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U. S. DEPARTMENT OF COMMERCE  
CHARLES SAWYER, Secretary  
WEATHER BUREAU  
F. W. REICHELDERFER, Chief

CONFERENCE OF  
WEATHER BUREAU  
FORECASTERS

May 24-28, 1948

WASHINGTON, D. C.



WASHINGTON: 1949

# **National Oceanic and Atmospheric Administration**

## **International Polar Year (IPY) 2007-2008**

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U.S. Weather Bureau

Conference of Weather Bureau Forecasters, May 24-28, 1948.

SCHEDULE OF SESSIONS

FORECASTERS' CONFERENCE

MAY 24-28, 1948

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National Oceanic & Atmospheric Administration  
U.S. Dept. of Commerce

MONDAY (May 24)

- A. M. 9:15 - 10:00 Announcements and Introductions--Mr. Oscar Tenenbaum
- 10:00 - 10:20 Opening Address --Dr. F. W. Reichelderfer
- 10:20 - 10:40 Progress since 1944 Conference --Mr. I. R. Tannehill
- 10:40 - 11:20 The Aviation Picture --Mr. D. M. Little
- 11:20 - 12:00 Communication Problems --Mr. T. R. Brooks  
and  
Mr. I. D. Boyle
- P. M. 1:30 - 5:00 Reorganization of Aviation Forecast Service --Mr. R. C. Schmidt

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TUESDAY (May 25)

- A. M. 9:30 - 10:45 Flight Advisory Weather Service--Mr. W. M. Rowe
- 10:45 - 12:00 Coordination of Forecasts --Mr. L. Harmantas
- P. M. 1:30 - 2:00 Familiarization Flights and Trips --Mr. D. M. Little
- 2:00 - 4:00 Report on WBAN Analysis Center --Mr. J. R. Fulks
- 4:00 - 5:00 Facsimile and Its Implications --Mr. I. R. Tannehill
- 8:00 - 9:15 Artificial Production of Precipitation --Dr. Harry Wexler  
and  
Dr. Ross Gunn

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WEDNESDAY (May 26)

A. M. 9:30 - 10:00 River Forecasting Program --Mr. R. K. Linsley, Jr.  
10:00 - 11:30 Quantitative Precipitation Forecasting --Mr. A. K. Showalter  
11:30 - 12:00 Training of Forecasters --Mr. A. V. Carlin  
P. M. 1:30 - 2:30 Research Program --Mr. E. M. Vernon  
2:30 - 5:00 Forecast Verification Program --Mr. A. W. Cook  
8:00 - 9:00 International Meteorological Organization --Mr. I. R. Tannehill

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THURSDAY (May 27)

A. M. 9:30 - 10:50 Specialized Forecasts --Mr. E. Ellison  
10:50 - 12:00 Forecast Terminology --Mr. W. Stevens  
P. M. 1:30 - 2:30 Standardized Forecast Terminology --Mr. A. B. Carpenter  
2:30 - 4:30 Five-day Forecasts --Mr. G. E. Dunn  
4:30 - 5:00 Policy with Respect to Private Practice of Meteorology --Dr. F.W. Reichelderfer

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FRIDAY (May 28)

A. M. 9:30 - 10:15 Policy on Radio Broadcasts --Mr. C. B. Carney  
10:15 - 10:45 Radio Broadcast Training Program --Mr. J. Fidler  
10:45 - 11:30 Weather Summaries --Mr. J. C. Ballard  
11:30 - 12:00 Progress on WRPC Program --Mr. W. C. Jacobs  
P. M. 1:30 - 2:30 Filing of Weather Maps --Mr. H. A. Downs  
2:30 - 3:15 Proposal for Rationalization of Synoptic Network --Mr. L. P. Harrison  
3:15 - 4:00 Forecasters and Regionalization --Dr. F.W.Reichelderfer  
4:00 - 4:45 Administrative Problems --Mr. W. F. McDonald  
4:45 - 5:00 Closing Remarks --Dr. F.W.Reichelderfer

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REPORT ON PROCEEDINGS1. Announcements and Introduction - Mr. Oscar Tenenbaum.

The Conference was called to order by Mr. Tenenbaum, who made several announcements. He stated that the Chief of Bureau had selected Mr. I. R. Tannehill as General Chairman of the Conference. Designated chairmen of discussions were asked to submit outlines of their topics, so that the discussions could proceed systematically and according to schedule. Committees were named to make reports on designated topics, and the written reports were expected in the Central Office 30 days after the conclusion of the Conference.

Free time had been provided just before the morning and afternoon sessions of the Conference for individual discussion of station problems with Central Office officials and for radio broadcast auditions to be conducted by the Training Section.

Mr. Tenenbaum requested nominations for the 90-day Central Office training details in the WBAN Analysis Center and Extended Forecast Section. After each of those present introduced himself to the group, Mr. Tenenbaum briefly outlined the agenda of the Conference.

An invitation was extended to the group to visit the offices of the Synoptic Reports and Forecasts Division, where a receiving drop facsimile machine had been installed, in order to observe the practical operation of the Air Force facsimile circuit.

II. Opening Address - Dr. F. W. Reichelderfer

Dr. Reichelderfer welcomed the attending forecasters to the Conference. He explained that because of limitations in cost and meeting space it was impossible to invite all who wished to come to the Conference. Conferences of forecasters should be held more frequently than in the past, he stated; the four years since the last conference was too long a period.

This conference should aim at an objective approach, he indicated, and try to separate those subjects which are urgent from those which are not essential, but which may have become so routine that we fail to examine them critically. The conclusions of the conference should deal with matters that are practical to accomplish. He stressed the need for teamwork. There are very few instances in the government service where local officials have as great a variety of duties as field Weather Bureau officials and operate as independently in close relationship to the public. Since it is impracticable to support specialized staffs for all duties, cooperation is essential at each station.

III. Progress Since 1944 Conference - Mr. I. R. Tannehill

Mr. Tannehill briefly summarized a report of Weather Bureau progress affecting forecasting services since the Forecasters' Conference of May 15-20, 1944. Following is the complete report:

SOME NOTES ON WEATHER BUREAU PROGRESS AFFECTING  
FORECASTING SERVICES SINCE MAY 1944.

