UNITED STATES DEPARTMENT OF COMMERCE
WEATHER BUREAU
WASHINGTON

June 7, 1963

IN REPLY, PLEASE ADDRESS
CHIEF, U. S. WEATHER BUREAU
WASHINGTON 25, D. C.
AND REFER TO
C-3.1

MEMORANDUM

TO : Area and State Climatologists, NWRC, Field Aides (HC), Field Aides, Regional Substation Management Units, River Forecast Centers, River District Offices, and Area Hydrologic Engineers (with copies to Regional Administrative Offices, Agricultural Service Offices, and Agricultural Forecast Offices for information)

FROM : Director, Climatology

SUBJECT: Climatological Services Memorandum No. 99

CLIMATOLOGICAL SERVICES OF THE U. S. WEATHER BUREAU 1963

In May 1961 Climatological Services Memorandum No. 86 was issued summarizing the status of the Office of Climatology as it existed at that time. In order to bring the information up to date, the attached new summary has been prepared.

H. E. Landsberg

USCOMM-WB-DC

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U. S. DEPARTMENT OF COMMERCE
WEATHER BUREAU

CLIMATOLOGICAL SERVICES

OF THE

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Washington, D. C.
May 1963

CLIMATOLOGICAL SERVICES OF THE U. S. WEATHER BUREAU, 1963

Introductory Note

The program of the Office of Climatology is under scrutiny by an Advisory Committee on Climatology appointed by the National Research Council. The Committee was established in 1955 at the request of the Chief of the Weather Bureau to furnish advice on progress in climatology, and to evaluate independently the technical program of the Bureau in climatology. The present membership of the Committee is as follows:

1. Dr. William E. Reifsnyder, Chairman of Committee
   School of Forestry
   Yale University
   New Haven, Connecticut

2. Dr. Douglas B. Carter
   Department of Geography
   Syracuse University
   Syracuse, N. Y.

3. Professor Vaughn Havens
   Department of Meteorology
   Rutgers University
   New Brunswick, N. J.

4. Dr. John R. Mather
   University of Delaware
   Dover, Delaware

5. Dr. David H. Miller
   Pacific Southwest Forest and Range Experiment Station
   Box 245
   Berkeley 1, California

6. Dr. Norman J. Volk, Director
   Agricultural Experiment Station
   Purdue University
   Lafayette, Indiana

The Committee meets about twice a year. The 15th meeting was held in May 1963 at Rutgers University. Minutes of all previous meetings have been reproduced in Climatological Services Memorandums (see numbers 50, 53, 54, 57, 61, 65, 68, 69, 75, 78, 80, 85, 90, 94).

I. Historical Background

We can attribute to Thomas Jefferson the early recognition of a need for systematic records of the climate of the United States. His lifelong interest in climatological work found only limited response in his own era. About a century after Jefferson published his first climatological notes a firm framework emerged for a survey of this most important natural resource of the country.

We can follow this development from a review in the "List of Climatological Records in the National Archives".* Although private records of United States weather had been kept for various lengths of time in a number of scattered localities, we read there that "No organized systems of taking meteorological observations were developed until agencies of the Federal Government interested themselves in the matter in the early part of the nineteenth century." Weather records were collected during the 19th Century by the Surgeon General's office, the General Land Office, the Smithsonian Institution, the Patent Office, and the Signal Corps of the Army. Finally the U. S. Weather Bureau was established in 1891 in the Department of Agriculture. This followed some twenty years of weather service rendered by the Office of the Chief Signal Officer of the U. S. Army. The new civilian Bureau inherited an operating system of work-processes along with the personnel, instruments, and a national network of stations and offices from the Signal Service. Reports of storms and effects of weather on crops, and a growing literature on weather and climate in general were part of the Signal Service inheritance.

Army Post Surgeons were first required by Dr. James Tilton, Surgeon-General, to "....keep a diary of the weather" in a May 2, 1814 order, and specific climatological objectives were outlined in the Surgeon General's order of 1817 which specifically relates the purposes of Army post weather observations to "medical topography ... prevalent regional complaints ... change of climate ... cultivation of soil ... density of population...." Around the middle of the century the Smithsonian Institution set up a system whereby voluntary observers were for the first time supplied with standard instruments, and this cooperative observer system continues in operation in the Weather Bureau today. Because of the possibility of forecasting destructive storms on the sea coasts and Great Lakes, Congress was persuaded to authorize the Weather Service from which the present Weather Bureau developed. The Act of October 1, 1890, creating the Weather Bureau, however, farsightedly included among the specific duties of its Chief "the taking of such meteorological observations as may be necessary to establish and record the climatic conditions in the United States."

The beginnings of a Climatological Service were already in operation on July 1, 1891, when the civilian Weather Bureau began its work. Over 2,000 stations were recording daily amounts of precipitation and maximum and minimum temperatures, and 180 more were observing atmospheric pressure, wind, clouds, and sunshine duration. Weekly reports were being published on the effects of weather on cotton and other crops. The published Annual Reports of the Chief Signal Officer and the Monthly Weather Review contained summaries, tabulations, and discussions of the nation's weather, pressure, temperature, precipitation, winds, atmospheric electricity, droughts, forest and prairie fires, sunspots, sandstorms, and other weather phenomena.

*List of Climatological Records in the National Archives, Washington, D. C.: March 1942, The National Archives Special List No. 1.

The public need for an agency to record and interpret the climates of the United States was recognized early in the history of the Weather Bureau by establishment of a Division of Climatology and Hygiene in 1892. The name was later changed to Climate and Crop Weather Division. The Office of Climatology is the direct descendant of these Divisions.

Industrial and agricultural developments have placed further emphasis in the last half-century on the demands for climatological information: a need for data and interpretations useful for planning of crops, housing, marketing, shipping, aviation, air conditioning, flood control, manufacturing, insuring against weather risks, and many other agricultural and commercial aspects.

This survey summarizes the program and facilities of the Office of Climatology as of Spring 1963. It shows our present operations and some of our plans for the future.

II. Present Organization

The Office of Climatology is located in Suitland, Maryland. It is part of the Central Office of the Weather Bureau, Department of Commerce (Washington 25, D. C.). There are four operating branches in the Offices, each with three or more sections; and a Chief Climatologist responsible for consulting services (see Figure 1).

The Climatological Investigations Branch carries on developmental work in methodology and applications of climatic data. It is made up of: (1) the Dynamic Climatology Section whose function is to study problems of aerological and synoptic climatology, microclimatology, and climatic trends; (2) the Bioclimatology Section which explores applications of climatology to plant, animal, and human life processes; (3) the Analytical Climatology Section which develops new procedures in statistical climatology and adapts machine and computer techniques to climatological problems; and (4) the Special Projects Section which handles special development programs.

The Climatic Field Service Branch handles staff functions for the climatic field activities of the Weather Bureau including the National Weather Records Center through: (1) its Field Programming Section which determines areal requirements for climatic observations, establishes bench-mark stations, and coordinates network operations, including staff advice on manning; (2) the Field Liaison Section which maintains operating contact with climatic personnel at State and Territorial climatological offices; and (3) the Climatic Documentation Section which determines methods and procedures for recording, processing, reproducing, and publishing climatic data.

The Climatic Advisory Services Branch develops policies and procedures for the dissemination of climatic information to the general public, to commerce and industry, and to other government agencies. A natural geographic division of much of the available data permits a logical division of the branch into three sections: Domestic, Foreign, and Marine. The Domestic Area Section is concerned primarily with the United States and its territories, including the issue of periodical bulletins, summaries, and other publications. These include the Weekly Weather and Crop Bulletin and the climatological

sheets for the National Atlas. Liaison is maintained with agricultural and commercial users of data to keep abreast of new developments and needs. The Foreign Area Section supplies United States users with climatic information about foreign land areas and data sources for foreign areas are continually surveyed. The Marine Area Section is responsible for furnishing climatic information over ocean areas. This includes plans for the care and use of marine climatic data and the maintenance of liaison with maritime interests. The "Mariner's Weather Log" is published by the section and appropriate climatic information prepared for publication in the United States Navy "Sailing Directions" and "Pilot Charts", and the Coast and Geodetic Survey "Coast Pilots".

The National Weather Records Center (NWRC) (see Figure 2) is located physically at Asheville, North Carolina, but it operates in most respects as the major operating Branch of the Office of Climatology. It has broad autonomy with direct responsibility for its own administrative and personnel actions and much of the total program. It furthers the interests of the National Weather Service and those of the specialized weather services operated by the military departments. The latter make use of NWRC as a common facility, but maintain there, as required, units of their own. The Air Weather Service, USAF, for example, has a staff of some 200 people and large scale computer facilities engaged in checking observations from its global network and providing climatological support to the Air Force.

The NWRC receives and processes surface data from more than 12,000 surface weather observing stations (regular Weather Bureau, Air Force, Navy and Cooperative), and upper air data from over 250 locations. Under an NWRC quality control program, the data are checked for accuracy and printer's copy for various climatological data publications is prepared. NWRC is the official agency designated by the National Archives as repository of all historical U. S. weather records. NWRC is responsible primarily for the assembly, quality control, processing and analysis, publication and final storage of U. S. climatic records, and a fast-growing file of weather records around the world on land and sea. This includes everything recorded about weather, from the contents of widely scattered weather journals kept in the 18th Century to the standardized regular entries being made now at upwards of 12,000 observing stations in the U. S., some hundreds of which record not merely the familiar once-daily temperature and precipitation values but hourly observations of these and a dozen other elements, as well as upper-air soundings of wind, pressure, temperature and humidity. NWRC furnishes many information services and specialized analyses based on its vast collections. The real purpose of the Center is to make the climatological data available in a suitable form for use in making decisions involving strategy, time and money. Collecting and checking the records provide the raw material for this purpose.

Since 1947 most U. S. weather observations have been recorded on punch cards and processed by machines. The expanding capabilities of punched card and magnetic tape systems have permitted continually increasing statistical summarizations and specialized studies without increasing the staff of less than 400 people. Requests from private citizens, industry, other government

agencies, universities and foundations are filled by the NWRC. The client pays the actual costs for his project.

The Chief Climatologist acts as adviser and consultant to all Bureau units on statistical and climatological problems. Basic statistical and climatological research necessary to the development of the programs of the Office of Climatology are carried out. Results of statistical research are adapted to climatological programs of the Bureau, and leadership is provided in the solution of problems in the field of climatology, and in the practical applications of meteorological statistics.

The Climatic Field Service is handled by Area and State Climatologists. Present plans call for five Area Climatologists in the continental United States, and another for the Pacific Area including Hawaii and the Trust Territory. Figure 4 shows their respective regions. As of early 1963 five of the six positions have been filled. The Area Climatologists are members of the scientific staff of the Office of Climatology. Their primary purpose is to furnish technical guidance to the State Climatologists and to handle larger regional problems. They also maintain contacts with regional private and government organizations. In the past eleven years, Area Climatologists have been instrumental in developing a number of special studies of climate-crop relations. These have resulted from their cooperation with the various regional groupings of Agricultural Experiment Stations. Area Climatologists have negotiated many cooperative agreements with State Universities whereby weather data taken prior to 1947 were placed on punched cards by University personnel. Various analyses of these cards are now under way.

The State Climatologists are responsible for climatological services within their respective States. This includes some recurring duties (for example, cooperation in preparing a weekly weather and crop bulletin for the State, collection of reports on severe storms, writing of climatological narratives to accompany data summaries). They cooperate with Agricultural Experiment Stations on studies of relations between climate and crops, irrigation problems, influence of climate on pests, etc. They encourage the use of climatological data for industrial, engineering, and commercial applications in their States and help State agencies, where appropriate, with climatological problems. Climatological Services Memorandum No. 87 is devoted entirely to the activities of State Climatologists.

III. Station Networks for Climatological Needs

The networks of observing stations which yield weather information useful for climatological purposes comprise (in 1963) more than 12,000 localities in the United States and the Caribbean. Since continuity in climatic records is very important, stations of three networks are maintained with a minimum of change. These three networks are: (1) the network of Principal Climatological Stations, called the 24-hour climatic network, (2) the network consisting of the foregoing plus the Ordinary Climatological Stations, called the "a" network, and (3) the Climatological Bench-Mark network of long-record temperature - and - precipitation stations. These climatically representative stations were chosen specifically for continuity value and prospective permanence.

The 24-hour Climatic Network of 179 First Order Weather Bureau and Federal Aviation Agency stations is shown in Figure 5. With few exceptions, these stations record each hour a complete surface weather observation. This includes wet- and dry-bulb temperatures, dewpoint, relative humidity, sky cover, cloud types with height and direction of movement, wind direction and speed, atmospheric pressure and tendency, ceiling, visibility, and present weather. Although far less numerous than those of the basis "a" network these 24-hour stations represent a fairly uniform national grid. They add to the data obtained by the "a" network in important ways: they provide dependable records of important climatic elements not observed at the "a" stations, and they supply data about the diurnal variation of temperature, wind, cloudiness, and other weather characteristics.

The "a" Network consists of about 5,000 stations manned chiefly by cooperative volunteer observers. It includes only those stations required to provide an adequate sample of data for areal statistics on weather and climate. The network ordinarily contains one station per 600 square miles.

The Climatological Bench-Mark Network has as its primary purpose the collection of data in negligibly changing local environments suitable for monitoring climatic changes. The number of stations considered necessary for this purpose is between 30 and 50 in the coterminous United States, plus about 10 in the other States and Territories (most of them in Alaska). Of 29 continental stations, shown in Figure 3, 19 are fully qualified for the network, having met strict criteria involving stability of location, freedom from environmental influence and change, reasonably long history of homogenous observations, and good prospects of future continuity. Negotiations are in progress for their official designation as Bench-Mark stations. Other stations will be so designated in the future. The stations are located for the most part on property owned by the Federal or State governments or public institutions (e.g., in National Parks, at Experiment Stations, or on University campuses) where supervision of the observing program, uniform instrument exposure, completeness and accuracy of record, and freedom from molestation are fairly well assured. It is planned to add recording equipment for observations other than precipitation and temperature (e.g., wind, solar radiation, soil moisture, soil temperature, and eventually, also electric potential, atmospheric pollution and radioactivity).

The "b" (hydrologic) network comprises precipitation-observing stations used primarily for river and flood forecast purposes, but important climatologically, too.

