

that the sensible heating contribution must result in an increase in H, and yet the further assumption had been made that H was constant. Dr. Bullock said that since he had had no way of observing or determining the change in H, he had used a constant value as a matter of convenience. He had run his computations using different values for this constant, and had found that as H was increased  $\bar{G}$  decreased.

Dr. F.A. Berson asked whether there was no simpler method of computing the net heat flux. Dr. Bullock replied that the absence of surface data had forced him to use equation (9) in estimating the heat flux. Mr. P. Price enquired whether the results were highly sensitive to variations in the MSL analysis. Dr. Bullock said that Mr. H.R. Phillipot had prepared independent MSL analyses, which had then been used to re-compute the  $\bar{G}$  values, and there had been very little change in the results. Mr. R.H. Clarke commented that 850 mb seemed a rather low level to take as the top of the heating layer - in some respects it may be better to take H as the height of the tropopause. Dr. Bullock agreed with this comment, but nevertheless felt that his conclusions were not really affected. In reply to a further comment by Mr. Clarke, Dr. Bullock said that he regarded the effect of the cooling of the warm air-mass to be insignificant, owing to the high stability of the air-mass at low levels. Mrs. J. Hopwood asked whether the results were dependent to a large degree on the assumptions that had been made - by changing these assumptions, might it be possible to arrive at a small negative value for  $\bar{G}$ . Dr. Bullock replied that he did not think this was likely. If it had been possible to allow for variations in H there may have been significant changes in the  $\bar{G}$  values, but in general the results should not be sensitive to the other assumptions made. Mr. C.E. Wallington said that it appeared that it may be possible to define the developing stage of a cyclone by looking at changes in the value of the ratio  $\bar{G}/\bar{D}$ , with which Dr. Bullock agreed.

T.T.G.

2 October 1969

## EVAPORATION, DRAINAGE AND WATER STORAGE OF A FIELD CROP

By C.B. Tanner

Professor Tanner is Head of the Department of Soil Science of the University of Wisconsin. Before embarking on the main subject of his address, Prof. Tanner remarked that, although interest in water balance problems was usually greatest in arid areas, it could be more profitable to concentrate attention on water balance problems in areas with abundant water where greater benefit would follow from optimal use.

Prof. Tanner then described the experimental measurement of terms in the water balance equation for a snap bean crop on well-watered sandy soil in Wisconsin. Drainage below the root zone was estimated from neutron probe measurements of soil moisture using an empirical drainage-soil moisture relationship

derived from lysimeter measurements on an alfalfa crop. Evaporation was available from the balance of precipitation, storage and drainage. He did not favour estimation of evaporation from bare soil and crop transpiration together as a single quantity, since transpiration was so critically dependent on stomatal resistance. Measurements of this resistance were made with a "stomatal resistance porometer". Evaporation from the bare soil was regarded as having an upper limit determined by capillary flow or available energy for evaporation, whichever was the more stringent limiting factor. It was found that available energy was usually the control.

Good correspondence was found between values of evaporation obtained from the balance of precipitation, storage and drainage, and from consideration of transport processes within the canopy and the soil (using stomatal resistance measurements for the canopy and energy available for soil evaporation).

In the discussion which followed, Prof. Tanner agreed that lysimeter estimation of evaporation from forest should be feasible as long as drainage measurements were made below the base of the root zone and were not made unrepresentative by horizontal non-uniformities in the soil. He also suggested that eddy correlation and heat balance techniques might be useful. In reference to exchange processes within crop canopies, he stated that transport coefficients were extremely sensitive to turbulence; this would be the subject of further experiments at Wisconsin.

G. A.

30 October 1969

## RECENT ADVANTAGES IN AUSTRALIAN ANTARCTIC GLACIOLOGICAL RESEARCH

By W. F. Budd

In introducing Dr. Budd of the Antarctic Division, Department of Supply, and the Meteorology Department, University of Melbourne, the Chairman of the Colloquium referred to the large contribution to Antarctic glaciology made by Dr. Budd in the last decade.

Dr. Budd first outlined the main topics to be discussed, pointing out that much of the work to be described was the product of a collaborative effort by Melbourne University and the Antarctic Division. The overall concern is with the Antarctic ice cap and the answers to such questions as: what is happening to it; how is this dependent on meteorological processes; and what is its history, particularly in relation to past climatic conditions?

A feature of glaciology is the relative unimportance of hydrostatic pressure and the importance of shear stresses. Ice studies are made on essentially four scales: from the crystal lattice, through polycrystalline sizes, to small and finally large-scale ice caps. Laboratory work is concerned with the first two and is