By

I. R. Tannehill

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A few of the forecasters who attended, or are familiar with, the Forecasters' Conference which was held in Washington, D. C. during the period of May 15-20, 1944, have expressed some doubt about its accomplishments. It is true that we did not accomplish as much as we hoped, but we should recall that in May, 1944 the country was still in the midst of the World War. Our efforts were concentrated on work connected with prosecution of the war, which lasted longer than we expected. Not all of the recommendations which were made as a result of that Conference have been put into effect, but a survey (\*) of conditions as they were at that time, compared with the situation at present, indicates that there has been a significant amount of progress in the organization and the activities of the Bureau as they affect forecasting.

The following remarks take into consideration those items which were discussed at the 1944 Conference in which the Bureau has made, or tried to make, progress during the past four years:

1. Size and Number of Forecast Districts. In 1944 the country was divided into 12 state forecast districts, 18 airway districts, and 23 or 24 FAWS areas. Since that time, the Seattle state district has been carved out of the San Francisco district, and we now have 13 state forecast districts. There has been no change in the airway forecast districts, but we now have 26 FAWS areas. (The FAWS offices at New Orleans and El Paso were established during the past three years). In addition, Specialized Service Units have been established and are functioning in six states. Six River Forecast Centers have come into existence during the past two years, and four of these are now in full operation.

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\* For this survey, I am indebted to Mr. Oscar Tenenbaum and a number of persons who assisted him in checking this information. The statements herein reflect the writer's views, but they do not imply definite commitments of the Chief of Bureau to carry out any program discussed.

A number of important objective considerations were listed by the Committee of the 1944 Conference which reported on this item as determining the location of District Forecast Centers. In addition to the considerations listed, it must be appreciated that the Weather Bureau must also consider practical aspects which have some bearing on the number and location of forecast centers and Weather Bureau offices. The Bureau favors the establishment of more and smaller state forecast districts, but is confronted with two limiting factors, namely: a lack of funds and an insufficiency of experienced forecasters to increase our forecast staffs.

With respect to airway forecast districts, although there has been no change in the number of such districts during the past four years, we have considered a proposal to increase the number of airway forecast districts so as to coincide with airway traffic control areas. Limiting factors here also include lack of funds and an insufficiency of available personnel, and in addition, insufficient communication channels.

2. Duties and Responsibilities of Head Forecasters. At the 1944 Conference, the forecasters agreed that the leading forecaster should take tours of duty with enough regularity to maintain his efficiency and standing among the other forecasters, but it was also agreed that he should not be required to carry a full schedule, since this might prevent him from carrying out his principal duties as a supervisor. A recent survey on this topic made by individual letters to leading forecasters indicated that practically all of our leading forecasters agreed in principle that:

- (a) When the leading forecaster is also the official in charge at a forecast center he should actively participate in making official forecasts to the extent of at least 25% of his time.
- (b) When the leading forecaster is not official in charge at the station he should participate in official forecasts to the extent of at least 50% of his time.
- (c) At those centers where the leading forecaster is official in charge and the position of supervising forecaster has been established under the leading forecaster, the supervising forecaster should participate in forecasting a minimum of 75% of his time.

The Central Office has noted that some who agreed in principle with this statement of policy explained why they found it advisable to except themselves. Such exceptions may be valid when there is a direct benefit to forecast accuracy, rather than to administrative efficiency. The Central Office's viewpoint is as follows:

An official-in-charge forecaster is usually selected because he is an outstanding forecaster. The Weather Bureau does not want to lose his services as a forecaster because of his promotion. Although it is not the desire of the Central Office to apply rigid rules, it is

considered that the administrative duties of a good forecaster usually are not as important to the Bureau as good forecasting. The Central Office has sought to establish the position of technical assistant to perform administrative duties at each of our district forecast centers in order to permit our forecasters to do more forecasting. If we expect to put out good forecasts, it must be a basic principle that so far as possible the best forecasters should continue in forecasting.

3. Staffing of Forecast Centers. From a personnel point of view, it appears that more progress has come about under this heading than under any other which was discussed at the 1944 Conference. There are still a few vacancies in forecast positions allocated to forecast offices, but action is now under way in these cases to have vacancies filled as soon as possible. In most cases, the staffs have been increased so that it is no longer necessary for one forecaster to prepare both state and airway forecasts on the same forecast track. This practice may still be necessary at a few centers during some part of the day, but as funds and personnel become available it is the aim to eliminate this as far as possible,

(a) District Forecast Classifications. In 1944 we had only one or two P-6 district forecaster positions in the entire country. Otherwise, the highest grade among leading district forecasters and among all non-forecasting officials in charge at district forecast centers was not above P-5.

Recommendations of the 1944 Conference in this respect have not yet been fully realized, but at eight of our district forecast offices a P-6 position has been set up for the Officials in Charge, who is also usually the leading forecaster. At those places, the Supervising District Forecaster has been classified as P-5. In 1944, district forecaster grades ranged from P-1 through P-4. At the present time, all district forecast positions have been graded up to P-4.

(b) Airway Forecast Classifications. In 1944, airway forecast supervisors were graded in positions ranging from P-2 to P-4. We have not realized the full recommendations of the 1944 Conference, but all airway forecast supervisors are now graded at P-4. In 1944 airway forecasters were performing at grades ranging from SP-6 to P-3. All airway forecasters now are graded at P-3, and the airway forecasters engaged in international aviation forecast services are graded at P-4, with a P-5 supervisor. Minimum airway forecast staffs now consist of one supervisor, and five associate forecasters.

(c) FAWS Staffing. In 1944 our FAWS staffs were manned almost exclusively with P-2's. There were two P-3 supervisors who were designated as area FAWS coordinators. We have not attained all the recommendations of the 1944 Conference, but we have made progress in that

all of our FAWS supervisors are now graded at P-3. Staffs now are as large as recommended in 1944, namely; one supervisor and five supporting forecasters. In a few cases, sub-professional assistants have been assigned to FAWS units.

4. Qualifications for Selection of Forecasters. Among the recommendations of the 1944 Conference Committee on this subject was for initiation of a practice forecast program to be used as a basis for selection of forecasters. The practice forecast program, which was in effect until about the beginning of the war, had to be discontinued because of wartime shortage of personnel. Considerable effort has been expended during the past several years in formulating a workable practice forecast program. Inability of forecasters to arrive at general agreement about the principles of verification and the significant elements which should go into such a program have been factors contributing to delay in the adoption of a practice forecast program. It is our hope that as a result of this Conference a practical verification program can be evolved to meet with the approval of most forecasters. The official verification program which has been in use since early 1944 is not a practice forecast program. Those who have worked with the PFR program have reason to doubt its ability to show forecast skill. Generally speaking, the PFR system appears to give an indication of the accuracy of the forecasts, but hardly the degree of forecast skill exercised by the forecaster. At any rate, it has provided an element of competition which has been beneficial.

