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THE SPECIAL PROBLEMS OF TROPICAL METEOROLOGY

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Mr. Johnson, Chief Meteorological Officer at the Headquarters of the Far East Air Force in Singapore, spoke on the special problems which face the meteorologist in detecting, understanding and forecasting tropical weather disturbances. The tropical cyclone was excluded from consideration, as a subject apart.

Climatic studies suggest that over land, the seasonal and diurnal variations of weather predominate; so much so that, without further evidence, the importance of disturbances of synoptic scale, and especially of travelling disturbances, might be doubted. The weather systems participating in the diurnal rhythms are essentially of convective and meso scale, however. Careful analysis shows that often these are simply the cellular expression of much larger scale systems. Some of the large systems are in fact travelling but many are quasi-stationary and developmental in character. The latter tend particularly to be masked by the high spatial and temporal variability of the convective rainfall, but they become apparent when 24-hr rainfall totals are mapped in areas having reasonably dense raingauge networks. These points were illustrated by reference to climatic data for the Far Eastern tropics and to examples of weather systems of Africa and the Far East as detected by synoptic analysis, by weather radar and by weather satellite photographs.

Tropospheric temperature gradients and the inter-diurnal variability of upper temperature are very small in the equatorial zone. They are certainly important for the structure and thermo-dynamics of tropical disturbances. However, it is doubtful whether they are of much significance as far as synoptic scale convective stability is concerned. Of much greater significance is the distribution of moisture, especially at mid-tropospheric levels. Conditional instability is a normal state in the humid tropics and some of the more violent tropical weather systems, such as the "Sumatra", the West African "Disturbance Line" and the "Monsoon Surges" of the Congo basin, depend essentially on its realisation: they feed on air from areas of fine or less disturbed weather and leave in their trail dull, moist, neutrally stable skies of layered aspect.

Horizontal pressure and isobaric contour gradients, like those of temperature, are small. Their physical effects are large. This was demonstrated using examples of tropical pressure, isallobaric, contour and streamline analyses for Asia and Africa. Interactions between temperate and tropical zones and between the systems of the two hemispheres are very obvious, and their importance in determining the location of convergence zones and for such special tropical events as Harmattan, Haboobs and Monsoon Surges was shown.

As yet, there is no operationally feasible system of numerical forecasting in the equatorial zone. Statistical upper wind forecasts are made by computer in Hawaii, but these depend only on simple linear regression. A considerable obstacle to the successful extension of middle latitude numerical methods to the tropics is the weakness of tropical flows. Measured values of the vorticity tend to be an order of magnitude less than in higher latitudes. Near the equator, vorticity is as difficult to measure directly as the divergence.