Another group of substations only is that generally referred to as the "c" network. It is not a network in the true sense of the term since the stations comprising it do not follow a planned system for one specific purpose such as those that make up the "a" or "b" networks. These "c" stations consist of (1) those required primarily for local public services; (2) those having a long record of observations but which are not included in the "a" or "b" network; and (3) special purpose stations such as those at experiment or research farms, at tower sites, and those reporting soil temperature or soil moisture data.

"First Order" stations are operated by one or more full-time employees, and their primary functions are taking observations (sometimes 24 a day), dissemination of forecasts and warnings, and furnishing weather information for the press, radio, and television.

Figure 7 gives an idea of the general distribution of all stations in the 48 United States.

Upper-Air Stations. The history of the observation, processing, analysis, and publication of climatic data for the upper-air closely parallels the history of developing air traffic. However, 19th Century climatologists already clearly recognized the importance of this part of atmospheric climate. The lack of workable data precluded anything like the study and evaluation of the forces in the third dimension. With the development of aviation, demands for information about the upper levels of the atmosphere multiplied. Instruments and methods were developed to obtain better data from the higher layers of the air. Kite observations preceded regular aircraft operations and continued until they were displaced by the airplane-observations (APOBS) of the 1920's. They consisted of mechanically recorded data on temperature, barometric pressure, relative humidity, and wind velocity to heights of about 3,000 meters. They were the chief data for early theoretical work on atmospheric structure. They proved the very great importance of upper-air information, at all levels, for explanation and prediction of the weather.

The expansion of aviation required regular weather information for safety and economy of operations. This led to the beginning of scheduled APOBS, in which an improved meteorograph (for automatically recording humidity, pressure, and temperature) was carried aloft in airplanes to heights of 4 to 5 kilometers. In many ways these APOBS were superior to the kite observations, but there were also bad limitations. They had to be made near localities with airport facilities. When the weather was hazardous, but most interesting to meteorologists because of high winds, icing, low clouds, the flights were often cancelled.

The number of APOB stations increased to 30 by 1937. In that year radiosondes were adopted as the upper-air recording instruments (for temperature, humidity, and pressure) and the first two radiosonde stations were established. In the next few years the APOBS were discontinued altogether. The military services established scores of radiosonde stations as aids in wartime aviation activities in the United States and abroad. At the same time the number of such stations operated by the Weather Bureau for civilian aviation, weather forecasting, and research needs steadily increased. By 1961 there were 138 radiosonde stations operated by the Weather Bureau. Figure 6 shows the complete radiosonde-rawinsonde network.

In addition to the elements of air-pressure, humidity, and temperature discussed above, observations of cloud base and upper level winds have also improved greatly with the progress of aviation. The heights of cloud bases were measured by ceiling balloons in earlier years. Now this is done with greater accuracy by the ceilometer, an instrument that measures electronically the angle between the horizon and a spot of light projected to the

cloud base. Mathematical relations are then worked out mechanically by the instrument to give a value of cloud height. Ceilometers have now been, or will shortly be, installed at all major airports.

For upper-level wind observations of speed and direction, pilot balloons (pibals), followed by theodolite and plotted (azimuth and elevation angles at 1-minute intervals) progressively throughout the observation, have been used since the beginning of the Weather Bureau winds-aloft program in 1917. Since 1917 wind observations have increased from 5 to 290 observing points, including a large network of stations taking rawin (winds aloft observation made by balloon and radio methods, without optical aid).

At this time, almost all radiosonde stations have been converted to rawinsonde stations, i.e., taking both radiosonde and rawin observations simultaneously. By these methods, observations are often taken to altitudes exceeding 100,000 feet. The value of these data, both in furthering knowledge of the atmosphere's behavior and as guidance material for airplane designers and airline operators is incalculable. Similar information is of vital concern in planning for Civil Defense against the dangers of fall-out from nuclear blasts and in the structural design of rockets.

Plans for Specialized Observations. It is evident from some of the foregoing that the basic daily temperature and precipitation readings taken at the unpaid climatological substations were practically the only observations made primarily to serve climatological needs. The observations of other elements - e.g., surface wind, sunshine, clouds, humidity, etc. - were made mainly to serve forecasting and other purposes. Any value the observations might have for climatology was secondary and coincidental.

In effect, we have had a fairly good coverage (2,000-12,000 stations) for 60 to 80 years of temperature and precipitation values for the 3,000,000 square miles of the U. S. proper.

However, for the numerous other elements that make up the climate we have had for the same area and time-period only from 200 to 300 predominantly urban observing stations. For some purposes (related primarily to forecasting practices and local interests) this number and kind of observing points has served more or less satisfactorily. For many other needs where local influences of topography or environment, for instance, might distort the natural measures of weather or where a small-scale survey required a greater density of registering points, neither the number nor the type of these stations has been sufficient.

How to correct this deficiency is both an important and complex problem. Agriculture needs more information on temperature, humidity, wind, and radiation in the lower layers of the atmosphere and on temperature and moisture in the soil. Engineering, now reaching into all corners of the country with housing and highway construction, stream regulation, heating and air conditioning, has ever increasing requirements for local climatological information. Heating and cooling load, water supply and drainage, health and recreation all depend on climatic factors. The question of how best to get data

for these purposes also includes questions of how many observing points are needed, whether the number per thousand square miles should be the same for the Great Plains as for the Rocky Mountain States, how this number compares for Arizona and Alabama, for the Pacific Coast and the Great Basin.

Besides this general question of the spread and density of stations-for-climate there is also the question of instrumentation. Specific items, at present very much alive in this question, are a dial-type maximum-minimum thermometer employing a mercury-in-steel sensing element, a recording precipitation gage, a substation wind recorder, a recording hygrothermograph. Also, automatic recorders for isolated island and mountain stations are under development; plans for microclimatic observations (probably at State or Federal Experiment stations) are part of the larger plan for expanded cooperative work with other agencies in agriculture, and exploratory work is well under way in a program for gathering much-needed data on soil-moisture, subsurface temperatures, evaporation, and evapotranspiration.

Because the only means of meeting many requirements for climatic data is through finely detailed micro-climatic observations, while for others the values obtained in the regular network are sufficient, plans for a way to serve both needs have been included in the Weather Bureau decadal plan. One favored idea is to establish in significant areas mobile observing units to pin down the relations between micro- and ordinary climatic observations by correlating a short-period micro-record made by the mobile station with records from stations in the macro-network. This should provide guidance for more specific interpretations than is now possible without micro-observing facilities or data.

IV. Present Practices in Climatological Data Processing

After observations have served their immediate operational uses in weather intelligence and forecasting, they have in the past been subjected to three major treatments. First, they were checked and edited, both to assure the quality of the observational program and to avoid inclusion of gross errors in the climatological record. Secondly, they were summarized and prepared for publication in current monthly and annual bulletins. Thirdly, they were stored, organized and catalogued for use in long-term climatic studies and research analyses.

Prior to 1948, these three actions were conducted at several hundred stations.

In 1948, however, with the establishment of the Weather Records Processing Centers (WRPC), the previously diffuse processing of climatological data was drawn together, standardized, and streamlined into an integrated procedure which operated on a current basis and used modern punched card processing techniques. This streamlining has continued with the consolidation (in 1962 and 1963) of the three WRPCs with the National Weather Records Center (NWRC) at Asheville, N. C.

In this program the observational records from more than 12,000 observing points now flow into the NWRC. There the data for most cooperative stations are transcribed currently to punched cards. At the several hundred first

order stations observers punch their own surface observation cards and mail them weekly to the NWRC. The cards are immediately put through a variety of machine runs which screen all elements of the data for reasonableness, flagging entries that fall outside tolerances established by the meteorologist. Observational specialists then edit the flagged entries in detail, and correct the errors disclosed by this editing. It is thus possible, within a time lag of a few weeks, to keep observing stations fully informed about the quality of their observing programs and records.

After editing the punched card record, data are prepared for current publication in monthly and annual state Climatological Data bulletins. Punched-card machine methods are used throughout this process, even to the preparation of final printer's copy on punched card tabulators. This machine-prepared copy is then assembled, photographically reduced, and printed on high-speed offset presses.

The data and punched cards then become part of the centralized weather records library at the National Weather Records Center. Long-term climatological summaries and analyses of the data for research programs are carried on at the NWRC. A wide array of punched card data processing and computing machines is used there, including a variety of electronic digital computers which are capable of performing very sophisticated statistical and mathematical operations on the data.

Development Work in Progress and Planned. Problems in servicing and processing climatological data, by no means completely solved, have in one sense even been aggravated by the accelerating advances in automatic data-handling and processing techniques. An example of this is the need for reduction of the growing mountain of perishable punched card records to a more efficient size, more permanent record-medium, and lower storage and maintenance costs.

In cooperation with the Bureau of Standards and the Census Bureau, equipment has been developed to reduce our punched card library to microfilm, with automatic future recall of the data whenever and in whatever form required. The Census Bureau has built, to Weather Bureau specifications, a punched-card-feeding microfilm camera that will microfilm 840 cards per minute, placing approximately 13,000 card images on a 100-ft. roll of 16 mm film. With this camera our entire present card library, jammed into 30,000 sq. ft. of floor space, could be housed in less than 300 sq. ft. of microfilm files. (If the present rate of accumulation is maintained, the presently allotted 30,000 sq. ft. of library space would be adequate for the next 1,000 years!) More than 100,000,000 cards have already been microfilmed, and the cards disposed of.

This reduction of punched cards to microfilm as a medium for machine processing has been made practical by the development of a Film Optical Scanning Device for Input to Computers called FOSDIC, a prototype of which has been built by the Bureau of Standards to Weather Bureau specifications. FOSDIC is a high-speed automatic means for reading the microfilm of punched cards. It employs the flying spot of an electron gun to scan the image of a punched card projected onto the screen of a cathode ray tube similar to the picture tube in a TV set. The prototype FOSDIC scans the microfilm for selection of

desired microframes at a rate of 4,000 frames per minute, and reads the data from the selected frames into a card-punching machine, for re-creation of the punched card record. A second model is under construction and will serve as direct input to high-speed electronic computers, or as input to conversion of the data to other high-speed media, such as magnetic tapes; and will operate at four times the speed of the prototype.

The reduction of the ever-growing volume of original meteorological observation forms another problem in data handling. In the past, attempts have been made to utilize standard microfilm techniques, but this has not been entirely satisfactory because it is impossible to organize data on film in a manner sufficiently versatile for their utilization in varied types of technical investigations.

The obvious solution is to develop a unitized type of micro-record similar to the micro-card but one which will provide a negative film copy at a cost comparable to standard microfilm. Such negative film could be used in the preparation of inexpensive positive (paper) copy which could be used with standard micro-card viewers. An automatic document-feeding 70 mm microfilm camera has been built which places several small images across the 70 mm film, resulting in a film negative similar to a micro-card. This camera has been named MIMiC (multiple image microcopy camera) and will be used in the filming of climatological records.

Another method for unitizing roll film microfilm is to cut the film into short strips and to load these strips into clear plastic jackets. This method has been used elsewhere for many years, but it has never been considered to be efficient enough for our purposes. Recent development of a semi-automatic jacket loader, however, has made this system more attractive, and it is planned to use it with climatological data microfilm. A unitized microfilm approach, using equipment which will automatically convert roll film to the sheet format, is also being planned for meteorological satellite cloud pictures.

In accordance with the Federal Records Act of 1950 the Weather Bureau has established a disposal program which, in general, provides for destruction of original recorder charts after 5 years, if microphotographic copy has been prepared. Similarly it provides for destruction of manuscript observational records after 30 years if microphotographic copy has been prepared.

V. Routine Publications

The number of people and purposes requiring climatological data is so great, and the variety of uses so wide, that the problem of publication will perhaps never be solved to the satisfaction of everybody. The program now in effect has been shaped by three-quarters of a century's experience with public needs combined with Weather Bureau capacities and limitations. It serves to make the basic data available on a broad scale, rather than to serve specific applications. Even so a casual examination of the publications might suggest that the Climatological Data and the Weekly Weather and Crop Bulletin are purposely intended to serve non-urban and agricultural interests, that the Local Climatological Data is meant to please large cities, and that its

Supplement favors aviation; but a closer look at these publications will show that each actually reflects the motive to serve as many users as well as possible.

The Weekly Weather and Crop Bulletin, National Summary is usually published each Tuesday at noon. It carries information of particular interest to agriculture. Crop data are collected in cooperation with the Statistical Reporting Service of the U. S. Department of Agriculture and with State agricultural agencies, and are combined with descriptions of concurrent weather. The section "Weather of the Week" is presented along with special discussions of the effects of weather on crops and farm activities. In season, small grains, pastures, corn, cotton, soybeans, and other crops are discussed separately. Weekly temperature and precipitation and monthly heating degree-day data are given in chart or tabular form. Near the 1st and 15th of the month the monthly Weather Outlook of the Extended Forecast Section is included, and in the first issue of each month charts of total precipitation for the previous month and departures from normal are given. When farm activities are at their peak, a written summary of conditions in each State is included covering the status of crops and the weather effects. Special articles of general interest to agriculture, such as droughts, are written from time to time, and charts and tabulations of current importance are also included. During the spring, ice conditions on the Great Lakes are discussed prior to opening of the shipping season.

The Local Climatological Data publication (Figure 8) is prepared monthly for nearly 325 cities in the United States and outlying stations. This publication includes daily climatological information and summaries for the month. Also included, where available, are hourly precipitation data. Brief summary tables of averages, departures, and extremes of temperature, precipitation, barometric pressure, and heating degree days are also included.

A monthly Supplement to the Local Climatological Data (Figures 9 and 9A) is published for over 225 stations where 24-hourly observations are taken each day. The supplement contains nine basic tables as follows:

A. Temperature and Wind Speed-Relative Humidity Occurrences (hourly observations).
B. Wind Direction and Speed Occurrences.
C. Hourly and Daily Occurrences of Precipitation Amounts.
D. Ceiling-Visibility Occurrences (hourly observations).
E. Occurrences of Weather by Hour of Day.
F. Averages by Hours.
G. 24-Hour Averages.
H. Occurrences of Weather by Wind Direction.
I. Hourly Observations.