For want of a truly objective system for measuring forecast skill, the Bureau has used other criteria in filling forecast positions; experience, education and opinions of supervising officials. While the Bureau has sought to improve the accuracy of the forecasts by appointing to forecast positions those who could fulfill the Bureau's minimum educational requirements, men who have shown superior forecasting ability, but who lacked sufficient formal education, have not been ignored.

Forecast authorities were abolished in 1946 when the classification system included the authority in the job description.

5. Training of Forecasters. On-station training of potential forecasters has been carried on at most forecast centers during the past four years. The amount and character of such training has varied among forecast centers. On-station training of a practical nature has also been afforded by placing prospective candidates for airway forecast positions in our FAWS units. In the same way, our airway forecasters are receiving training which will be valuable in qualifying for district forecast positions. All of this training has been extremely useful, but it has been difficult to appraise such usefulness objectively. Assignment of research forecasters to forecast centers may offer an opportunity for systematic planning and guidance in any future on-station training program.

The Weather Bureau has not conducted any regional Technical Conferences for the training of potential forecasters during the past four years. However, the military services carried on considerable training of this nature during the war years, and the Weather Bureau, by employing many of those who received this training, has thus been able to take advantage of meteorological training which bore considerable similarity to the RTC classes of some seven or eight years ago.

As a partial substitute for the RTC classes, during the past two years experienced district and airway forecasters have been assigned to the Central Office for 90-day details. We have usually been able to assign two forecasters at one time. Two-thirds of the 90-day detail is spent in the Extended Forecast Section and one-third in the Analysis Center. The men chosen are expected to contribute to the operation of these units, to increase their own practical knowledge and experience, and to carry some of the benefits back to others on station.

Under statutory authority granted by the Civil Aeronautics Act of 1938, the Weather Bureau has continued to detail up to ten members of its personnel for training at Government expense at higher institutions which have established recognized meteorological departments.

6. Publicity and Salesmanship. The most obvious reaction when the subject is mentioned is to direct our attention to the rapid growth of the direct radio broadcasts. The 1944 Conference made a recommendation on this subject. Excellent local public service programs have been built around radio broadcasts and the Weather Bureau is now able to reach more of the general public on an intimate plane than at any time before in the history of the Bureau. The Bureau needs no direct salesmanship in order to obtain more such direct radio broadcasts. As a matter of fact, we have had to restrain further growth of this program where it might result in requirements for increased personnel or deterioration of other essential services. However, there is still room for improvement in the presentation of the broadcasts, and as you all know, the Weather Bureau has entered upon a program which should lead to improvement of this aspect of our service.
7. Improvement in Service. Improvement of our radio broadcasts is just part of the broad subject of "Improvements in Service" which was discussed at great length and in considerable detail during the last Forecaster's Conference. Among the topics which were presented by the Committee on this subject at the last Conference were the following:
  - (a) Terminology in state and local forecasts. With respect to state and local forecasts, the Weather Bureau has tried to break away from the stereotyped phraseology which forecasters had apparently fallen into the habit

of using as a result of the verification system in use some ten years ago and before. Circular Letter No. 100-41, written in 1941, advised forecasters to use the dictionary in stating their forecasts so that the public would understand exactly what the forecaster expected. This advice brought about some improvement, but during the last few years our attention has been called to a tendency to drop back into the habitual use of stereotyped phrases. On the credit side of the ledger, we can point to less of a tendency to use "weasel" words. Furthermore, forecasts give more detail as to elements expected than they did years ago. In addition to the shippers' bulletin, many of our district forecast centers include maximum and minimum temperatures in their state forecasts. This is one way to amplify temperature forecasts. With no desire to restrict forecasters in their expressions, we feel that there is a need for a more flexible and specific forecast terminology. This may require some education of the public, but with the aid of our direct radio broadcasts, this should not be hard to attain. Once attained, this uniformity in understanding should be a boon to the forecasters themselves, as well as to the general public.

- (b) Specialized Service Units. The Weather Bureau has established Specialized Service Units at several places in the country. Perhaps these might more appropriately be called State Service Units. These units have been particularly successful in increasing and improving services to agriculture and industry, and in providing localized forecast service to many communities which previously had only generalized state forecasts available. Primarily, because of lack of appropriations, there is no immediate prospect of expansion of our Specialized or State Service Units.
- (c) Forecast Advisory Board. Action was taken on recommendation of a committee of forecasters, but because of some unexpected changes in the personnel at Washington, the Forecast Advisory Board has not functioned recently. The project has not been dropped. It is hoped that this activity can be resumed shortly.
- (d) Flight Advisory Weather Service. The FAWS units, which were originally set up partly because of the need for supplying weather information to the Army Air Forces, had to make adjustments in operations with the ending of the war. We are still in the period of adjustments and we have noted certain defects in the operation of the units. To remedy this situation, we are planning

to hold a Conference of F/WS supervisors in Washington, D. C. this Fall.

- (e) Extended Forecast Data. There have been some changes in the material being transmitted from the Extended Forecast Center to the field, primarily as a result of recommendations of the previous conference and from district forecasters detailed to the Central Office. This added material consists of prognostic daily charts for the five-day period and also a five-day Mean Trend Chart on five days a week. Further changes are to some extent dependent upon the feasibility of assigning additional personnel at the Extended Forecast Center.

Experimental 30-day forecasts are now sent on a confidential basis to district forecast centers and other offices in the form of a printed folder, in which observed and prognostic 700 mbs contour patterns, temperature and precipitation anomalies and climatological data are conveniently presented. Special 30-day forecasts are also furnished on a confidential basis to research offices of a few industries having a nation-wide weather problem. Action is in process to make these forecasts available for confidential information at more of our offices, but the work is still in the experimental stage and general public distribution is not contemplated at present.

