These headings could be further sub-divided.

A programme has been prepared for international studies of rivers. Each nation is to undertake its own work to cover the rivers within its own regions. The circulation of salts in the hydrologic cycle, sediment transport and its relation to type of vegetation, are aspects which will be studied on an international basis. Australia is unique in various ways and hydrologic data gathered here would be of great value in building up a global picture of the distribution and behaviour of water.

Mr. Langbein finally discussed requirements for education and training in hydrology. Better training for hydrologists than was available at present was required. International co-operation was also required to create an interest in the subject among young people. Grants to students for research were very necessary.

24 September 1963

RECENT ADVANCES IN RADAR PROBING OF THE ATMOSPHERE

by D. Atlas

(The Bureau of Meteorology participated in this Colloquium an Atmospheric and Electrical Physics sponsored by the Physics and Electrical Engineering Departments of the University of Melbourne and the RAAF Academy, Point Cook).

Dr. Atlas, Chief of the Weather Radar Laboratory, U. S. Air Force Cambridge Research Laboratories, Office of Aerospace Research, Sudbury, Massachusetts, U. S. A., prefaced his talk with the observation that about 15 years ago radar observations were only qualitative but now it has advanced to a quantitative science.

Continuing, Dr. Atlas said the reflectivity of a raindrop depended directly on the sixth power of its diameter. The total reflectivity from precipitation depended on the cumulative effect of the number and diameter of raindrops.

It was found that for precipitation the relation between the diameter of the raindrops and log number of raindrops in rainfall was linear, the slope of the line varying with the rainfall rate. There is also a relationship between reflectivity and rainfall rate. When reflectivity is plotted against rainfall rate a scatter about a mean line through the origin is obtained. This scatter indicates an uncertainty in the instantaneous estimate of the rainfall rate.

The 24-hour rainfall could be obtained by integration of this rainfall rate and could be accurate to about 2 per cent. It is noted that a Japanese estimate of the accuracy compared with ordinary rain gauge results was only 14 per cent.

An automatic computer has been built which can select average intensity levels (rainfall rates) of echoes from rainfall and from these the total rainfall in a period of time. It can also select and remember the maximum altitude of the echo.

From the intensity of echoes at heights of 20, 000 feet and above it is possible to detect tornadoes and severe storms. A continuous watch would need to be maintained for strong intensity echoes at this height. This continuous watch need not be kept by an observer on duty all the time, but an alarm can be used to warn the operator whenever any special phenomenon occurs.

In reply to questions from the audience, Dr. Atlas made the following comments.

(a) The correction for attenuation due to rain should be made when assessing rainfall rate. It must be understood, though, that the application of this correction may not be meaningful if the calibration of the radar is not accurately known. Recent measurements indicate that corrections for alttenuation in the past have been too large.

(b) The reflectivity of wet ice is approximately 0. 2 times that of water, while the reflectivity of dry ice is 0. 05 times that of water. Ice on the other hand has 10 to 20 times the diameter of water droplets. Therefore, when height is plotted against reflectivity it is seen that the reflectivity is greater at heights where hail or ice is present than at lower heights where only water droplet are present. Recently it has been found that a mushy coating around an ice nucleus has a greater reflectivity than ice or water.

(c) Measurements of reflectivity give an indication of the composition of rainclouds and therefore an insight into the rain-producing mechanism.

Dr. Atlas then proceeded to describe the principles and use of Doppler radar. The Doppler shift of the radar beam could be measured and by analysis of the Doppler spectra the drop size distribution for different rates of precipitation could be determined for both water and snow.

Also wind speed, wind shear and the fall speed of rain droplets could be measured by Doppler radar, and it would be possible to obtain the entire vertical wind profile in a short period of time.

Another important use of Doppler radar is in the analysis of the wind structure of tornadoes.

9 October 1963

JET STREAMS AND TURBULENCE

by E. R. Reiter

At a special colloquium, Dr. Reiter, Associate Professor, Department of Atmospheric Science, Colorado State University, Fort Collins, Colorado, U. S. A., a visitor to the Meteorology Department of the University of Melbourne, gave a talk on jet streams and clear air turbulence, with special reference to the high altitude turbulence measurements over southern Australia by a team, with an instrumented Canberra Aircraft, from the Royal Aircraft Establishment, Farnborough, England. An account of Dr. Reiters talk will be published in the next issue of this Magazine.

19 November 1963

OPERATIONAL AND RESEARCH ASPECTS OF METEOROLOGICAL SATELLITE DATA

by L. F. Hubert

Mr. Hubert, Chief of the Synoptic Research Section, Meteorological Satellite Laboratory, U. S. Weather Bureau, commenced his talk with the introductory remarks that almost from the day of launch of TIROS I on April 1st, 1960, large scale cloud patterns were used in operations. The gross cloud patterns revealed the presence of cyclones and generally disturbed regions.

In addition infra red radiation data were obtained on later TIROS satellites and these are useful for determining the cloud heights. So far this has been done only in research studies but will soon be available quickly enough for operational use.

An important aspect in the interpretation of television cloud pictures for both operations and research is the exploitation of meso-scale and sub-synoptic scale patterns.

It is essential that we investigate this class of phenomena in order to understand the underlying thermo- and hydro-dynamics, but it is not necessary to await these results to use the information revealed in day to day analysis. Certain patterns have been seen so frequently that we have come to known some of the general atmospheric conditions, even though there are