For stations issuing the Local Climatological Data, an annual issue, Local Climatological Data with Comparative Data, contains a brief description of the general climate of the locality and a station history. One table shows data recorded for the past year - monthly totals, averages, and in some cases extremes of the elements of temperature, precipitation, relative

humidity, wind, sunshine, and degree days. In addition, there is a table of normals, means, and extremes of the same elements for the period of record. Tables of average monthly and annual temperature, precipitation, degree days, and snowfall cover the period of record since the beginning of this century.

A periodical Climatological Data is issued for each State (or group of States). It covers observations from all regular networks. The monthly issue contains daily maximum and minimum temperatures, daily precipitation, snowfall and snow on the ground, evaporation and wind, and soil temperature in addition to monthly summaries. The annual issue contains monthly and annual averages and departures from long-term means of temperature, precipitation, and evaporation; total wind movement; soil temperature and soil moisture tables; a table of temperature extremes and freeze data; a station index and a location map.

Climatological Data, National Summary contains pressure, temperature, precipitation, and wind data for selected U. S. stations. There is a general summary of weather conditions over the country. Special articles describe hurricanes, unusual weather, and river and flood conditions. A table summarizing severe storm damage by States is also included. Average monthly radiosonde and pilot-balloon data are presented in tabular form; so are solar radiation data. Charts of the United States graphically portray temperatures, precipitation, snowfall, percentages of sunshine, tracks of cyclones and anticyclones, solar radiation, and monthly average upper air winds and heights. The annual issue presents summaries of all these data for the year and includes information on excessive rainfalls, hurricane tracks and tornado paths.

Storm Data presents by States the place, time, character, and estimated damage of all reported severe storms or unusual weather phenomena. It is published monthly.

Climatic Data for Northern Hemisphere and World. For research and as a historical record, the value of a series of maps which show the continuity of weather over the largest possible area has been obvious for a long time to everybody concerned with the study of meteorology and the history of weather. The first successful attempt to do something about it was launched in 1873 by the Chief Signal Officer of the Army, before the Weather Bureau was established, and on July 1, 1875, with the United States defraying all expenses, the daily issue of the "International Bulletin of Simultaneous Reports" began in Washington. By 1878, with the cooperation of other countries, it became possible to start a series of daily international weather charts covering the Northern Hemisphere principally. This series continued through 1887.

By 1891, when the Weather Bureau was established, this series had stopped, and thereafter was not resumed for half a century. There were probably several reasons for this, including two wars and the beginning of another, but the most compelling reason was the lack of sufficient money to gather and publish the material. In 1941, however, with aviation established as a major war weapon, and with demands for world-weather knowledge critically increased, the Army, Navy, and Weather Bureau joined forces to produce the first ten years of a series of analyzed Historical Northern Hemisphere maps.

Thanks to the help of the Air Force this historical series was extended back to 1899, and carried forward. In the post-war period it was jointly supported by the Weather Bureau, Navy and Air Force, but the Weather Bureau assumed complete responsibility for this publication in 1955. It is now a series of synoptic surface and 500-mb charts, and listings of data for the entire Northern Hemisphere. The charts are for 1200 Greenwich Mean Time. Because of their proved value in many fields, the "Data Listings" are published as daily bulletins. It contains the 0000 G.M.T. upper air observations and the 1200 G.M.T. surface observations for the entire Northern Hemisphere. In addition, it contains all other upper air observations available for North American stations and for overseas bases operated by the United States. The listings and charts are prepared by a special section at the National Weather Records Center. In order to cover more fully the meteorology of extreme weather conditions (hurricanes, for example) it is planned to publish many more surface and special data associated with the critical weather periods and events.

The Mariners Weather Log is a bimonthly publication containing meteorological information for the maritime industry. Included is material on weather and shipping on the Great Lakes as well as on the oceanic areas in the Northern Hemisphere. Each issue usually contains two major articles and several smaller contributions of current maritime interest. Recent ocean weather is described and a table of selected ship gale observations is included. Regular features include cyclone tracks North Atlantic and North Pacific, Climatological Data U. S. Ocean Station Vessels, and a marine diary of average weather conditions.

VI. Special Service Programs

Upper Air Summaries. Up to about 1950, the best summaries of winds over the United States appeared in the Weather Bureau's 1941 Airways Meteorological Atlas. This contained upper-level wind data for 58 stations in the continental United States. The bulk of these observations were for 500-, 1000-, 3000-, and 5000-meter elevations. Above these levels the data were extremely biased towards lower-speed and fair-weather winds. The reason for this was that the summaries were all based on pilot-balloon observations, which became very selective in high winds and foul weather.

With the development of aircraft capable of flight in almost all types of weather, the need for better summaries became increasingly acute. The advent of jet aircraft, with requirements for flight at higher elevations, made new data imperative. This is how the needs were met:

The Weather Bureau, under Navy sponsorship, produced 3 volumes of wind data from 111 stations ranging from Korea across the Pacific, the United States and the Atlantic to the coast of Europe, including data to heights of 40,000 feet based primarily on rawin observations. Bias at higher elevations was eliminated by geostrophically scaling winds for missing observations, with the effect of including as many values at 40,000 feet as at lower elevations. These are presented in the form of wind rose tabulations, by direction and speed groups. Also, wind aid values for aircraft flying in any of the 16 cardinal directions were computed for each observation by a new method and

presented in frequency distributions. Summaries showing the percentage probability of any given amount of wind aid or retardation were shown by seasons for various routes.

The Weather Bureau, in cooperation with the Sandia Corporation, computed wind vector and vector deviation values for 13 surfaces ranging from 950 to 30 mb., for a large network of stations. All missing values at each level were filled in, so that this 5-year summarization is based on as many observations at 30 mb. as were available at 950 mb. The Weather Bureau has published the Upper Air Climatology of the United States (issued as Technical Paper No. 32) in three parts. Part I contains average monthly values of height, temperature, humidity, and density for all standard pressure surfaces for all raob stations having at least an 8-year record for the period 1946-1955. Part II contains extremes and standard deviations of height and temperature. Part III is a summary of vector winds and wind shear at various pressure surfaces between 500 and 30 mb.

Under sponsorship of the then Federal Civil Defense Administration, the Weather Bureau prepared Civil Defense Technical Bulletin 11-31, June 1957, "Probability of Fallout Debris Deposition". This shows the probability of fallout occurring in distance and direction around a large network of selected locations, in event of a nuclear detonation.

At present, the Weather Bureau, in cooperation with and under sponsorship of the FAA, is preparing a series of publications to describe the weather to be expected by supersonic aircraft flying at levels between 50,000 and 80,000 feet.

Agreements reached by the World Meteorological Organization (WMO) have led to an international exchange of climatological data. Mean monthly values of surface temperature, humidity, rainfall, and of upper air height, temperature, and humidity at standard pressure levels, have been furnished as promptly as possible by most countries of the World for publication early the following month in the Weather Bureau's bulletin Climatic Data for the World. As a result of action by the Second Congress of WMO in 1955, the World Meteorological Organization sponsors this publication, which continues to be issued by the Weather Bureau. These arrangements are expected to pave the way for collection of basic data for such world-wide summaries as appeared earlier in Clayton's World Weather Records.

Climatological Atlas. For a long time there has been a need for a modern presentation of U. S. climate. Considering the geography that makes this country extremely rich in climatic diversity - three sea coasts, mountain ranges, plains, inland lakes, deserts, forested lands - and considering also the almost limitless uses the people have for climatic information, the need for up-to-date climatic charts becomes obvious.

This is a large undertaking. It requires climatologists, statisticians, electric accounting machine operators, and draftsmen to do the work. Anything much less than half a century of reliable records would be insufficient for dependable conclusions about trends, and some other details of

climatic dynamics. Only in the last decade or so, enough of the right kind of data have become available for a modern Climatic Atlas of the U. S.

Considerable progress has been made on production of a great National Atlas of the U. S. Basic plans have been prepared by the Earth Sciences Division of the National Research Council - National Academy of Sciences. This Atlas, designed to present all significant material on geography and resources of the country, is to be in loose-leaf form with a standardized format. The Weather Bureau will cooperate with other government agencies by issuing, from time to time, new climatological charts to become part of this Atlas. The charts that have been issued to date are listed below. A copy of one of the charts in the series is shown in Figure 10.

Standard Deviation of Monthly Average Temperature, degrees F.
Maximum Persisting 12-Hour 1000-mb. Dew Points (°F), Monthly and of Record.
Mean Annual Number of Days Maximum Temperature 90°(F) and Above.
Mean Annual Number of Days Minimum Temperature 32°(F) and Below.
Mean Annual Precipitation in Millions of Gallons of Water Per Square Mile by State Climatic Division, with Mean Annual Precipitation in Millions of Gallons of Water per Capita by State Climatic Divisions, on back.
Mean Annual Total Precipitation (in.), with graphs of Mean Monthly Total Precipitation for Selected Stations, on back.
Mean Annual Total Precipitation (in.) by State Climatic Divisions with graphs of Mean Monthly Total Precipitation for Selected State Climatic Divisions, on back.
Mean Annual Total Snowfall (in.), with graphs of Mean Monthly Total Snowfall for Selected Stations, on back.
Mean Daily Maximum Temperature (°F) January.
Mean Daily Maximum Temperature (°F) July.
Mean Daily Minimum Temperature (°F) January.
Mean Daily Minimum Temperature (°F) July.
Mean Date of First 32°(F) Temperature in Autumn.
Mean Date of Last 32°(F) Temperature in Spring.
Mean Length of Freeze Free Period (Days).
Mean Percentage of Possible Sunshine, Monthly and Annual.
Mean Relative Humidity (%), Monthly and Annual.
Mean Sky Cover, Sunrise to Sunset, Monthly and Annual.
Mean Total Precipitation (in.), Monthly, Jan.-Aug. (by State Climatic Divisions).
Mean Total Precipitation (in.) Sept.-Dec. and Division Names (by State Climatic Divisions).
Pan and Lake Evaporation.

Climates of the States presents tabular, textual, and map information concerning the climate of each state.

Letter Supplements dealing with various climatological aspects such as Tornado Occurrences in Major Cities, Temperature Extremes (Highest and Lowest), etc., are issued from time to time.

CLIMATOLOGICAL INFORMATION for all foreign areas of the world is provided by the Foreign Area Section. This Section keeps up to date on the availability of climatological information for foreign areas which would be useful in satisfying requests which are received from within the Weather Bureau, defense agencies, other government agencies, commercial interests, and the general public. On reimbursement from Air Weather Service and other government agencies bibliographic surveys are made of climatological information and climatic maps which are available in the Weather Bureau Library as well as other libraries in the Washington area. Results of these surveys are published in several series of publications. Compilations and summaries of climatological information are prepared for various climatological elements for utilization in supplying requests. Special projects based on collections of worldwide data resulting from the above are undertaken. Since many of the basic sources of climatological information are in the foreign languages of the areas under study, a small translation unit is maintained in the Foreign Area Section and from time to time translations of foreign language articles are published in another series. Various foreign aid programs of the government often require climatological information for planning purposes. Increased travel, international air traffic, marketing of U. S. products abroad and the spreading of U. S. commercial enterprise to foreign areas are resulting in continually increasing demands for foreign climatological information.

Marine and Ocean Projects. The marine climatological work concentrates on services to civilian and military maritime interests of the Government. The climatic material for the United States Coast and Geodetic Survey publication Coast Pilots, The U. S. Navy Oceanographic Office Sailing Directions and Pilot Charts are a primary job. Other routine work includes climatological data for foreign surveys, and data for cases in Admiralty courts; also articles on marine climatology for Oceanographic Office Pilot Chart map backs, and for the Weather Bureau Climatological Data monthly and annual national summaries.

All this requires continuous liaison with other government offices concerned with marine climatological problems. For the operational use of our merchant marine cooperative observers on the "4th seacoast", the Marine Section prepared Weather Bureau Technical Paper No. 35, Climatology and Weather Services of the St. Lawrence Seaway and Great Lakes. The outstanding work now in preparation is a seven volume Marine Atlas sponsored by the U. S. Navy, five of which have been completed. An adaptation of this Atlas entitled Climatological and Oceanographic Atlas for Mariners is now underway. Volume I, North Atlantic Ocean, and Volume II, North Pacific Ocean, are now available. This Atlas is designed for maritime use and includes oceanographic material. Most of the work on this is done at the National Weather Records Center, Asheville, North Carolina.

Research in Hurricane Climatology is conducted in the Marine Section. Two of the latest reports are Technical Paper No. 36 - "North Atlantic Tropical Cyclones, Tracks and Frequencies of Hurricanes and Tropical Storms, 1886-1958"; and National Hurricane Research Project Report No. 42 - "Climatology of 24-Hour North Atlantic Tropical Cyclone Movements".

Decennial Census of U. S. Climate. Under the Decennial Census of U. S. Climate 1960 program monthly normals of sea level pressure and temperature and quintile values of precipitation were prepared for 57 stations for the 1931-1960 period. The selected stations were those for which monthly averages are exchanged internationally by radioteletypewriter shortly after the end of each month. The normals were published by the World Meteorological Organization. Also prepared, or in preparation, are monthly normals of temperature, precipitation, and degree days for 318 First Order stations; monthly normals of temperature and precipitation for 3334 substations and 359 divisions; 5 or 10 year summaries of hourly observations for 103 First Order stations; heating degree day normals for 2070 substations and 318 First Order stations; monthly averages for 359 state climatic divisions; daily normals of temperature and heating degree days for 318 First Order stations; mid-month normals for 320 First and Second Order stations. All of the above are for the 1931-1960 period. Also work has been started on collection for publication of World Weather Records and the Climatic Summary of the United States, both for the period 1951-1960.

Special Funding Arrangements. The unique data collection in possession of the Weather Bureau is a monopoly, equally valuable to scholars and operators in the meteorological field. It has to be administered with a keen sense for the public responsibility inherent in such a national treasure. It seems best to perform centrally as many services as possible at NWRC on a strict, business-like cost-reimbursement basis. In this way data, tabulations, and analyses can be made available at low cost to other agencies, industrial consumers, private meteorological consultants, and research workers. Nearly half of our over-all effort in climatology is carried on under special funding arrangements. Among our primary customers are the U. S. Navy (Aerology and Oceanographic Office), U. S. Army (Corps of Engineers, Signal Corps), Federal Aviation Agency, TVA, Forest Service and many other government agencies. A legion of private firms have larger or smaller work agreements with us. It is natural that we would like to serve climatological and meteorological research more and better than we were able to in the past. Wherever possible, research data are given priority treatment.