- (f) Use of Analysis Center Transmissions. In accordance with recommendations made at the last Conference, 30-hour prognostic charts are now being transmitted on Service "C" in addition to the 12-hour prognostic charts. At the present time, these 30-hour prognostic charts are transmitted twice a day, although they are prepared by the WBAN Analysis Center four times daily. Lack of suitable time on Service "C" is the barrier to the transmission of these charts on a 4-times-a-day basis. Since June, 1947 two 24-hour 700 mb prognostic charts have been prepared daily and transmitted on Service "C". Additional information is now on Service "O".
- (g) Airway Forecast Service. At the last Conference, the Committee which submitted the report on "Improvements in Forecast Service" stated that the airway service had been overlooked at the 1944 Conference. We have attempted to meet that criticism at this Conference. The major portion of the first two days of this Conference will be devoted to the Airway Forecast Service.

- 8. Quantitative Forecasting of Rainfall. The last four years have seen the Weather Bureau undertake an expansion of the quantitative precipitation forecast program. Forecasters have had an opportunity to build up considerable experience

in this field. This will be discussed further at this Conference.

- (9) The Short-Range Forecast Research Development. During the past four years the Short-Range Forecast Section in the Special Scientific Services Division has presented several studies of objective methods of short-range forecasting. Some of these studies have proved to be useful in practical forecasting. In addition, we have been able to establish research forecaster positions at several of our forecast centers and it is hoped that eventually as funds become available, we may be able to establish such positions at every forecast center in the country.
- (10) Summary. The war continued for more than a year after our first Conference. The period of readjustment was more difficult than we anticipated. International aviation developed rapidly as a result of the new ICAO organization, and this put another burden on forecast staff and administration. We had to hold the line in forecasting in many parts of the world until countries devastated or impoverished by war could take over the work. We are still in the position of providing technical and forecasting skill in foreign places. In other respects, the international phases of our work have taken time and skilled personnel. We reached a position where most of the countries of the world looked to us for guidance and technical help and advice in meeting the more exacting requirements of post-war aviation, industry, commerce and agriculture. Another factor was the change in working hours which required adjustments, mainly increases in staff, to convert from long hours of wartime duty to the new 40-hour week. These are not apologies. We can feel that we have accomplished a great deal in spite of great obstacles, and the Bureau can be proud of its progress, not only in the United States, but in broad and exceedingly important international fields.

#### IV. The Aviation Picture - Mr. D. M. Little.

Mr. Little stated that we sometimes get the feeling that our aviation services are devoted exclusively to the commercial air carriers. Nevertheless, we are actually also trying to service private flyers.

Pointing to the letter, he discussed the question of broadcasting spot weather or sequence reports over commercial radio stations. The Bureau had been urged to foster such broadcasts, but had resisted because such material could not be properly controlled to avoid jeopardizing flying safety. We could not be sure that our current up-to-the-minute information would be broadcast, and some of this material would be uninteresting to the general public. To meet the demand for flying weather broadcasts, we have worked with the CAA toward establishing government broadcasting stations which would broadcast weather information continuously.

Mr. Little then went into the matter of cooperation and liaison with CAA. At present we enjoy the best cooperation with the CAA that we have ever had, not only in Washington, but also in the field and at our regional offices. One method to get this cooperation is by having a Bureau liaison man work with the CAA in Washington. Mr. Robert Craig, who was selected for that liaison job a year and a half ago, now handles coordination of all problems which mutually concern the two agencies. A recent result of this liaison was a circular on space requirements for FAWS units, issued by both agencies. Formerly, the Bureau was paying rent for FAWS offices at some places and not for others; now we have a uniform arrangement whereby the CAA provides a certain amount of space, including storage space, without cost to the Bureau.

Mr. Little then discussed the recommendations of the President's Committee and the Joint Congressional Committee on Air Policy. Of particular concern to the Weather Bureau, were the following five recommendations:

1. Necessary funds should be authorized to enable the Weather Bureau to furnish weather information on routes newly approved by the Civil Aeronautics Board.
2. Necessary funds should be authorized to enable the Weather Bureau to continue investigation of causes and characteristics of thunderstorms and hurricanes.
3. The Weather Bureau should designate qualified personnel at airports where no official weather observers are stationed, to act as voluntary official weather observers and assist the private flyer by disseminating weather information obtained from airways or other observation centers.
4. International cooperation should be encouraged for prompt exchange of accurate weather information over the oceans and in Arctic regions, where observations and reports are desirable to serve air routes.
5. The Federal Government should continue to cooperate with ICAO to improve weather service over the oceans by means of weather-station vessels, with due regard to navigation and Search and Rescue activities.

Of interest to the Weather Bureau was a recommendation that the Civil Aeronautics Board should encourage action by commercial air carriers to achieve over-all economies, particularly by joint operation of airport facilities and meteorological services. Some airlines have already started cutting down on meteorological personnel.

At Mr. Little's request, Mr. Dunn briefly explained the plan to start radio facsimile transmissions of weather maps to the FAWS and briefing offices, and possibly the airline offices, at the Chicago Municipal Airport. Mr. Dunn stated that it was not planned to prepare special charts for facsimile transmission; after an ozalid

copy of the regular map had been prepared for use of the forecaster, the manuscript map would be cut up in sections for transmission.

Mr. Little also discussed services to international aviation, and in this connection referred briefly to the Standards and Recommended Practices (SARPS) of ICAO and the General Regulations of I. M. O.

V. Communication Problems - Mr. T. R. Brooks and Mr. I. D. Boyle

Mr. Brooks delivered the following talk on Communication Problems, which was of interest to forecasters:

"I know that many of you remember the days when we had two observations a day and when the reports were collected first by the circuit system and then by the SGL D&A system and distributed to stations according to pre-arranged lists. The simplicity of communications at that time was in sharp contrast to the present complexity of the communications system which involves vast networks of closely scheduled teletype lines and radio telegraph and telephone channels required not only to meet domestic needs, but also to provide weather information for air and sea navigation over the entire globe. This has meant a shift from use of commercial telegraph to government-owned or leased lines and facilities.

"Doubtless, all of you are familiar with the fact that at first GAA had only one airway teletype system. In 1941 another circuit was added so that we then had two circuits, namely: "A" and "C". During the war the Army built up still another circuit now known as Service "O", which at the close of the war was taken over by the Civil Aeronautics Administration. The scheduling of all meteorological material on these circuits is a function of the Weather Bureau. According to the latest reports, Service "A" has grown to 31,000 miles, Service "C", 28,000 miles, and Service "O", 11,000 miles, making an overall total of approximately 70,000 miles. The job of scheduling these circuits, which is handled by the Synoptic Section of the SR&F Division, is a very formidable one. Mr. Boyle will discuss this in greater detail later.

