Geographic and Climatic Notes on the Project Shower Area

By W. A. MORDY

International Meteorological Institute in Stockholm.

The Saddle Area on the Island of Hawaii was chosen for Project Shower because its climatic and geographic characteristics are particularly suitable for cloud and rainfall measurements. Nearly all of the observations and measurements in the pages which follow were made in this area or in the air just to windward of it. A brief description of the terrain and climate is offered here as an aid to the reader.

The name Saddle refers to the col region between Mauna Loa (13,680 ft) and Mauna Kea (13,784 ft). On the windward slopes of these two large mountains, orographic rainfall is a frequent occurrence (circa 250 days/yr), nearly as frequent as the tradewind conditions which characterize the flow patterns in this part of the Pacific Ocean. Rain falls from clouds which form during the day as the tradewinds aided by a sea breeze component, flow up the relatively gentle slopes. (Approximately 1 : 20 through the col and at cloud base level near the mountain bases, and characteristically 1 : 7 near the mountain tops) For typical wind conditions, air rising up these slopes, independent of convection, would rise at the rate of only 10 to 20 cm/sec. An account of the tradewind-seabreeze regime which influences the climate of this region has been given by LEOPOLD (1949).

In fig. 1 the general characteristics of the region are shown schematically. The cloud bank, shown as a continuous cloud sheet, is usually made up of many individual clouds for which this schematic cloud would form an envelope. However, even such conditions

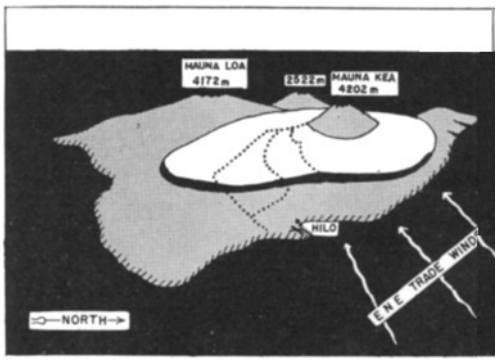

Fig. 1. Schematic map of the Island of Hawaii showing the main orographic cloud which was studied during Project Shower. Dotted lines under cloud show road systems along which many of the measurements were made.

as pictured are not unusual. The two roads shown on the location map in fig. 2, along which special raingages were placed during the project and along which many other measurements were made in the course of the work, are shown as dotted lines under the cloud. The Hilo airport and Club 299, headquarters for the work, are just east and south of the City of Hilo. The radiosonde balloons are released from the U.S. Weather Bureau Station at the airport. Pilot balloon ascents given in the appendix were made mainly along the coastal roads shown.

Average annual rainfall for this region is given in fig. 3 a and the reader may find it interesting to compare the daily patterns, during the project as given in the appendix

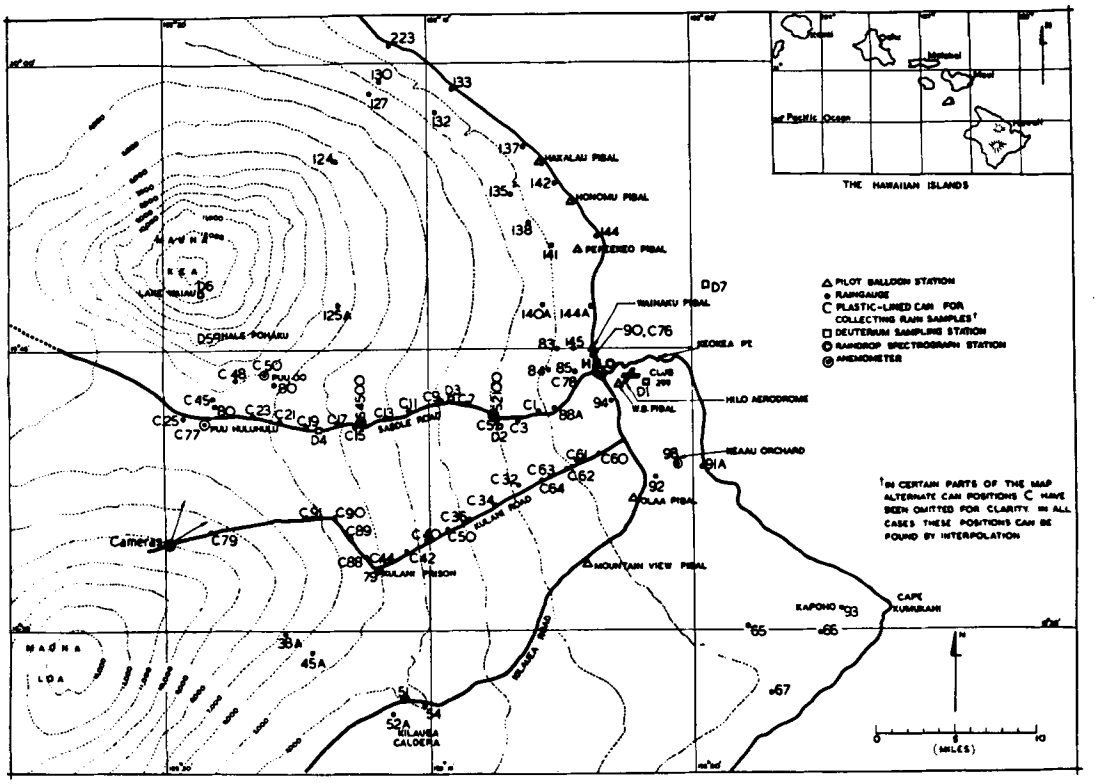

Fig. 2. Location map of Project Shower. Map shows the location of the special raingages (C_1, C_2, etc.), extra wind observations (Mountain Viev Pibal etc.), Camera locations and other observations mentioned in the reports and appendix.