Investigations. An operating service is prone to be satisfied with furnishing answers to questions placed before it and to discharge its routine duties competently. There is always the danger that its work may become stereotyped. The best guard against this occupational hazard of bureaucracy is a forward look toward the frontiers of knowledge. In applied climatology a great deal remains to be done, and hence, efforts by all our professional personnel toward improvements of theory, practice, and techniques of climatology are encouraged. Examples of projects under way are: study of world climatic trends; homogeneity testing and power-spectrum analysis of long-period records; development of a methodology for determining the climatological liklihood of various severities of meteorological drought; rural-urban climatic comparisons; study of pain and weather-sensitivity; and the production of new methods for presenting high level wind, temperature, and density data. This is not an exhaustive list but an indication of our interest in contributing to the development of the science of climatology.

VII. Outlook

The preceding presentation is an account of the climatological work in the Weather Bureau as it now stands.

Most important in our plans is the establishment of full-time positions of State Climatologists where these are not now in existence. These positions are intended to furnish better climatological service in all parts of the country. Close cooperation with State agencies, land-grant colleges, and agricultural experiment stations is envisaged. The duties of the State Climatologists, in addition to the routine work on weather and crop bulletins, severe storm reports, and descriptive climatological summaries for the State, include analytical and developmental work. Particularly, attention will be devoted to use of climatological data for general agricultural purposes, irrigation, water supply problems, recreation, industrial and urban development planning in the State.

In fulfillment of the legal responsibility of the Weather Bureau adequately to describe the climate of the United States, its territories and possessions, a series of climatological summaries is in progress. These will comprise the climatography of the U. S. Multi-year compilations of tables of climatic data for first-order and substations were the first step. A comprehensive revision and publication of long-term records (as a sequel to the old Bulletin W) is planned for the next decade. The same basic data are to serve for new climatological maps of the country. These, as mentioned above, will become part of the National Atlas.

Climatology will take an important place in the planning and development of the modern aviation program. Airport runway alignment, route studies and terminal probabilities, as well as aids to forecasters, are all essential to a well-planned system.

With progress in the establishment of bench-mark stations there will be an analysis of the older records in search of climatic trends.

Better documentation practices for old and new climatic data and improved techniques of processing and storing will remain one of our most important aims. In this respect we feel keenly the need for active participation in developmental work directed toward new approaches to climatological problems by use of specially adapted machines, computers and reproduction equipment.

We hope to explore, preferably cooperatively with colleges and universities, the potentialities of snyoptic climatology. We are conscious of the valuable "feed-back" mechanism inherent in climatic material for the forecaster. In addition, there are new avenues of applying climatology to problems of plant and animal life, and human health and well-being. We hope to make some useful contributions in these fields.

KEY PERSONNEL IN CLIMATOLOGY

Office of Climatology - Washington, D. C.

Director - Helmut E. Landsberg
Assistant to Director - Robert W. Schloemer
Chief Climatologist - Herbert C. S. Thom
Climatic Advisory Service Branch - Milton L. Blanc
    Domestic Area Section - John L. Baldwin
    Foreign Area Section - David Smedley
    Marine Area Section - Arthur I. Cooperman
Climatic Field Service Branch - Harold B. Harshbarger
    Assistant Chief of Branch - Lothar A. Joos
    Field Programming Section - Joseph H. Hagarty
    Field Liaison Section - (Vacant)
    Climatic Documentation Section - Harold S. Lippmann
Climatological Investigations Branch - Pauls H. Putnins
    Dynamic Climatology Section - Benjamin Ratner
    Bioclimatology Section - Wayne F. Palmer
    Analytical Climatology Section - Julius F. Bosen
    Special Projects Section - Ralph H. Frederick

National Weather Records Center - Asheville, North Carolina

Director - Gerald L. Barger
Deputy Director - William H. Haggard
Science Advisory Staff - Harold L. Crutcher
Digital Systems Staff - Raymond L. Joiner
Project Coordinating Staff - Earl M. Ritchie
Data Management Staff - Sherman M. Brewster
Personnel Section - Gilbert W. Ehrsam
Adm. Operations Section - Milton G. Johnson
Synoptic Climatology Section - William M. McMurray
Climatography Section - Gilbert E. Stegall
Climatic Analysis Section - Norman L. Canfield
Data Reduction Section - Grady F. McKay
Climatic Information Section - William T. Hodge
Data Verification Section - (Vacant)

AREA CLIMATOLOGISTS

Northeastern Area Climatologist - WBO, New York City - James K. McGuire
Southeastern Area Climatologist - WB Regional Administrative Office, Fort Worth, Texas - Claude K. Vestal
Central Area Climatologist - Iowa State College, Ames, Iowa - Robert F. Dale
Northwestern Area Climatologist - WBO, Seattle, Washington - Marvin D. Magnuson
Southwestern Area Climatologist - (Vacant)
Pacific Area Climatologist - WBO, Honolulu, Hawaii - Merle J. Brown

LOCATIONS OF STATE AND TERRITORIAL CLIMATOLOGISTS

Alabama - Weather Bureau Airport Station, Montgomery * - A. R. Long
Alaska - Weather Bureau Regional Administrative Office, Anchorage - C. E. Watson
Arizona - Weather Bureau Airport Station, Phoenix - Paul Kangieser
Arkansas - Weather Bureau Airport Station, Little Rock * - Robert O. Reinhold
California - Weather Bureau Office, San Francisco - C. R. Elford
Colorado - Weather Bureau Office, Denver - Joseph W. Berry
Connecticut and Rhode Island - Weather Bureau Airport Station, Hartford, Conn. - J. J. Brumbach
Florida - University of Florida, Gainesville - Keith Butson
Georgia - University of Georgia, Athens - Horace S. Carter
Idaho - Weather Bureau Airport Station, Boise - David J. Stevlingson
Illinois - University of Illinois, Champaign - W. L. Denmark
Indiana - Purdue University, Lafayette - Lawrence A. Schaal
Iowa - Weather Bureau Office, Des Moines - Paul J. Waite
Kansas - Weather Bureau Office, Topeka - A. D. Robb
Kentucky - University of Kentucky, Lexington - A. B. Elam, Jr.
Louisiana and Mississippi - Weather Bureau Office, New Orleans * - E. J. Saltsman
Maine, Massachusetts, New Hampshire, and Vermont - Weather Bureau Office, Boston, Mass. - Robert E. Lautzenheiser
Maryland and Delaware - Weather Bureau Airport Station, Baltimore, Md. - W. J. Moyer
Michigan - Weather Bureau Office, East Lansing - A. H. Eichmeier
Minnesota - Weather Bureau Office, Minneapolis * - J. H. Strub
Missouri - Weather Bureau Office, Columbia - James D. McQuigg
Montana - Weather Bureau Airport Station, Helena - R. A. Dightman
Nebraska - Weather Bureau Office, Lincoln - Richard E. Myers
Nevada and Utah - Weather Bureau Airport Station, Salt Lake City, Utah - Arlo Richardson
New Jersey - Weather Bureau Office, Trenton - Donald V. Dunlap
New Mexico - Weather Bureau Airport Station, Albuquerque - Frank E. Houghton
New York - Cornell University, Ithaca - A. Boyd Pack
North Carolina - Weather Bureau Airport Station, Raleigh - A. V. Hardy
North Dakota - Weather Bureau Airport Station, Bismarck * - A. A. Skrede
Ohio - Weather Bureau Office, Columbus - L. T. Pierce
Oklahoma - Weather Bureau Office, Oklahoma City - Stanley Holbrook
Oregon - Weather Bureau Office, Portland - Gilbert L. Sternes
Pennsylvania - Weather Bureau Airport Station, Harrisburg - Nelson M. Kauffman
Puerto Rico and Virgin Islands - Weather Bureau Office, San Juan - J. V. Vaiksnoras
South Carolina - Weather Bureau Airport Station, Columbia - Nathan Kronberg
South Dakota - South Dakota State College, Brookings - Walter Spuhler
Tennessee - Weather Bureau Airport Station, Nashville - Morton Bailey
Texas - Weather Bureau Airport Station, Austin - Robert B. Orton
Virginia - Weather Bureau Airport Station, Richmond - Daniel L. Sala
Washington - Weather Bureau Office, Seattle - Earl L. Phillips
West Virginia - West Virginia University, Morgantown - Robert O. Weedfall

Wisconsin - University of Wisconsin, Madison - Marvin W. Burley
Wyoming - Weather Bureau Airport Station, Cheyenne - John D. Alyea

* Full time State Climatologist position not yet established.

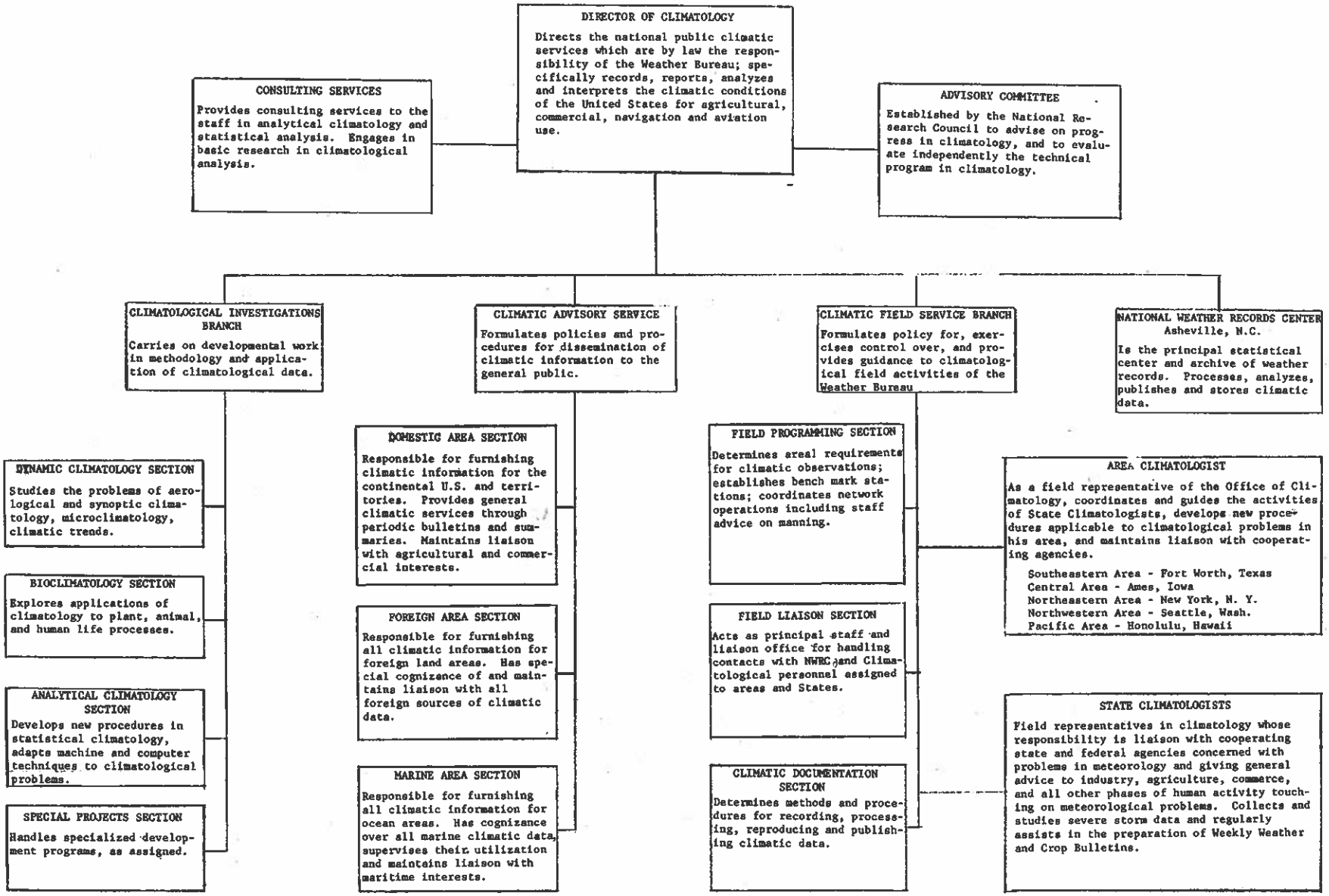
DIRECTOR OF CLIMATOLOGY
Directs the national public climatic services which are by law the responsibility of the Weather Bureau; specifically records, reports, analyzes and interprets the climatic conditions of the United States for agricultural, commercial, navigation and aviation use.
CONSULTING SERVICES
Provides consulting services to the staff in analytical climatology and statistical analysis. Engages in basic research in climatological analysis.
ADVISORY COMMITTEE
Established by the National Research Council to advise on progress in climatology, and to evaluate independently the technical program in climatology.
CLIMATOLOGICAL INVESTIGATIONS BRANCH
Carries on developmental work in methodology and application of climatological data.
CLIMATIC ADVISORY SERVICE
Formulates policies and procedures for dissemination of climatic information to the general public.
CLIMATIC FIELD SERVICE BRANCH
Formulates policy for, exercises control over, and provides guidance to climatological field activities of the Weather Bureau
NATIONAL WEATHER RECORDS CENTER
Asheville, N.C.
Is the principal statistical center and archive of weather records. Processes, analyzes, publishes and stores climatic data.
DYNAMIC CLIMATOLOGY SECTION
Studies the problems of aerological and synoptic climatology, microclimatology, climatic trends.
BIOCLIMATOLOGY SECTION
Explores applications of climatology to plant, animal, and human life processes.
ANALYTICAL CLIMATOLOGY SECTION
Develops new procedures in statistical climatology, adapts machine and computer techniques to climatological problems.
SPECIAL PROJECTS SECTION
Handles specialized development programs, as assigned.
DOMESTIC AREA SECTION
Responsible for furnishing climatic information for the continental U.S. and territories. Provides general climatic services through periodic bulletins and summaries. Maintains liaison with agricultural and commercial interests.
FOREIGN AREA SECTION
Responsible for furnishing all climatic information for foreign land areas. Has special cognizance of and maintains liaison with all foreign sources of climatic data.
MARINE AREA SECTION
Responsible for furnishing all climatic information for ocean areas. Has cognizance over all marine climatic data, supervises their utilization and maintains liaison with maritime interests.
FIELD PROGRAMMING SECTION
Determines areal requirements for climatic observations; establishes bench mark stations; coordinates network operations including staff advice on manning.
FIELD LIAISON SECTION
Acts as principal staff and liaison office for handling contacts with NWRC and Climatological personnel assigned to areas and States.
CLIMATIC DOCUMENTATION SECTION
Determines methods and procedures for recording, processing, reproducing and publishing climatic data.
AREA CLIMATOLOGIST
As a field representative of the Office of Climatology, coordinates and guides the activities of State Climatologists, develops new procedures applicable to climatological problems in his area, and maintains liaison with cooperating agencies.
Southeastern Area - Fort Worth, Texas
Central Area - Ames, Iowa
Northeastern Area - New York, N. Y.
Northwestern Area - Seattle, Wash.
Pacific Area - Honolulu, Hawaii
STATE CLIMATOLOGISTS
Field representatives in climatology whose responsibility is liaison with cooperating state and federal agencies concerned with problems in meteorology and giving general advice to industry, agriculture, commerce, and all other phases of human activity touching on meteorological problems. Collects and studies severe storm data and regularly assists in the preparation of Weekly Weather and Crop Bulletins.