"As a matter of historical interest, the first teletype system for handling weather reports was a pony teletype circuit between the Weather Bureau office at Hadley Field and the communication station near Newark. At about this same time, pony circuits were established at Cleveland and between the communication station at Concord, California, and the Weather Bureau office at Oakland. These pony circuits were established to facilitate handling of observations between the Weather Bureau office and the flying field which before that had been telephoned. This was in 1927. Hadley Field and Oakland were terminal points on the Transcontinental Air Route. Weather Reports for flying this route were at first transmitted by telephone and later by point-to-point radio.

"The present airway teletype system had its beginning on the pony circuit between Concord and Oakland. After this circuit had been in operation a month or so, Dr. Rossby came out to California with Guggenheim funds to establish some sort of an airway. He previously had proposed to Mr. Guggenheim that a Model Airway be established between New York and Cleveland. However, Mr. Guggenheim was backing, to some extent, a company known as the Transcontinental Air Transport--at least he had bought its first airplane. This company was planning to operate between San Francisco and Los Angeles. It happened that Dr. Rossby went to California to set up this Model Airway at the same time that Dr. Gregg was on the Pacific Coast to set up a telephone system for use in connection with flying activities between San Diego and Portland. When Dr. Rossby came out to Oakland and saw the local teletype, he went to PT&T and sold them the idea of donating a teletype circuit between San Francisco, Fresno, Bakersfield, and Los Angeles. The PT&T donated this system for a year. At the same time Mr. Little, under the direction of Dr. Gregg, was putting in a telephone system for day and night operation. Dr. Rossby's plan was for operation during daylight only as he had no night observers. The upshot of this was that the Chief of the Weather Bureau told Major Bowie to cooperate with Rossby in working out a system which would take care of both day and night flying. The result was that the Weather Bureau ran the system at night and Rossby during the day. Arrangements were made for hourly reports to be collected principally by telephone. After Dr. Rossby left California the system was turned over to Major Bowie and the Weather Bureau ran it for a year, that is - until July 1, 1928.

"Sometime during 1928, Mr. Hingsburg, then the Chief of the Bureau of Lighthouses, came to San Francisco. He was gathering facts as to the best system to be used for furnishing flight control weather advices, etc., for operations along civil airways. At that time there was a big argument as to whether this kind of service should be established through use of radio or teletype. Mr. Hingsburg was on the side of radio, but the success of the Model Airway circuit convinced him that teletype was the best method and the circuit was taken over by the Bureau of Lighthouses in July, 1928. Following this, the airway teletype system was soon extended along the Transcontinental Route and after that, its success being assured, spread very rapidly as new air routes were established.

"The communication circuits with which the Weather Bureau is concerned now extend eastward to Europe and westward to the Philippines and Japan. The North American-European exchange of weather bulletins is accomplished by radio telegraph, radioteletype, and CW broadcasts. The principal radio-teletype channel is from New York to Santa Maria and thence by relay to Shannon, Paris and Port Lyautey, French

Morocco. Approximately 25,000 foreign reports per day are received in the United States over this channel, while an estimated 10,000 reports a day are relayed eastward from La Guardia. This is supplemented by a radio telegraph channel from Dorval, Canada, to Prestwick, Scotland, and backed up by a CW broadcast four times daily by CAA radio station WSY at New York".

"On the Pacific side, CAA or Army maintained circuits extend from Japan and the Philippines to Honolulu from which point reports are carried over radio-teletype circuits to Anchorage, Alaska, and San Francisco. These principal channels across the Pacific are supplemented by an Army Circuit extending from Japan to Adak in the Aleutians and thence to Fairbanks. To the south, Central and South America are served by radio teletype and CW broadcasts from WEK, New Orleans, while to the north we are tied into the Canadian circuits, in such manner as to permit free exchange of reports with the Canadian Meteorological Service. The channels used for International exchanges may be regarded as feeder circuits into the United States and reports from these circuits are scheduled on regular relay over Service "O". This job of scheduling is performed by the Synoptic Section of the SR&F Division.

"Telegraph for many years was the principal basis for Weather Bureau communications, but for most purposes is now supplementary to the teletype. The principal use of telegraph now is for the collection of river, crop, weather and off-airway reports and for the dissemination of warnings, especially those sent to radio stations for immediate broadcast. However, these are important uses and our business should be handled promptly. Unreasonable delays should be brought to the attention of the local Western Union office or to this office if you can't get results from your local contacts.

"Use of commercial telegraph for administrative purposes has been greatly curtailed since the establishment of the PBA teletype network. This network was set up to handle government message business and connects 56 principal cities in the United States. The cost of sending messages over this system amounts on an average to less than a cent a word. As an example during a recent month, 19,292 words were sent at a cost of \$142.60, which is less than four-fifths of a cent per word. Recently, the usefulness of this system was greatly enhanced by the adoption of the refilo system by which messages addressed to any office or individual in the United States will be carried over the network to the point in the network nearest to the destination and there refiled with Western Union for delivery to the addressee. It is obviously incumbent

on us to use the PBA system rather than TWX or other commercial channels for administrative messages so far as possible. The system should not be used for priority traffic such as forecasts, warnings and observations. Also, it should be remembered that the system works only during regular government office hours. In addition to the PBA network, use of the Army and Navy network is open to government agencies without cost except where delivery charges are involved. I have seen long messages from Washington to Manila sent via Army channels that cost us only ten cents apiece. This ten-cent charge was for effecting delivery either by telephone or messenger.

"The cost of telegraph to the Weather Bureau considered from the standpoint of rates has increased greatly during the last decade. In 1939 the FCC changed the government differential from 40% to 60% of the commercial rate, in 1943 from 60% to 80% of the commercial rate and in October, 1947 from 80% to the full commercial rate. Each of these upward steps was followed by demands for an increase in the special Western Union rate by Western Union and Postal Telegraph. Following the 80% rise, Western Union wanted to jack up the special rates to a very high level. As a result, we dropped negotiations for a special rate and accept regular government rates. By shortening hauls, use of day or night messages and use of special rates such as serial and longram wherever feasible, the Bureau managed to lessen the impact of the rate increases so that the rise in cost of our telegraph business was far below that which would have otherwise resulted.

"I think all Weather Bureau officials appreciate the importance of using serial and other special rates whenever practicable. The serial rate is especially applicable to hourly, 3-hourly, or 6-hourly observations and to forecasts sent more than once a day.