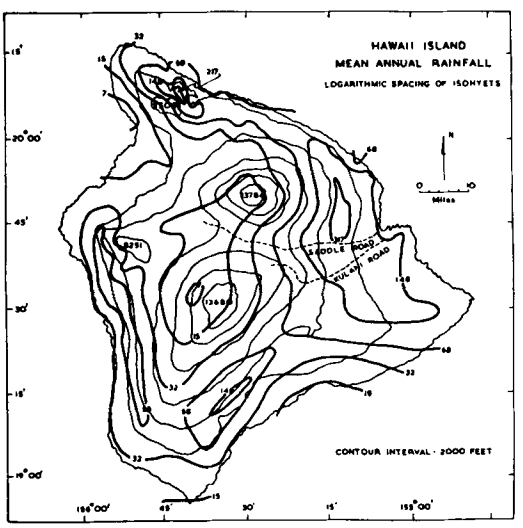

Fig. 3 a. Average Annual Rainfall in inches for the Island of Hawaii.

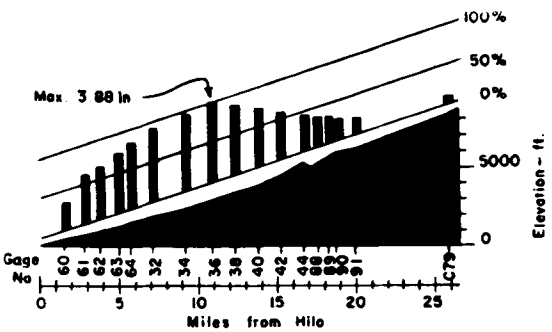

Fig. 3 b. Twenty-four hour rainfall for Kulani road raingages. Length of bars represents percentage of maximum rainfall measured. Gage number correspond to those on location map preceded by the letter »C«. Black areas show topographic profiles along the Kulani road.

with this annual pattern for their surprisingly consistent similarity. A typical daily rainfall gradient, measured during the project is given in fig. 3 b to demonstrate how consistently

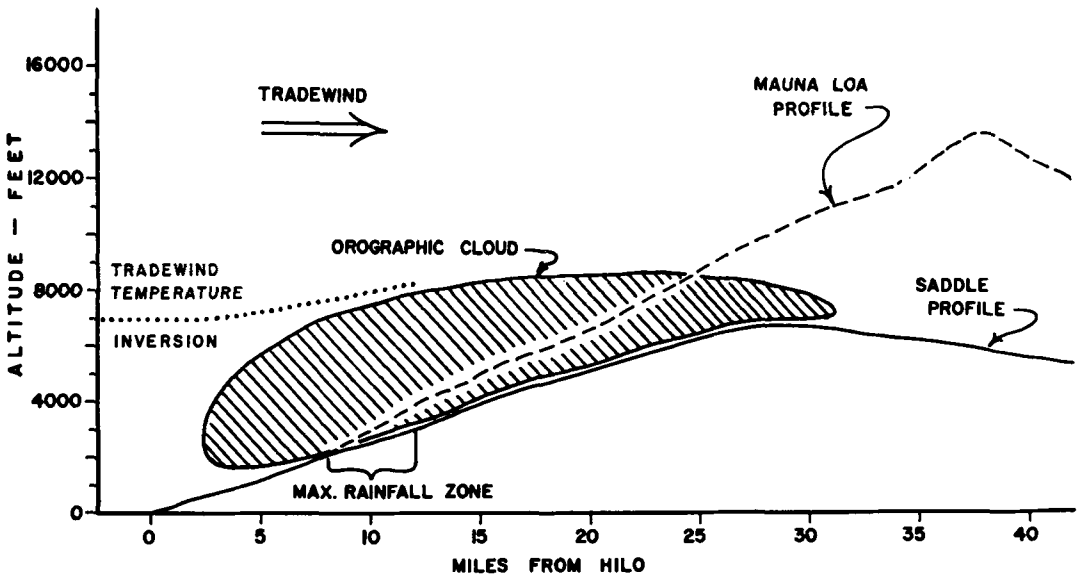

Fig. 4. Cross-section through Hilo (far left) and Mauna Loa-Mauna Kea saddle showing typical position of orographic cloud. Projection of Mauna Loa profile on cross-section is indicated by dashed line.

the rainfall decreases toward the crest of the Saddle area. Maximum rainfall corresponds roughly to maximum cloud thickness although both cloud base and cloud top rise toward the leeward edge of the cloud (fig. 4).

One of the advantages for study of this cloud was the fact that it has, essentially, four fixed boundaries, i.e. the mountain slope at cloud base, Mauna Loa at the south, Mauna Kea at the north, and the tradewind temperature inversion at the top (fig. 1, fig. 4). The tradewind temperature inversion is not a plane surface near the mountains but is distorted by the wind and the clouds curving upward 1,000 ft or more depending on conditions towards the mountains and the col area.

A second advantage, and a very important one for this work, was that here was an orographic cloud of sizable dimensions which, because of smooth terrain, could be flown through at low elevations by aircraft. The flights as described by Squires and Warner were made, for the most part, on a path which lay roughly over the Saddle Road shown in the schematic diagram and location map.

It has been mentioned that cloud thickness and rainfall decrease as one moves inland. This is also true of the average raindrop size (see Blanchard and Spencer) and the amounts of dissolved material in the rainwaters (see Eriksson).

In combination, then, these features provide some striking advantages for rainfall research as they offer near laboratory conditions for the measurements described in the pages that follow.

REFERENCE:

LEOPOLD, L. B., 1949: The interaction of trade wind and sea breeze, Hawaii, J. of Meteorology, **6** pp. 312—320.