FIGURE 1

THE NATIONAL WEATHER RECORDS CENTER

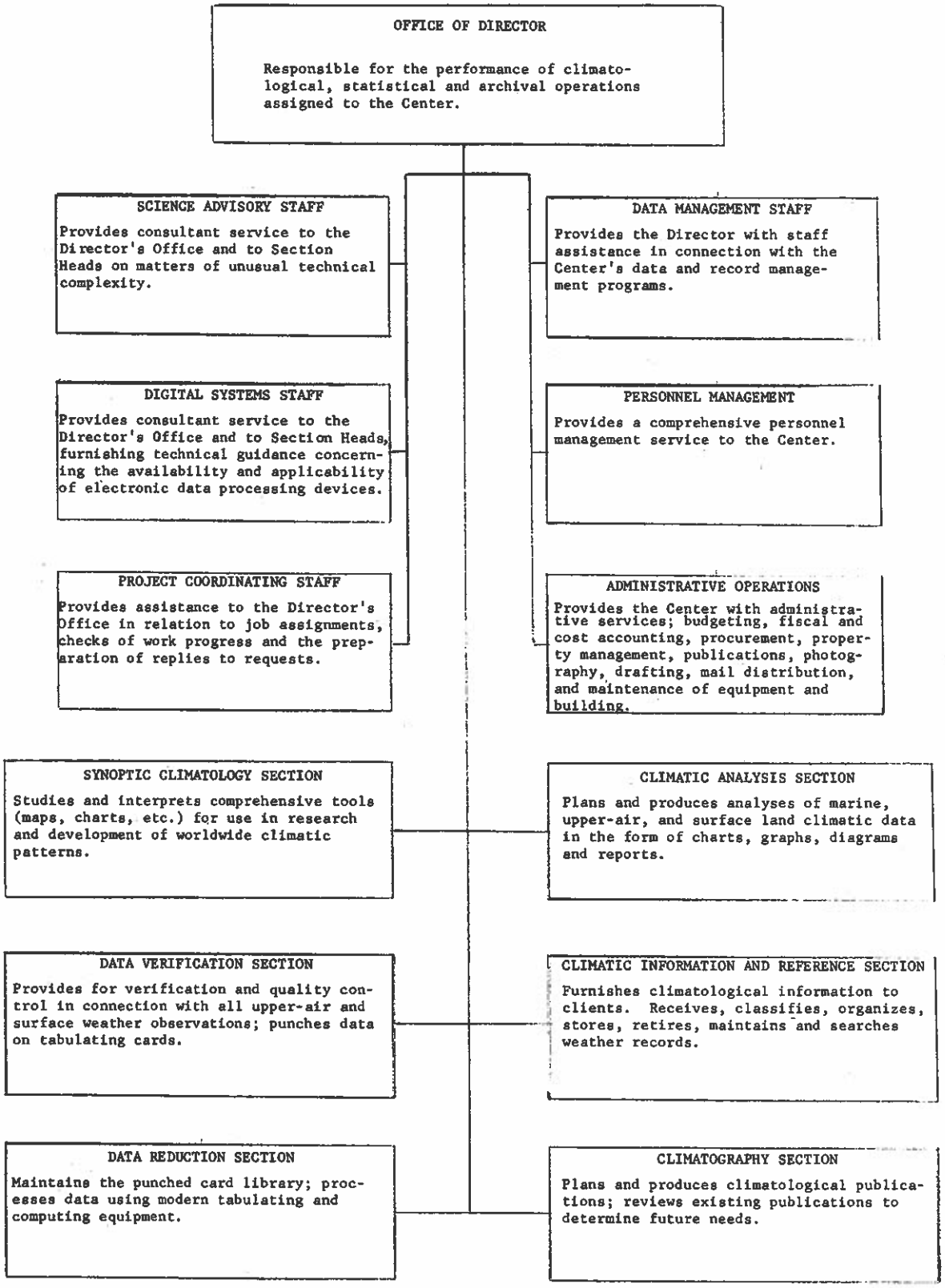

FIGURE 2

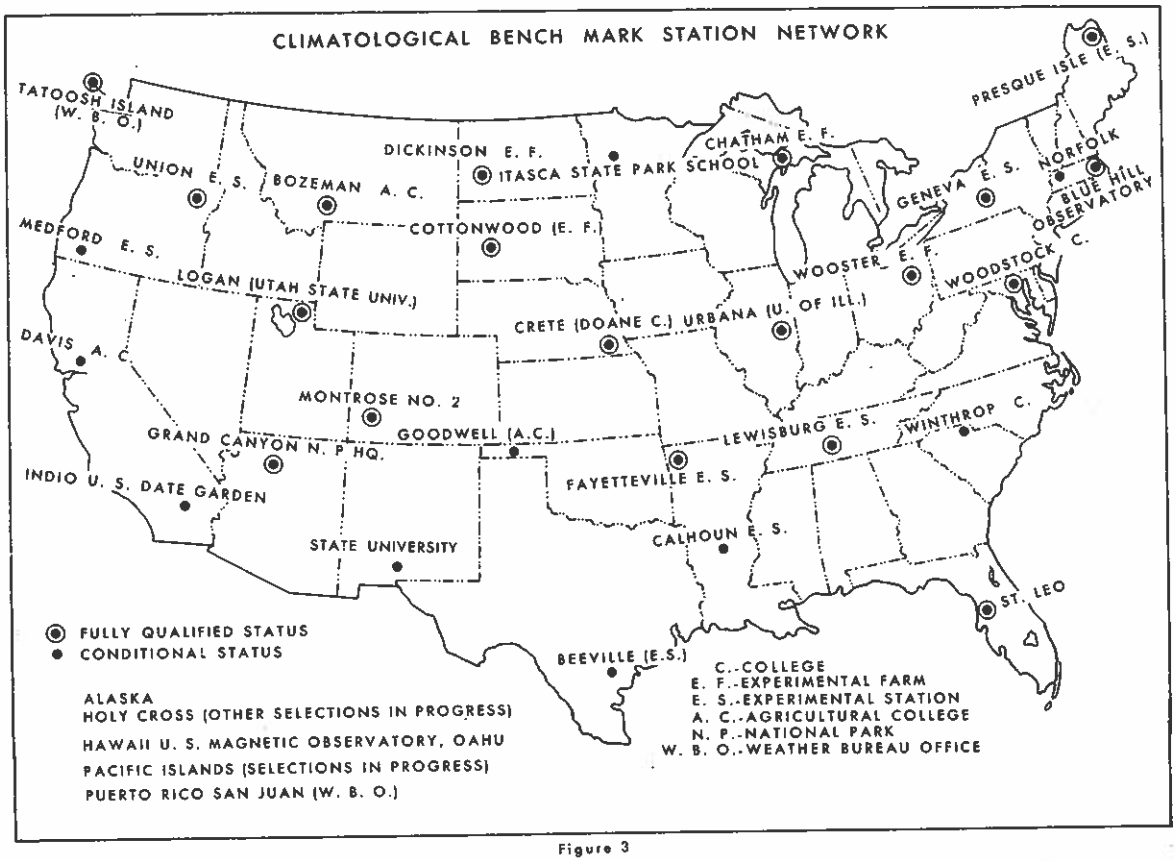

Figure 3

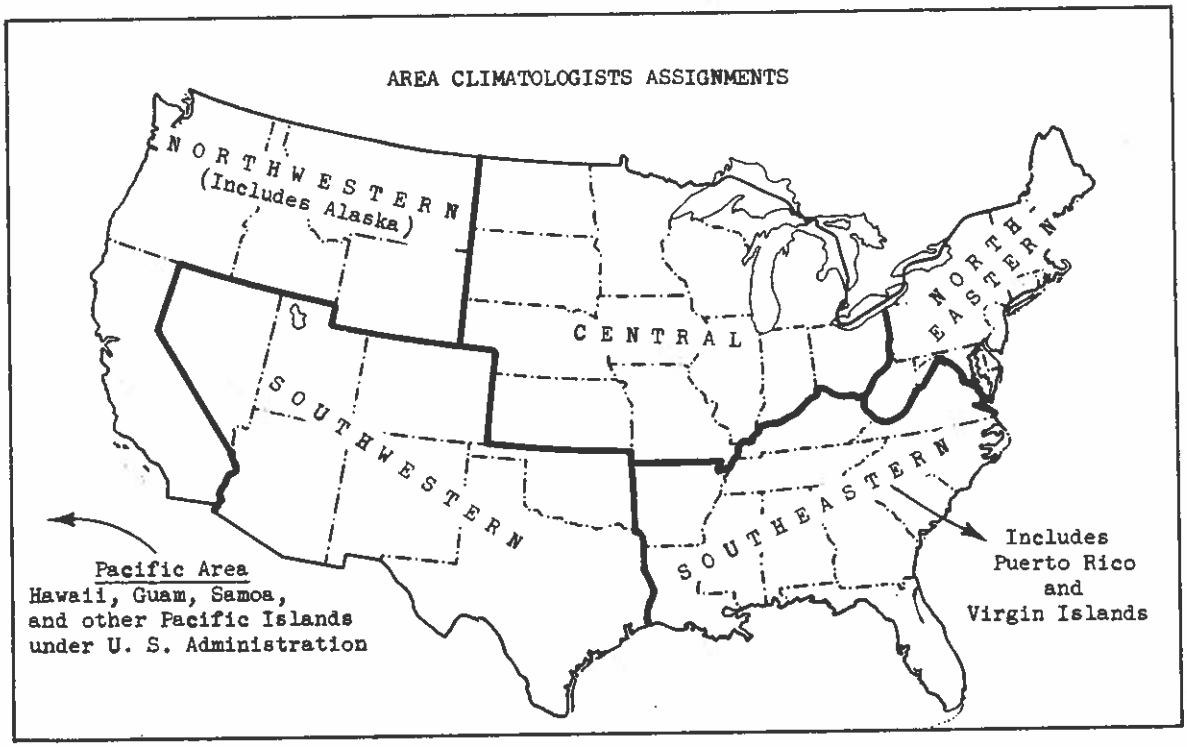

FIGURE 4

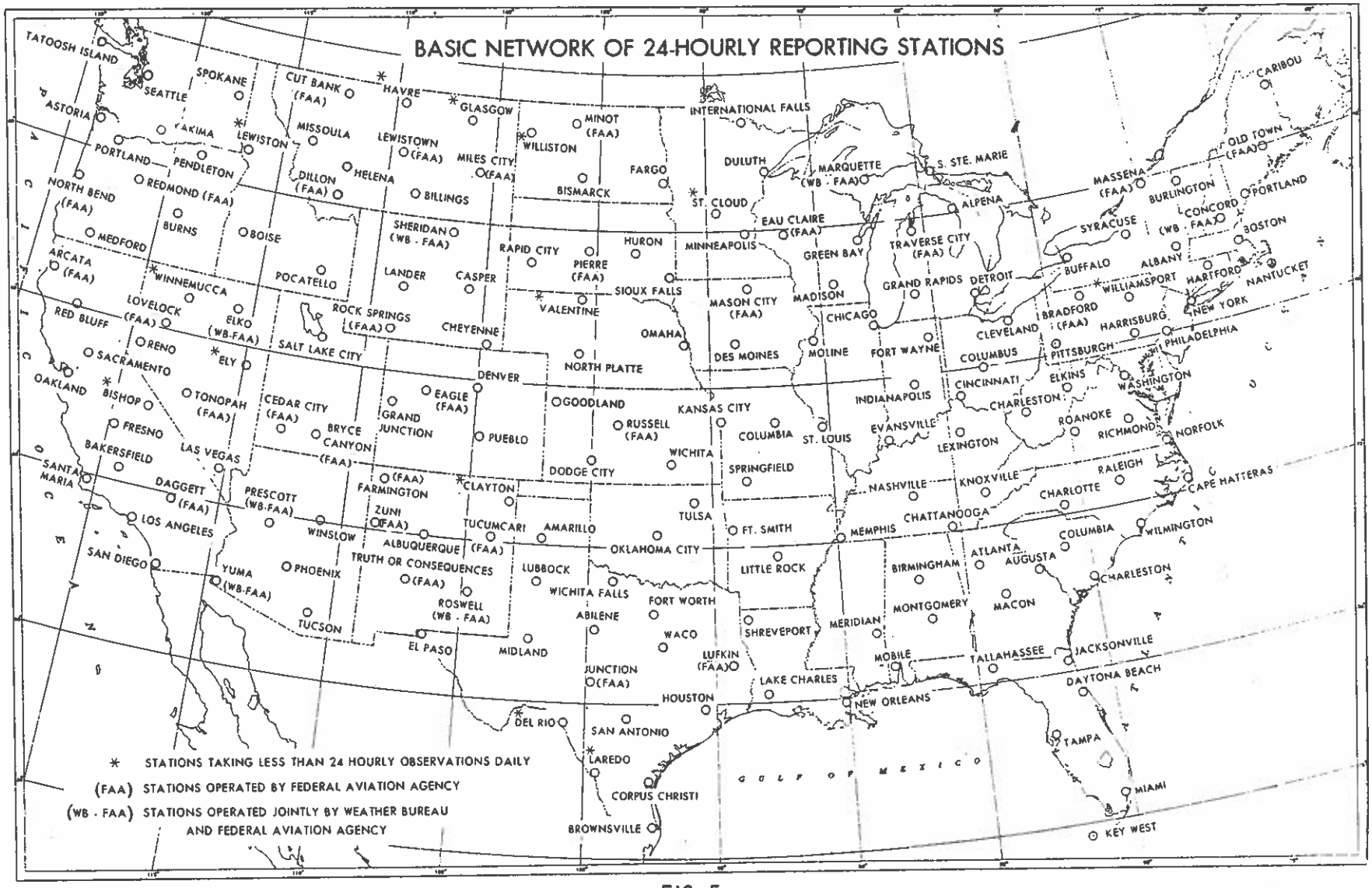
BASIC NETWORK OF 24-HOURLY REPORTING STATIONS
TATOOSH ISLAND
SEATTLE
SPOKANE
CUT BANK (FAA)
HAVRE
GLASGOW
INTERNATIONAL FALLS
MINOT (FAA)
WILLISTON
ASTORIA
YAKIMA
LEWISTON
MISSOULA
LEWISTOWN (FAA)
MILES CITY (FAA)
DULUTH
MARQUETTE (WB - FAA)
S. STE. MARIE
CARIBOU
OLD TOWN (FAA)
PORTLAND
PENDLETON
DILLON (FAA)
HELENA
BISMARCK
FARGO
ST. CLOUD
ALPENA
MASSENA (FAA)
BURLINGTON
PORTLAND
NORTH BEND (FAA)
REDMOND (FAA)
BILLINGS
EAU CLAIRE (FAA)
SYRACUSE
CONCORD (WB - FAA)
BOSTON
MEDFORD
BURNS
BOISE
SHERIDAN (WB - FAA)
RAPID CITY
HURON
MINNEAPOLIS
GREEN BAY
TRAVERSE CITY (FAA)
ALBANY
ARCATA (FAA)
WINNEMUCCA
POCATELLO
LANDER
CASPER
PIERRE (FAA)
SIOUX FALLS
MASON CITY (FAA)
MADISON
GRAND RAPIDS
DETROIT
BUFFALO
WILLIAMSPORT
HARTFORD
NANTUCKET
LOVELOCK (FAA)
ELKO (WB-FAA)
ROCK SPRINGS (FAA)
VALENTINE
CHICAGO
CLEVELAND
BRADFORD (FAA)
HARRISBURG
NEW YORK
RED BLUFF
RENO
ELY
SALT LAKE CITY
CHEYENNE
OMAHA
DES MOINES
MOLINE
FORT WAYNE
COLUMBUS
PITTSBURGH
PHILADELPHIA
SACRAMENTO
NORTH PLATTE
INDIANAPOLIS
CINCINNATI
ELKINS
WASHINGTON
OAKLAND
BISHOP
TONOPAH (FAA)
CEDAR CITY (FAA)
DENVER
EAGLE (FAA)
GOODLAND
KANSAS CITY
CHARLESTON
ROANOKE
FRESNO
GRAND JUNCTION
BRYCE CANYON (FAA)
PUEBLO
RUSSELL (FAA)
COLUMBIA
ST. LOUIS
EVANSVILLE
LEXINGTON
RICHMOND
NORFOLK
BAKERSFIELD
LAS VEGAS
WICHITA
SPRINGFIELD
RALEIGH
SANTA MARIA
DAGGETT (FAA)
PRESCOTT (WB-FAA)
FARMINGTON (FAA)
CLAYTON
DODGE CITY
NASHVILLE
KNOXVILLE
CHARLOTTE
CAPE HATTERAS
ZUNI (FAA)
TULSA
FT. SMITH
MEMPHIS
CHATTANOOGA
LOS ANGELES
WINSLOW
TUCUMCARI
AMARILLO
ALBUQUERQUE (FAA)
OKLAHOMA CITY
ATLANTA
COLUMBIA
WILMINGTON
SAN DIEGO
YUMA (WB-FAA)
PHOENIX
TRUTH OR CONSEQUENCES (FAA)
LUBBOCK
LITTLE ROCK
BIRMINGHAM
AUGUSTA
CHARLESTON
WICHITA FALLS
FORT WORTH
ROSWELL (WB - FAA)
MONTGOMERY
MACON
TUCSON
ABILENE
SHREVEPORT
MERIDIAN
EL PASO
MIDLAND
WACO
LUFKIN (FAA)
MOBILE
TALLAHASSEE
JACKSONVILLE
JUNCTION (FAA)
LAKE CHARLES
DAYTONA BEACH
HOUSTON
NEW ORLEANS
DEL RIO
SAN ANTONIO
TAMPA
LAREDO
GULF OF MEXICO
CORPUS CHRISTI
MIAMI
BROWNSVILLE
KEY WEST
* STATIONS TAKING LESS THAN 24 HOURLY OBSERVATIONS DAILY
(FAA) STATIONS OPERATED BY FEDERAL AVIATION AGENCY
(WB - FAA) STATIONS OPERATED JOINTLY BY WEATHER BUREAU AND FEDERAL AVIATION AGENCY

FIG. 5

UPPER-AIR NETWORK

NOT INCLUDING PIBALS

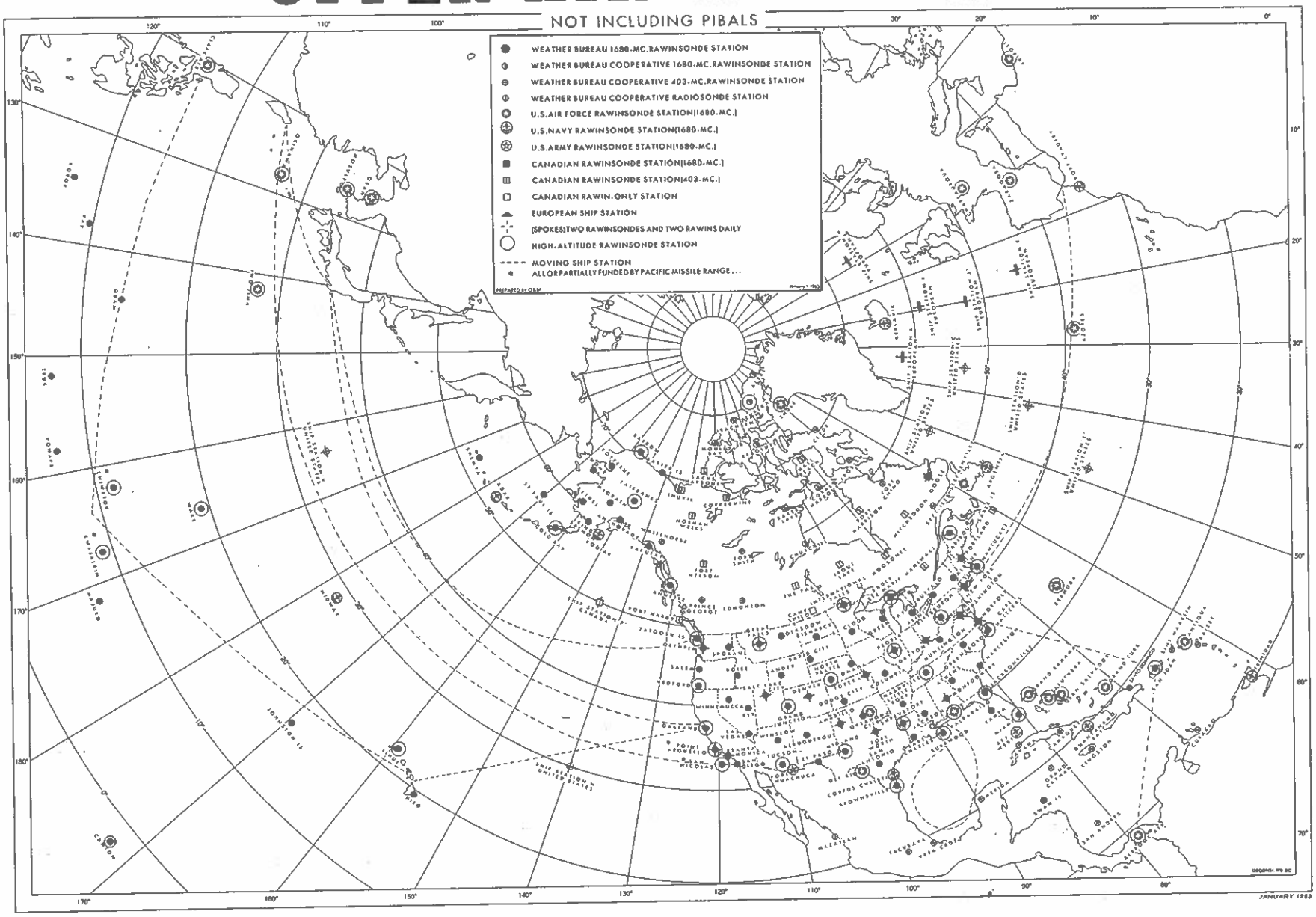

FIGURE 6


COOPERATING SUBSTATIONS IN THE UNITED STATES IN 1952
(10,700 STATIONS)

FIGURE 7

U. S. DEPARTMENT OF COMMERCE, WEATHER BUREAU

LOCAL CLIMATOLOGICAL DATA

BOSTON, MASS.
LOGAN INTERNATIONAL AIRPORT
NOVEMBER 1962

Latitude 42° 22' N. Longitude 71° 01' W. Elevation (ground) 15 ft. Eastern Standard time used