"The use of telephone for transmission of observations for entry on the teletype system has gradually increased as much faster service can usually be realized. This is important when communications schedules are to be met and we have always approved a changeover to telephone when recommended for this reason.

"Use of TWX for transmission of forecasts and reports has also increased. Often TWX is cheaper than either telephone or telegraph and is usually more satisfactory. Of course there are limitations, especially in the matter of collecting observations, but there have been a number of installations within the last year at off-airway reporting stations.

"The use of TWX for administrative messages has decreased since PBA facilities have been made available. In most cases, use of PBA, or day or night letters, for administrative messages, is just about as satisfactory as TWX and very much cheaper. While the medium to be used in sending administrative messages is left to the judgment of the responsible official, we should bear in mind the necessity for using the most economical channel or rate consistent with the circumstances in the particular case. On the other hand, there is no restriction on use of long-distance telephone or TWX or priority telegrams when required.

"Another point that should be mentioned is use of priority. Coincident with the rate increase, Western Union asked for the abolition of priorities on government messages. The Weather Bureau was willing to agree to this for telegrams of a non-urgent character, but insisted that priorities be retained for urgent government messages. We stressed the necessity for priority handling of observations, warnings, and forecasts. The result of the hearings was a FCC order establishing priority for urgent government messages when so marked by the sender. We have issued a circular letter on this and I think everyone is aware of the importance of using priority for observations, forecasts, warning messages and other traffic that must reach its destination as soon as possible, or in time to meet fixed schedules."

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Mr. Boyle gave the following talk, which dealt primarily with scheduling weather information on teletype circuits:

#### USING COMMUNICATIONS FOR METEOROLOGICAL PURPOSES

"It is frequently said that the Weather Bureau is not a communications agency, but this statement may be very misleading to those not acquainted with the various systems which are used for the collection and dissemination of meteorological reports, analyses, forecasts, etc. At the present time, approximately 25,000 foreign weather reports are received in the United States and handled over channels scheduled by the Weather Bureau. In addition, approximately 20,000 domestic reports are handled each day, not counting the duplication which exists on the various circuits comprising the three national networks. As Mr. Brooks pointed out, we use CAA facilities almost exclusively in the United States. However, the Weather Bureau does make extensive use of Air Force, Navy and commercial facilities for collecting weather information on a world-wide basis.

"It is necessary to perform the scheduling of collectives from a central location and these functions are a part of the duties assigned to the SR&F Division. Although centrally located scheduling functions makes coordination of schedules on the various circuits a simple matter, there are still several problems which are introduced by having the scheduling office located at a distance from the circuits actually being scheduled. For instance, the Synoptic Section arranges schedules for Services "A", "C" and "O", some circuits of which are in the western portion of the United States, but we are unable to observe the operation of these circuits and as a result, discrepancies and some confusion frequently takes place. In that connection, I should like to say that the Central Office would appreciate hearing from you fellows in the field when you notice circuit operation which is ineffective or which is not being performed according to the schedules as planned in the Manuals of Operations. In the last few years, Communications Editing Units have been established at La Guardia Field, Miami, and more recently, at San Francisco. It is our hope that those units will be able to watch the circuits coming into their offices rather closely, and will inform the Synoptic Section regarding discrepancies of operation and make recommendations where improvements can be brought about.

"In setting up schedules for any meteorological data, certain information is absolutely essential. First of all, we must know the data which is available, the source from which it comes, the nearest point on the appropriate network where it can be entered on the long lines, the distribution desired for these data, and the time information is desired. Very seldom is all of this information furnished with the original request for a schedule, which makes it necessary for the Synoptic Section, cooperating with other sections and divisions here in the Central Office, to supply the necessary information. Apparently, in most cases we have been able to anticipate the needs at the field stations, but frequently it is necessary to modify the schedules after a few weeks' trial. It would, of course, be ideal if we could set up the schedules without the necessity of rearrangements at a later date, but this probably will never be effected in all instances.

"The scheduling process consists of a number of steps, many of which must be coordinated with other divisions and other agencies before final action can be taken. These steps are:

1. Getting the report to a point on the long lines system.
2. Determining where the required relays should be made.

3. Checking with the CAA or other agency as to the operational problems, which include equipment, personnel, and time.
4. Making the necessary change in the Manual of Operations, sometimes by WAMES, and at other times by printed revisions.

"Almost all scheduling is a compromise between that which we would like to have and that which we must accept, due to operational limitations, time limitations, or limitations on availability of material. Each office on a particular tele-type circuit requires a slightly different group of reports to furnish the service demanded by that office. As a result, on a typical Service "A" circuit on which there are probably sixty to a hundred different offices, the over-all requirements of the circuit must be a summation of the individual requirements with a certain amount of subtraction where this load goes beyond the operational capacity of the circuit. Scheduling would be a comparatively easy matter if time were available on all circuits to meet requests, but such a situation has not existed for the last six years, and it is doubtful whether we will ever reach the point where all requests can be met. There is also the question of timing the reports on a circuit. In the case of Service "A" Circuit 8002, which extends from New York to Chicago, the timing question becomes very important. Those stations on the Eastern end of the circuit want reports from New England to the middle Atlantic Coast first, while those stations on the Western end of the circuit desire to have the Middle Western stations relayed to the circuit first. This is one of the biggest problems confronting us in the relaying of reports, particularly on Service "A".

"In order to facilitate the handling of reports on Service "A", the CAA has developed and installed message diversion (MEDIS) equipment. This equipment is a mechanical device for sorting out reports desired for further relay and eliminating those not requiring relay. In many ways this system offers great advantages over the block relay system which we have used in the past, but there are quite a few adjustments which must be made before this system works at the maximum efficiency.

"Another major problem in the handling of meteorological data is the determination of which of the three systems shall be used to handle a certain block of traffic. The cost of these three systems is justified to the Bureau of the Budget and to Congress by CAA, and certain statements must be made as to the type of traffic that is to be handled over each individual system. If scheduling breaks down the division between the three systems we would get a hodge-podge system of three networks paralleling each other in destination and in material handled. An investigation of such a miscellaneous system might have an adverse effect on the appropriation of funds for the operation of such a network.

"For this reason, we have divided the three systems into:

1. Service "A" for airway weather reports
2. Service "C" for domestic synoptic weather reports, and
3. Service "O" for international weather reports.

