation plan development so that catchment plans for the main agricultural areas can be completed within ten years.

13. Land and water resources development in Queensland

by F. B. Haigh

Irrigation and Water Supply Commission, Brisbane

This paper draws attention to the potential for land and water resources development in Queensland by comparison with achievements to date in Victoria.

The need is stressed for a greater concentration of scientific effort in solving problems of more intensive land use and more efficient animal husbandry in the tropic zone, and in obtaining a sound assessment of our actual land and water resources if this national need is to be adequately met.