Date	Temperature (°F) Maximum	Minimum	Average	Departure from normal	Degree days (base 65°)	Precipitation Total (Water equivalent) (In.)	Snow, Sleet (In.)	Snow, Sleet, or Ice on ground at 7 A.M. (In.)	Wind Prevailing direction	Average speed (m. p. h.)	Fastest mile Speed (m. p. h.)	Fastest mile Direction	Sunshine Total (hours and minutes)	Percent of possible	Sky cover Sunrise to sunset (tenths)	Sky cover Midnight to midnight (tenths)	Thunderstorm or distant lightning	Weather restricting visibility to ¼ mile or less	Peak Wind Speed (mph)	Peak Wind Gust Dir.	Total Surface Radiation (Langleys)	Day of Week	Date
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	55	41	48	-1	17	.92	0	0	WNW	16.3	26	W	3:39	35	8	6			33	W	139	Thu	1
2	48	35	42	-7	23	0	0	0	E	9.9	15	NW	10:01	97	2	3			21	NW	308	Fri	2
3	49	39	44	-5	21	.40	T	0	NE	25.1	40	NE	0:00	0	10	10			49	NE	34	Sat	3
4	53	41	47	-2	18	T	0	0	WNW	13.6	21	W	5:55	58	7	9			29	SW	231	Sun	4
5	46	34	40	-8	25	0	0	0	WNW	14.7	20	NW	4:47	47	8	7			29	NW	186	Mon	5
6	38	33	36	-12	29	T	T	0	NW	16.3	21	NW	0:00	0	10	10			28	NW	55	Tue	6
7	48	29	39	-9	26	0	0	0	WNW	10.0	17	W	10:06	100	0	2			22	W	277	Wed	7
8	58	39	49	+2	16	T	0	0	SW	10.4	12	SW	2:49	28	9	7			17	SW	163	Thu	8
9	53	44	49	+2	16	0	0	0	E	10.4	15	E	7:38	76	7	7			22	E	230	Fri	9
10	59	49	54	+7	11	1.14	0	0	ENE	16.9	28	E	1:17	13	9	10			37	E	44	Sat	10
11	50	40	45	-1	20	.01	0	0	NW	22.0	35	NW	2:18	23	10	7			51	NW	119	Sun	11
12	50	34	42	-4	23	0	0	0	NW	10.0	18	NW	9:45	98	1	2			26	NW	284	Mon	12
13	41	32	37	-9	28	.16	0.3	0	NNW	10.7	15	NE	0:00	0	10	10			19	NE	22	Tue	13
14	36	31	34	-12	31	T	T	T	NW	19.7	29	NW	0:57	10	9	8			39	NW	113	Wed	14
15	41	31	36	-9	29	.01	T	0	NW	28.5	37	NW	5:41	58	9	9			48	NW	164	Thu	15
16	52	35	44	-1	21	T	0	0	WNW	15.8	24	W	9:36	98	2	4			32	NW	275	Fri	16
17	51	36	44	-1	21	T	0	0	WNW	10.0	15	W	6:49	70	5	4			20	NW	178	Sat	17
18	43	32	38	-6	27	.40	0.6	0	N	15.9	23	N	0:00	0	10	10			31	N	14	Sun	18
19	40	27	34	-10	31	0	0	1	WNW	12.2	19	NW	8:35	89	5	6			24	NW	265	Mon	19
20	38	31	35	-9	30	T	T	0	S	7.6	15	SW	0:00	0	10	10			18	SW	65	Tue	20
21	53	36	45	+1	20	T	0	0	S	11.5	19	S	1:29	15	10	10			26	S	102	Wed	21
22	51	42	47	+4	18	.75	0	0	WNW	16.3	33	NW	0:00	0	10	9		FR	44	W	20	Thu	22
23	46	38	42	-1	23	0	0	0	W	16.2	26	W	6:43	70	3	4			36	W	209	Fri	23
24	44	35	40	-3	25	.01	0	0	NW	14.4	26	W	2:13	23	8	6			32	W	101	Sat	24
25	40	31	36	-6	29	0	0	0	N	13.8	15	N	5:25	37	9	7			21	N	161	Sun	25
26	43	29	36	-6	29	0	0	0	NNW	11.0	15	N	9:06	96	3	3			21	N	244	Mon	26
27	51	30	41	-1	24	0	0	0	NW	5.8	9	NW	9:11	98	1	0			13	NW	229	Tue	27
28	52	33	43	+2	22	0	0	0	WNW	5.1	7	SE	9:17	99	0	0			10	SE	226	Wed	28
29	54	34	44	+3	21	0	0	0	WNW	6.7	8	N	9:14	98	0	0			14	N	225	Thu	29
30	62	34	48	+8	17	0	0	0	S	6.6	8	SW	9:18	99	0	0			13	SW	212	Fri	30
31																							31
Sum	1445	1055	—	—	—	3.80	0.9	—	—	403.4	—	—	151:47	—	185	180	—	—	--	--	4875	---	Sum
Avg	48.2	35.2	—	—	—	—	—	—	—	13.4	Fastest	Dir.	Possible	%	6.2	6.0	—	—	Peak	Dir.	163	---	Avg.
										Misc.	40	NE	294:03	52	—	—	—	—	51	NW	---	---	Misc.