This division, at times, causes some inconvenience to stations, particularly those close to the boundaries of the United States where foreign reports are needed, but Service "O" is not available. This has been taken care of in a few cases by the installation of receiving only drops on Service "O" and in other cases by asking CAA to make the necessary installation.

"Another problem which is frequently rather perplexing is the question of availability of reports for relay. This is true, especially of foreign reports required for relay on Service "O". As Mr. Brooks said, many of the foreign countries have not stabilized their meteorological activities and as a result, the reliability of reports from some locations is quite low. This results in a large block of reports for some transmissions and a very few, or maybe none at other scheduled periods. As a result, the load on the circuit is very irregular, sometimes the machines are overcrowded and sometimes they are standing idle for lack of data. Here, also, we are confronted with a lack of reliable information as to the availability. For instance, we recently had the question of relays of Canadian Raobs to Service "O" at Everett, Washington. The CAA stated that the Canadian Raobs were not regularly available at Everett, and consequently, could not be transmitted on Service "O". We wrote to Canada regarding the availability at Everett, and they stated that the Raobs were being regularly transmitted on the Canadian circuit which extends into the Everett relay station. We still do not know what the exact status of the reports was, but I am informed by Mr. Dunn that the receipt of Canadian raobs at Chicago has improved considerably, the current receipt averaging about 95%.

The sole purpose of scheduling meteorological communications is to make meteorological data available to the office requiring them in time to be of maximum utility. Since the Synoptic Section in itself does not use the material transmitted over the various circuits, it is not always possible for us to determine the effectiveness of our scheduling activity. We must, of necessity, work from manuals applying certain theories and practices in setting up the various schedules. The people in the field offices, particularly the Forecast offices, are in a much better position to determine whether a scheduling arrangement performs the function which was desired. For this reason, we would appreciate hearing from field stations

relative to the utility of schedules which we have set up.

"We have attempted on three different occasions to set up budget requirements for establishing monitor stations on the various circuits, but we have been unable to get these requests through the Bureau of the Budget. Until such monitoring stations can be justified, it will be necessary to rely on field stations and inspection trips from the Central Office to determine whether we are doing a good job."...

Following Mr. Boyle's talk, there was some discussion from the floor on current communication problems. In connection with the establishment of the MEDIS system, some complained that too many unnecessary reports were being received, and that tearing and sorting teletype paper was putting an excessive burden on sub-professional employees at some stations.

#### VI - Reorganization of Aviation Forecast Service - Mr. R. C. Schmidt.

Mr. Schmidt passed out copies of a summary of questionnaires which listed current and proposed features of regional and terminal airway forecasts and which had previously been mailed to Airway Forecast Centers and FAWS offices. On the basis of this summary, Mr. Schmidt had prepared another paper proposing three feasible changes which were favored by the majority of those responding to the questionnaire: (1) Increase in the length of the forecast period, (2) Changes in content and arrangement of regional forecasts, (3) Changes in presentation of certain items in terminal forecasts. This paper also presented other changes favored by those questioned, but which would apparently require additional funds and might, therefore, have to be deferred.

There appeared to be general agreement that the forecast period should be lengthened. The majority favored a 12-hour period, but Mr. Hutchinson voiced the thought that this would extend the period beyond the limit of our ability. Mr. Schmidt replied by pointing out that forecasts for longer periods than official issues were actually being given to pilots, frequently by sub-professional employees, and he stated that it would be better to have such forecasts prepared by the best qualified personnel. Mr. Carpenter indicated that such extended forecasts were usually prepared only for and at individual forecast centers, and that preparing longer-period forecasts for the number of terminals assigned to each center would add a tremendous amount of additional work, which would hurt the accuracy of the forecasts. Conceding that there might be some loss in accuracy with the extension of the period, Mr. Schmidt stated that the verification of terminal forecasts in WNA's forecast district, made in same detail as the 8-hour forecast period but extended for 30 hours beyond that period, was better than 72%. The rating for the last 12 hours of that extended period was no worse than for the 30-hour period as a whole.

Mr. Vernon suggested that 18-to-24-hour terminal forecasts be prepared for key points, but Mr. Stevens wondered whether this would

not arouse cries of discrimination by stations whose forecasts were not as extended. Mr. Rowe stated that public requests caused sub-professionals at many stations to make 24-hour terminal forecasts; would it not be better, he asked, to have these forecasts prepared at the forecast centers? Mr. Ballard thought that a longer forecast period would require more forecasters, and Mr. Knarr pointed to a need for more preparation time. Mr. Schmidt stated that the pending proposal to schedule state forecasts ahead of airway forecasts would give airway forecasts an additional 17 minutes, but Mr. Knarr considered this insufficient. Mr. Harmantas suggested staggering the preparation of the forecasts. Mr. Knarr suggested that forecasters should be relieved of briefing duties, whereupon Mr. Tenenbaum reminded the Conference that this would require additional personnel at forecast centers and that Congress had imposed a ceiling on the Bureau's employment. When Mr. Schmidt asked for a vote on whether terminal forecasts should be lengthened to 12 hours without additional personnel, the choice was 14 to 3 in favor of the proposal.

The next item dealt with changes in the content and arrangement of regional forecasts. Mr. Voelker opposed adding winds aloft at the end of terminal groups, because these groups were not arranged on a geographical basis.

Mr. Schmidt stated that the great majority responding to his questionnaire favored the preparation of high level wind forecasts in the WBAN Analysis Center. Discussion followed on the feasibility of preparing such forecasts four times daily since raob material is available only twice daily, and it was the consensus that high level forecasts should be made only twice daily.

The report of the committee appointed to make recommendations for improving the airway forecast service was as follows:

#### REPORT OF COMMITTEE ON "AIRWAY FORECAST REORGANIZATION"

Recommendations, based on a survey of all airway forecast centers and later discussions during forecasters' conference:

##### 1. RECOMMENDED IMMEDIATE REQUIREMENTS

- (a) Period of airway terminal forecasts be increased to 12 hours.
- (b) Period of regional be increased to 12 hours plus a 12-hour general outlook.
- (c) Forecasts for one or more major terminals in each airway district be extended to cover through daylight hours of the following day, each forecast center to make own decision as to number of terminals in district to be so extended. The portion of forecast beyond 12 hours to be in a very general abbreviated form, mainly to indicate whether below minimum, above minimum, or marginal conditions were expected

- (d) Turbulence and winds aloft be removed from regionals and indicated at end of terminal groups.
- (e) To save teletype time and space, each terminal forecast group to be accompanied by a brief statement of cloud types, tops, turbulence, icing and winds aloft. This would take the place of listing these elements separately for each terminal and in the case of winds aloft and turbulence would also replace mention of these items in regionals.

