Recent Instrumentation Developments In Meteorology

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This report is concerned with new instruments developed and in use in the past three years (since 1957) that are of current meteorological importance.

The report is divided into two basic classifications: instruments that are used at the base station, be it on land or sea; and those used in upper air measurements.

There are four new instruments or systems now employed at the U.S. Weather Bureau land based meteorological stations. The first is the Rotating Beam Ceilometer. This instrument is designed to give nearly instantaneous cloud heights at a point over the runway where a pilot on an instrument approach to a landing would leave the lowest layer of clouds and gain visual contact with the runway. This instrument is located on the runway area, and has a maximum height measurement of 4,000 feet. In the near future the U.S.W.B. hopes to have a model with a range comparable to the older fixed beam ceilometer, i.e., 10,000 feet.

The Transmissometer is an instrument devised to measure visibility at the runway. It is installed near the touchdown point which is normally one-third of the distance down the runway. This instrument uses a

projector and a light receiver usually spaced at a distance of 500 or 750 feet from one another. It will be used in conjunction with the rotating beam ceilometer to acquire much greater accuracy of data necessary for aircraft operation at the landing area. This model of the ceilometer is now installed at Will Rogers Airport in Oklahoma City.

The Hygrothermometer is a multi-purpose instrument designed to measure and record on a dial current air temperature, minimum and maximum temperature over any time span, and the dew point temperature. The dew point measurement equipment functions on the principle that a chemical salt solution has an equilibrium temperature i.e. solution does not absorb or give up moisture to the air. Electrical conductivity is used to create measurements. This instrument is now in use but it has one prominent fault, that is its remoteness from the runway.

The Automatic Meteorological Observing System (AMOS IV) is an amazing computer-recorder. It calculates sea-level pressure equivalent, runway visibility range, mean wind speed over several minutes, and cloud height distribution. This machine has a high speed operation of from 75 to 2,000 words per minute, and the ability to know when to make special observations. It also can prepare climatological records on either tape or punch cards. In the future it will serve by relieving weather bureau personnel of these tedious tasks. In addition it can also serve as a remote weather station when connected to a radio teletype.

Many advances are now in progress in gathering data from three-fourths of the earth's surface, namely the water surfaces.

The U.S. Navy and Coast Guard are the most active in this field, developing such instruments as the Transbuoy System developed by the Navy for use in the north Atlantic and north Pacific Oceans as a free-floating automatic weather station. Its transmitter has a range of up to 4,000 miles at night, and broadcasts barometric pressure, air temperature, sea water temperature, wind speed, and wind direction. The battery will operate for approximately six months, if used to broadcast for only three minute transmissions six times daily. Range Direction Finders located on shore fix its position, and thus its drift i.e. ocean current and surface wind force vectors, can be computed. The pilot model was first launched from a ship in 1957.

The Parachute Weather Buoy incorporates the good features of two older models known as the "grasshopper-type" station which was parachuted from an aircraft to the ground, and the free-floating weather buoy known as the "Hurricane Monitoring Buoy." It is able to operate for two months on six-hour intervals, and broadcasts wind speed, wind direction, barometric pressure, air temperature, and sea-water temperature.

The Boat-Type Automatic Weather Station is situated in a 20-foot long superstructure. Four water-tight wells hold the complex components plus eight other wells for battery storage or additional electronic instruments. It was developed for the Navy by Percival Lovell and William Hakkarinen at the National Bureau of Standards. The main problem in this operation was the anchorage which was solved by an elaborate system of ¾-inch polypropylene semibuoyant cable and ¾-inch chain. A 1¼-inch chain was used with a 500-pound mushroom anchor to moor it.

Great strides have been made in observations of the upper air. Such improvements as the new Weather Surveillance Radar 57 with a range of up to 250 miles is now in operation at various stations including Will Rogers Airport. It is differentiated from the older models in that it has two receivers, one with linear and the other with logarithmic gain sys-

tems. The latter receiver improves the hydrologic portion of the set. This set is also equipped with a companion photorepeater scope to which is attached a camera for photographic reproductions.

In the near future the U.S.W.B. hopes to have these sets installed from coast to coast. These sets will be connected to an automatic collection of radar-scope displays at central locations. The incorporation of a number of the displays at central locations into composite maps will show the rainfall distribution over large areas.

Correlated radar which increases strong incoming signals and diminishes those that are random is now in operation. This relatively inexpensive system was first tested in the Dallas area on an FPS 10 radar set stationed at Duncanville, Texas on the fifth of May 1959. The correlator can be switched off at will and the regular radar picture will still be visible. Other details are unavailable due to military security.

The new radiotheodolites are equipped with provision for the new transponder principle attachment which measures the slant range of observation balloons. The new radiotheodolite tracking unit will increase the maximum measurement of the wind from 49 miles per hour (in the old SCR-658 set) to 124 miles per hour in the new one (WBRT 57) at a balloon ascension rate of 350 meters per minute.

The Naval Transosonde System is a floating constant-level balloon system used to obtain trajectories of air parcels, upper-air wind data, atmospheric pressure and soon — air temperature and humidity. These data are being gathered over the Atlantic and Pacific Oceans at an altitude of 35,000 feet. It is used in conjunction with the Transobuoy System to furnish meteorological information similiar to regular land based analysis and forecast centers.

It is to be noted that much has been accomplished in the field to rocketry and satellites such as the Rocketsondes, Tiros I, and the Pioneer V Space Probe. While this paper does not discuss these new explorer vehicles they should be mentioned at this time, and kept in mind with future developments in the field of meteorological instrumentation.

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