T in columns 7, 8, 9 and in the Hourly Precipitation table indicates an amount too small to measure.

TEMPERATURE: (°F)

Average monthly		41.7
Departure from normal		-3.2
Highest	62 on	30th
Lowest	27 on	19th
Number of days with —		
Max. 32° or below		0
Max. 90° or above		0
Min. 32° or below		10
Min. 0° or below		0

HEATING DEGREE DAYS (base 65°):

Total this month	691
Departure from normal	+88
Seasonal total (since July 1)	1145
Seasonal departure from normal	+157

BAROMETRIC PRESSURE (In.)

Avg. station (elev. 124 *feet, m. s. l.)			29.923
Highest sea level	30.69	on	27th
Lowest sea level	29.01	on	22d

#Pyrheliometer located on top of the Federal Bldg (elvn 333 ft) in downtown Boston, Mass. (Gm. cal. per cm²).

PRECIPITATION: (In.)

Total for the month			3.80
Departure from normal			-.13
Greatest in 24 hours	1.48	on	31-1st
Snow, Sleet—			
Total for the month	0.9		
Greatest in 24 hours	0.6	on	18th
Greatest depth on ground	1	on	18th, 19th
Dates of — Hail	None		
Sleet	3d, 15th	Glaze/Rime	None

Symbols used in columns 18-19

A = Hail
BS = Blowing snow
DL = Distant lightning
D = Dust
S = Sleet
F = Fog
H = Haze
K = Smoke
L = Drizzle
N = Sand
R = Rain
S = Snow
T = Thunderstorm
ZL = Freezing drizzle
ZR = Freezing rain

*When this elevation differs from the present station elevation this level was selected to permit comparison of data for a longer period of homogeneous record.

The month was stormy and cold--the coldest November since 1947. Storms of wind or rain or even snow, separately or in combination, came in rather frequent succession through the 22d, Thanksgiving Day. Thereafter the weather was mostly bright and sunny, particularly so during the last five days.

Effective with data for November 1962, daily temperature normals used to calculate values in Column 5 of this bulletin are climatological standard normals based on the period 1931-1960.

HOURLY PRECIPITATION (In.)

Date	A. M. Hour ending at 1	2	3	4	5	6	7	8	9	10	11	12	P. M. Hour ending at 1	2	3	4	5	6	7	8	9	10	11	12	Date
1	.06	.05	.10	.18	.22	.15	.13	T	.03	T	T	T													1
2																									2
3									T	.02	T	.01	.01	.03	.03	.01	.07	.17	.04	.01	T	T	T	T	3
4	T	T															T	T	T	T	T	T	T		4
5																									5
6											T	T	T	T											6
7																									7
8																						T	T	T	8
9																									9
10					T	T	.01	.07	.05	.12	.36	.19	.33	.01					T	T	T	T	T	T	10
11	.01	T	T		T	T	T	T	T	T				T	T										11
12																									12
13									T	T	T	T	T	T	T	T	T	T	.01	.05	.05	.04	.01	T	13
14	T	T	T	T	T	T		T	T																14
15														T	T	T					T	T	T	.01	15
16	T																							T	16
17																									17
18	T	T	T	T	T	T	T	T	T	T	T	.01	.05	.05	.07	.07	.04	.04	.04	.01	.01	.01	T	T	18
19																									19
20													T	T	T	T	T	T	T	T					20
21	T	T	T	T									T										T	T	21
22	.04	.03	.11	.07	.05	.05	.06	.05	.04	.04	.05	.04	T	.01	.05	.02	.04	T	T						22
23																									23
24									T	T	.01	T													24
25																									25
26																									26
27																									27
28																									28
29																									29
30																									30
31																									31

Corrections, if any, to data in this issue will be published in a later issue.

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USCOMM-WB-Asheville-12/5/62---925

FIGURE 8

U. S. DEPARTMENT OF COMMERCE, WEATHER BUREAU

LOCAL CLIMATOLOGICAL DATA (SUPPLEMENT)

BALTIMORE, MARYLAND
FRIENDSHIP INTERNATIONAL AIRPORT
MARCH 1962

(Based on one month's record)

EASTERN STANDARD TIME

A TEMPERATURE AND WIND SPEED–RELATIVE HUMIDITY OCCURRENCES (HOURLY OBSERVATIONS):

WIND	0 - 3 KNOTS (0 - 3 M.P.H.)						4 - 10 KNOTS (4 - 12 M.P.H.)						11 - 21 KNOTS (13 - 24 M.P.H.)						22 KNOTS AND OVER (25 M.P.H. AND OVER)						TOTAL OBS.
REL HUMID. / TEMP (°F)	UNDER 30	30-49%	50-69%	70-79%	80-89%	90-100%	UNDER 30	30-49%	50-69%	70-79%	80-89%	90-100%	UNDER 30	30-49%	50-69%	70-79%	80-89%	90-100%	UNDER 30	30-49%	50-69%	70-79%	80-89%	90-100%	
79/75													3	8	2						1				14
74/70								1					2	3	2						1				9
69/65														1	4	1									6
64/60							12	3	4		2	2	10		1	1	1	1							37
59/55							8	7	8	2		1	5	8	6	1									46
54/50							9	17	12	1			10	11	2	1	1								64
49/45			2				3	28	13	6	1	5	6	18	5	3	5	6							104
44/40			4	2	3	2	2	10	23	10	19	7		17	9	3	6	6		1					124
39/35	1					1	5	11	32	14	11	4		12	16	5	10	4				1	1		122
34/30		2	2			2	3	9	31	12	3	12		12	12	6	2	16							124
29/25				2			1	12	26	8	4	1		6											50
24/20								7	8		1			4											20
19/15			1					9	2					4	1										17
14/10															1										1

B WIND DIRECTION AND SPEED OCCURRENCES:

DIRECTION	HOURLY OBSERVATIONS OF WIND SPEED									AVERAGE SPEED	
	KNOTS: 0-3	4-6	7-10	11-16	17-21	22-27	28-33	34-40	41 OVER	TOTAL	KNOTS
	M.P.H.: 0-3	4-7	8-12	13-18	19-24	25-31	32-38	39-46	47 OVER		M.P.H.
N	1	25	40	24						90	8.8 / 10.1
NNE		9	21	16	17					63	11.9 / 13.7
NE	2	16	13	20	6					57	10.0 / 11.5
ENE	1	8	15	17	1	1	1			44	10.6 / 12.2
E		3	15	8						26	9.3 / 10.7
ESE		7	7	1						15	7.5 / 8.7
SE	2	13	7	1						23	6.2 / 7.1
SSE		3	5	1						9	7.8 / 9.0
S	4	9	9	2	3					27	7.8 / 9.0
SSW	2	2	6	6	6	2				24	13.0 / 15.0
SW	1	5	8	8	6					28	11.4 / 13.1
WSW	2	1	8	4						15	8.7 / 10.1
W		20	35	23	5					83	9.6 / 11.0
WNW	1	9	32	22	17	3				84	11.6 / 13.4
NW		11	33	39	8	1				92	11.2 / 12.9
NNW		6	31	18	1					56	10.2 / 11.8
CALM	8									8	0.0 / 0.0
TOTAL	24	147	285	210	70	7	1			744	10.1 / 11.6

C HOURLY AND DAILY OCCURRENCES OF PRECIPITATION AMOUNTS:

AMOUNTS (Inches)	FREQUENCY OF OCCURRENCE FOR EACH HOUR OF THE DAY: A.M. HOUR ENDING AT 1	2	3	4	5	6	7	8	9	10	11	Noon	P.M. HOUR ENDING AT 1	2	3	4	5	6	7	8	9	10	11	Mid.	NO. OF DAYS WITH	AMOUNTS (Inches)
TRACE	3	3	1	1	2	2		1			1		3	2	1	1	4	3	2	4	1	2	4	2	3	TRACE
.01 to .09	1						1									1	1	3	2	1	2	4	1	2	2	.01 to .09
.10 to .24	2	2	2	1	1	1	1		3	1	1	1		1	3	2	1	1	4	3	2	3	1	1	1	.10 to .24
.25 to .49				1	1	2	2	3					1	1			1	2	1			1	1		2	.25 to .49
.50 to .99																									2	.50 to .99
1.00 to 1.99																									2	1.00 to 1.99
2.00 & Over																										2.00 & Over
TOTAL	6	5	3	3	4	4	4	3	3	2	1	2	4	4	4	4	6	6	7	7	6	7	7	7	13	TOTAL

D CEILING–VISIBILITY OCCURRENCES (HOURLY OBSERVATIONS):

VISIBILITY (MILES)	CEILING (FEET): 0	100	200	300	400	500-700	800-900	1000-1400	1500-1900	2000-2900	3000-4900	5000-9900	OVER 9900	TOT.
0 TO 1/8														
1/8 TO 1/4			2											2
1/4 TO 1/2			2	6	7	2								17
1/2 TO 3/4			1	5	7	7	1	1						22
3/4 TO 1					3	3	1	1		1	1	1	1	12
1 TO 2 1/2					4	2	3	15	9	4	8	6	11	62
2 1/2 TO 5					1		2	7	6	11	22	23	234	306
5 TO 10								2	1	2	7	9	302	323
10 TO 30														
30 OR MORE														
TOTAL			5	11	22	14	7	26	16	18	38	39	548	744

E OCCURRENCES OF WEATHER BY HOUR OF DAY:

HOUR OF DAY	CLOUDS SCALE 0 - 10: 0-3	4-7	8-10	CEILING OR VISIBILITY LESS THAN: 200 FT. OR ¼ MILE	800 FT. OR ½ MILE	1000 FT. OR 3 MILES	WEATHER TYPES: RAIN WHEN HEARD	FREEZING RAIN FREEZING DRIZZLE SLEET	SNOW, SLEET	FOG	FOG WITH SMOKE	SMOKE OR HAZE	THUNDERSTORM	RELATIVE HUMIDITY (%): 01	30-49	50-69	70-89	90-100	WIND SPEED: P.S.T.	KNOTS: 4-6	7-10	11-21	22 & OVER	M.P.H.: 4-7	8-12	13-24	25 & OVER
00	18	3	10			3	4	2			3	5			1	6	14	3	4	3	1	9	12	9	
01	16	4	11			3	4	3			2	6		1	5	14	3	4	4	1	5	17	8	
02	16	4	11			3	4	2			2	5			5	15	2	5	3	3	7	13	7	
03	15	4	12			3	4	1			2	5			8	13	2	5	3	11	13	7	
04	17	4	10			3	3	1		2	2	4			7	11	7	3	3	2	6	18	8	
05	18	4	9			3	3	1		2	1	6			6	12	6	4	3	1	9	15	6	
06	20	2	9			2	3	1		1	1	6			6	12	9	4	4	2	10	11	8	
07	17	4	10			2	3	1		1	1	6	2	4	7	11	7	1	4	2	8	12	9	
08	16	6	9	1		2	5	2		1	1	6	2	4	9	13	3	2	2	2	9	16	9	1
09	16	3	12			1	3	2			1	3	2	2	11	11	3	3	2	2		18	12	1
10	15	3	13			2	4	2			1	3	2	2	14	8	2	2	2	2	2	15	13	1
11	13	7	11			1	4	1			1	3	2	2	11	6	2	4	1	1	2	9	18	1
12	12	7	12			1	3	1			1	2	1	1	8	12	4	2	1	1	3	8	16	1
13	13	4	14			1	2	2			1	2	1	1	9	13	3	3	2	1	3	6	20	
14	8	8	15			2	3	2			1	2	1	1	9	12	4	3	1	1	3	8	19	1
15	9	7	15			2	3	2			1	2	1	1	11	11	4	2	1	1	2	6	22	
16	11	7	13			2	3	2			1	3	1	1	9	10	6	2	1	1	3	7	19	1
17	13	6	12			2	3	2			1	3	1	1	5	12	7	2	1	1	3	9	18	
18	14	6	11	1		2	3	2			1	3	1	1	3	13	6	2	1	1	3	13	9	
19	17	5	9			2	3	2			1	3	1	1	2	12	8	2	1	1	3	12	8	
20	19	3	9			2	3	2			1	3	1	1	2	11	9	2	1	1	3	11	7	
21	18	3	10			3	4	2			2	3	1	1	1	9	11	2	1	1	4	9	8	
22	16	2	11			3	4	2			2	4	1	1	2	6	12	2	1	1	4	9	10	1
23	17	3	11			3	4	2			3	4	1	1	2	7	11	2	1	1	4	8	14	1
	366	109	269	2	5	54	89	66			38	82	13	34	80	224	221	76	72	71	24	147	285	280	8

F AVERAGES BY HOURS

HOUR (LOCAL TIME)	SKY COVER (NO. TENTHS)	STATION PRESS. (IN.)	DRY BULB (°F)	WET BULB (°F)	REL. HUM. %	DEW PT. (°F)	WIND: PREVAILING DIRECTION	SPEED (KNOTS)	SPEED (M.P.H.)
00	4	29.85	38	33	64	26	N	9	10
01	4	29.85	37	33	69	25	N	9	10
02	4	29.85	37	32	64	25	N	8	10
03	5	29.84	36	32	65	24	NNW	8	10
04	4	29.84	35	31	66	24	NNE	8	10
05	4	29.85	35	31	67	24	N	8	9
06	4	29.85	34	30	69	24	W	8	10
07	4	29.86	34	31	67	24	WNW	8	10
08	4	29.88	39	34	61	25	NW	10	12
09	4	29.88	42	36	56	26	NW	12	14
10	5	29.87	44	37	52	26	NW	12	14
11	5	29.86	46	38	50	26	NW	13	15
12	5	29.85	48	39	47	27	NNW	12	14
13	6	29.83	49	40	45	27	WNW	12	14
14	6	29.81	50	40	45	27	NW	13	15
15	6	29.80	51	41	44	27	WNW	12	14
16	6	29.79	50	40	44	26	W	13	15
17	5	29.80	49	40	46	27	WNW	12	14
18	5	29.81	47	39	50	27	W	9	11
19	4	29.82	44	37	54	27	N	9	10
20	4	29.82	42	36	57	26	NW	9	10
21	4	29.83	41	35	60	27	N	8	9
22	4	29.83	40	35	63	27	W	9	10
23	4	29.84	39	34	64	27	N	9	10

G 24-HOUR AVERAGES

DAY	SKY COVER (NO. TENTHS)	STATION PRESS. (IN.)	DRY BULB (°F)	WET BULB (°F)	REL. HUM. %	DEW PT. (°F)	RESULTANT WIND *: SPD.	RESULTANT WIND *: MEAN DIR. (Deg.)
1	3	30.21	32	26	44	12	NNW	340
2	2	30.40	22	17	43	3	NNE	276
3	1	30.15	25	19	37	2	NNW	191
4	1	29.91	30	23	38	5	N	17
5	7	29.73	32	29	76	25	NE	268
6	10	29.40	34	33	91	31	NNE	460
7	7	29.79	34	30	61	22	NNE	389
8	1	30.02	33	28	56	18	NE	112
9	9	29.89	32	31	87	29	E	108
10	9	29.90	38	35	80	32	N	95
11	9	29.98	39	37	81	34	ENE	237
12	7	29.42	47	44	83	42	NNW	79
13	5	29.46	44	40	84	39	WNW	246
14	6	29.75	41	35	57	26	W	261
15	4	29.86	40	34	58	25	WNW	246
16	4	29.86	38	31	50	20	WNW	325
17	1	29.91	41	33	43	19	WNW	282
18	0	30.04	41	32	36	15	NW	322
19	5	29.88	41	35	59	25	WSW	154
20	6	29.73	47	43	73	38	NE	60
21	10	29.50	44	43	89	41	ENE	302
22	6	29.67	47	40	58	31	NNE	192
23	3	29.81	46	39	56	30	WNW	225
24	1	29.86	45	36	46	24	NW	268
25	5	29.86	48	37	93	19	NW	266
26	6	29.75	50	39	34	22	N	202
27	1	29.76	51	40	37	23	NW	239
28	0	29.95	52	40	33	23	WNW	127
29	3	29.99	57	45	44	33	SSW	176
30	4	29.89	66	54	49	45	SSW	336
31	8	29.68	65	58	69	54	SSW	338

H OCCURRENCES OF WEATHER BY WIND DIRECTION:

WIND DIR.	CEILING (FT.): 0	100-200	300-400	500-900	1000-1900	2000-4900	5000-9900	OVER 9900	VISIBILITY (MI.): 0-1/8	3/16-3/4	1/4-1 1/2	1 1/2-2	3-4	5 AND OVER	WEATHER TYPES: RAIN	FREEZING RAIN	DRIZZLE	SNOW, SLEET	HAIL	FOG	FOG WITH SMOKE	SMOKE OR HAZE	THUNDER-STORM
N		1	2	2	3	4	2	76		1	2	1	2	84	1			4		5			
NNE		1	8	2	11	2	1	38			9	3	11	40	2		1	13		18			3
NE			6	7	12	4	1	1	26		1	12	13	31	7		2	14		17	1		7
ENE		2	13	7	9	1	2	1	9		5	14	9	16	22		2	5		23	11	14	
E			1	1	3	5	2	7	7				8	18	7		1			3	1	6	
ESE					1		2	2	10				2	13								2	
SE					1	1	2	1	18				2	21	4			1		1			
SSE			1	1			2		5			1	1	7	4			1		1			
S				1		1	2	2	23				1	23	2					1			
SSW				1	2	4	1	7	17				1	23	2					1			
SW						3	1	1	26			1		27	1								
WSW			1			3	1	1	10				1	14	1							1	
W		1	1	1		6	8	6	66			1	1	81	2					1		1	
WNW				1		6	7	7	70			1	1	82	1					2			
NW		1				1	2	8	88		1		3	88	2					4			
NNW						1	1	5	54				2	54						2			
C			1			2		5	5				3	5	2					3			
TOTAL		5	33	23	42	18	30	39	548		2	17	34	62	629	60		6	30		82	13	34

A 5-year summary of frequency tables similar to Tables A, B, C, D, and E above, and generally covering the period 1949-1954, is available for this station. It is for sale at 10 cents per copy by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

* Resultant Wind: The vectorial sum of all surface wind directions and speeds for each day. It is obtained by resolving each hourly wind observation into components from north and east, summing them over the day, and reconverting the summed components into a single vector. The daily resultant wind speed may be obtained by dividing the Total Movement by 24.

Subscription Price: Monthly Local Climatological Data $1.00 per year including annual Summary if published; $1.00 per year for monthly Supplement only; $1.50 per year for monthly Summary, monthly Supplement and annual Summary if published. Single copy prices: 10 cents for monthly Summary; 10 cents for monthly Supplement; 15 cents for annual Summary.

Checks and money orders should be made payable and remittances and correspondence should be sent to the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C.

USCOMM-WB-Asheville, N. C. --- 4/23/62 --- 425

FIGURE 9

I (cont'd)

HOURLY OBSERVATIONS:

BALTIMORE, MARYLAND
FRIENDSHIP INTERNATIONAL AIRPORT
MARCH 1962

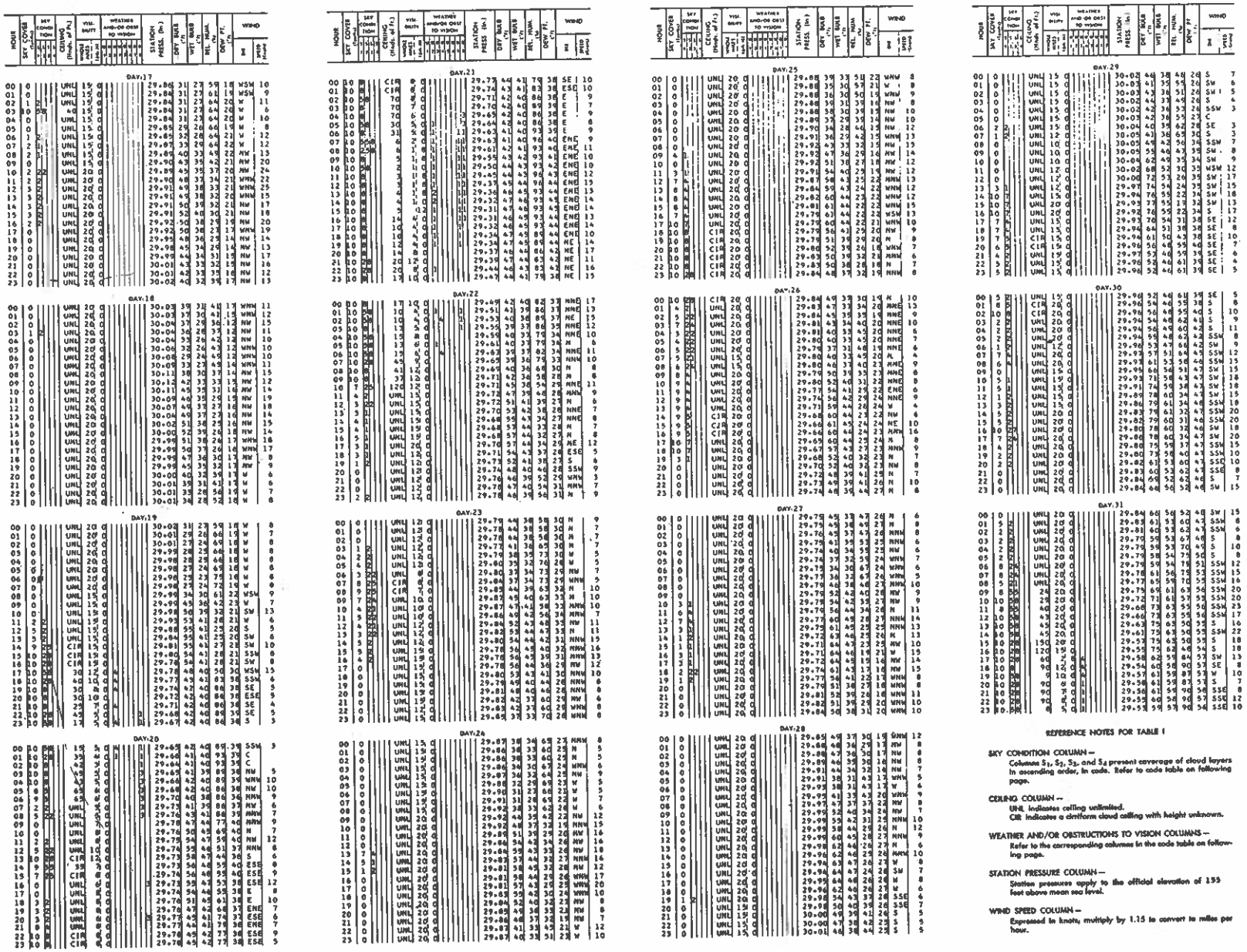


FIGURE 9A

REFERENCE NOTES FOR TABLE I

SKY CONDITION COLUMN —
Columns S_1, S_2, S_3, and S_4 present coverage of cloud layers in ascending order, in code. Refer to code table on following page.

CEILING COLUMN —
UNL indicates ceiling unlimited.
CIR indicates a cirriform cloud ceiling with height unknown.

WEATHER AND/OR OBSTRUCTIONS TO VISION COLUMNS —
Refer to the corresponding columns in the code table on following page.

STATION PRESSURE COLUMN —
Station pressures apply to the official elevation of 155 feet above mean sea level.

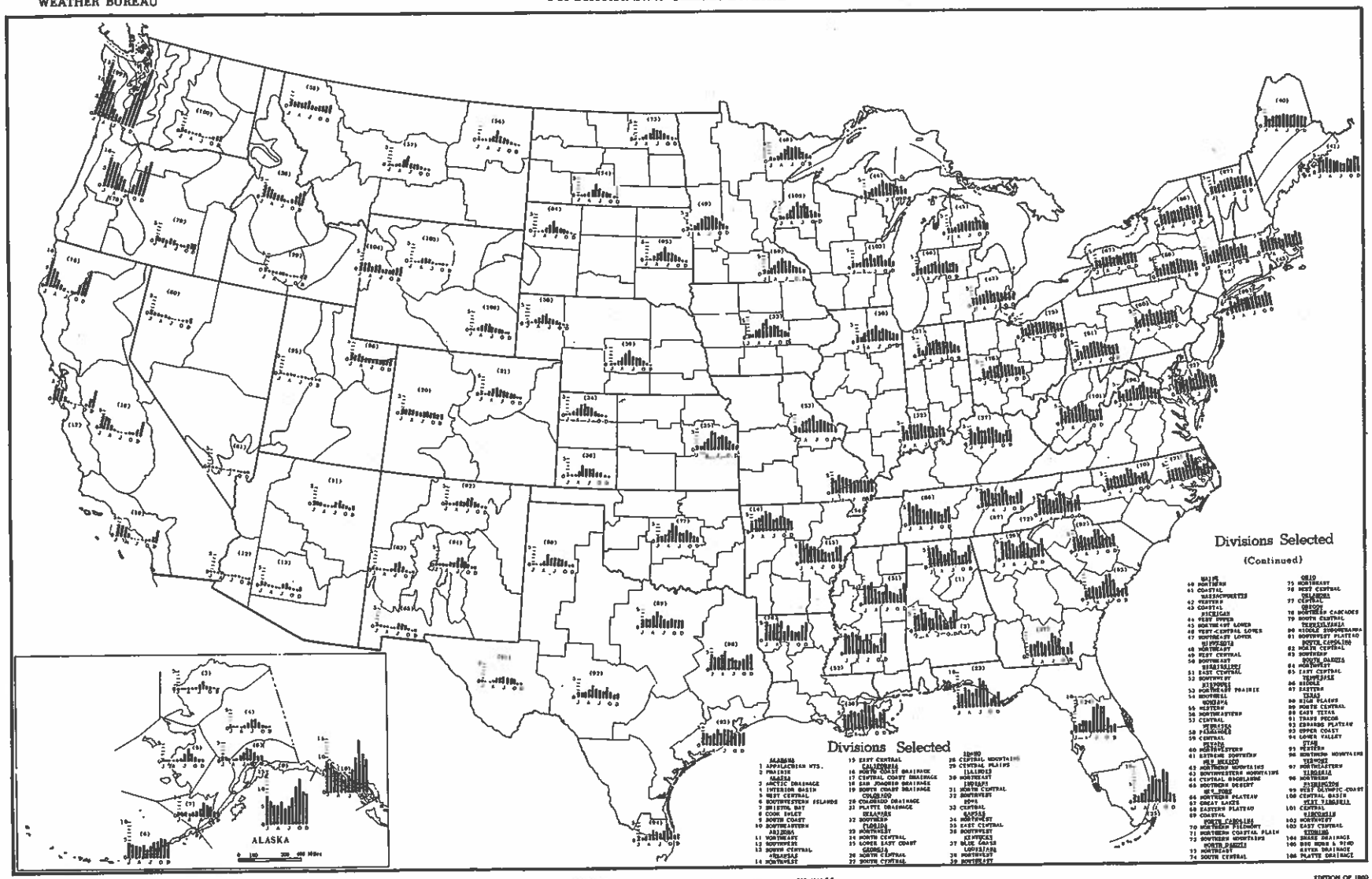
WIND SPEED COLUMN —
Expressed in knots; multiply by 1.15 to convert to miles per hour.

UNITED STATES
DEPARTMENT OF COMMERCE
WEATHER BUREAU

MEAN MONTHLY TOTAL PRECIPITATION (Inches)
For Selected State Climatic Divisions

SHEET OF THE NATIONAL ATLAS
OF THE
UNITED STATES

FIGURE 10



Base map by U. S. Weather Bureau
Subject data based on 3515 station records, 1931-55
Prepared by Office of Climatology

SCALE 1:10,000,000

EDITION OF 1960

MEAN MONTHLY TOTAL PRECIPITATION (Inches)
For Selected State Climatic Divisions

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