## 2. RECOMMENDED FUTURE CHANGES

- (a) High level winds aloft be issued from a single center, such as analysis center, providing this does not require more than a few additional personnel.
- (b) Airway forecasters should be divorced from all public service while preparing forecasts.
- (c) Professional personnel, not observers, should brief pilots at major airports.
- (d) A "forecast" or "advisory" teletype or telephone circuit should connect each airway forecast center with terminals within the airway district.
- (e) Terminal and regional forecasts for any area should be prepared by the same forecaster, that is, there should be no centers preparing terminal forecasts only.

### ADDITIONAL COMMENTS ON RECOMMENDATIONS 1a and 1b.

Approximately 80% of the airway forecast centers favored these recommendations. Those voting against increase in length of forecast period indicated that they recognized the need for this, but that some increase in plotting and/or briefing personnel would be needed to give the forecasters at those stations sufficient uninterrupted time to prepare forecasts for longer periods. The acceptance of these recommendations by those voting "yes" was with the understanding that staffs not be permitted to drop below authorized complement.

R. C. Schmidt (signed)  
R. C. Schmidt, Chairman

Louis Harmantas (signed)  
L. Harmantas

G. T. Stephens (signed)  
G. T. Stephens

P. H. Chapman (signed)  
P. H. Chapman

VII - Flight Advisory Weather Service - Mr. W. M. Rowe

After speaking about the purpose and responsibilities of FAWS, Mr. Rowe asked whether FAWS should be quartered in the ARTC room. Some favored removing FAWS from the ARTC room and rendering advisory service by interphone. Mr. Rowe then discussed the desirability of uniformity in FAWS practices. He spoke about the presentation of weather information, the use of glass map displays and of other forms of graphic presentation of current weather. Without additional assistance to keep the display up to date, Mr. Rowe expressed doubt about the capacity of FAWS personnel to render advices and also maintain a display board. Although he favored cross-sections for portraying tops and bases of clouds, keeping them up to date presented a large problem. The use of interphone was then taken up and there was some discussion about the advisability of connecting FAWS units by this means with all Weather Bureau airport offices in the same control zone. Mr. Tannehill favored the idea, but stated that funds to make such a plan effective were not available at the present time.

Then Mr. Rowe discussed the use of FAWS for briefing pilots. He recommended that pilot briefers be established at airport stations so as not to interfere with the chief purpose of FAWS; i.e., to render advices to ARTC. Mr. Tannehill cautioned against laying down dogmatic rules which might hinder the rendering of public service. Traditionally, the Weather Bureau has always considered public service its foremost purpose.

Mr. Rowe then took up the question of the advisability of staffing FAWS with map plotters. He pointed out that map plotting is necessary at many FAWS offices; by trying to plot maps on busy days, professional FAWS personnel were unable to render proper service to ARTC.

Mr. Rowe's final item was on the subject of the relationship between the FAWS and the airway forecasters. FAWS personnel do not have sufficient time nor proper facilities for making original forecasts. Yet they are called upon to furnish original forecasts, as well as to engage in local briefing and rendering public service.

Mr. Knarr opposed having the FAWS perform such duties. Mr. Lieurance agreed with Mr. Knarr in this and stated that a large percentage of time was being spent at some places in public service work instead of in the basic purpose of FAWS. On the whole, however, he thought that the basic responsibilities of FAWS were being performed in a very commendable way.

VIII - Coordination of Forecasts - Mr. Louis Harmantas

All will concede, Mr. Harmantas began, that forecasters should avoid criticizing each other's forecasts; such practices destroy confidence and serve only to lower the prestige of the profession in general and of the Weather Bureau in particular. Yet the distribution of conflicting forecasts is permitted, and unfortunately reconciliation of differences cannot always be effected. Until such time as objective methods of forecasting have been developed whereby forecasts made

by two or more qualified forecasters for the same area are in reasonable agreement, coordination of the basic elements of a forecast is necessary. This is equally true of forecasts covering overlapping areas or those involving pressure systems that might affect more than one district during the same forecast period. Admittedly, complete coordination cannot be effected unless a higher authority is empowered to render decisions on unreconcilable differences. However, it is not desirable that the individual forecaster should be deprived of the opportunity for independent thinking or of the responsibility for forecast preparation. The main consideration should be the coordination of forecasts and any plan aimed at coordination of forecasts must include the following considerations:

1. The coordinated forecast should be a guidance forecast prepared exclusively for use by the forecast centers.
2. Forecasters should retain responsibility for the issuance of official forecasts for their respective areas.
3. Participation in the program must not result in any additional duplication or appreciable increase in the work load at forecast centers.

Mr. Harmantas stated that past verification records indicate that the average results among forecasters at any one station are fairly comparable. He was of the opinion that in general there are no outstanding differences in verification either between forecasters at a station, or in the average results among stations. He, therefore, concluded that guidance forecasts issued regularly by a Central Forecast Unit would not be detrimental to the accuracy of the forecasts issued by field forecast centers and would, moreover, provide the desired coordination. Furthermore, since the WBAN Analysis Center has fairly complete communication facilities and established plotting and analyses units, the Central Forecast Unit should logically be attached to the Analysis Center.

Going into detail, he stated that the meteorologists selected to staff the Unit must possess the highest level of ability and experience. This is of primary importance if the field forecaster is to have complete confidence in the Unit's product. He outlined the scope of activity of such a unit as follows:

1. Forecasts issued by the Central Forecast Unit should not be detailed, since (a) this would not be practicable, and (b) the field forecaster should be well qualified to provide any details required.
2. The Central Forecast Unit should be available at all times for any consultation by Forecast Centers; and in addition to the regular duties assigned, the Unit should provide, on a request basis, information or forecasts of long-range character or of wide-area coverage.

3. The Central Forecast Unit should have a sufficient number of adequate communication channels for satisfactory fulfillment of duties stated in Paragraph 2. These channels may be additional to those required for distribution of regularly prepared material.
4. The Central Forecast Unit will coordinate forecasts within its own unit prior to release, whenever they are prepared in sections.
5. The coordinated forecast may be in the form of a prognostic chart; if in plain language it should be given in general terms.
6. The Central Forecast Unit should act as a Storm Warning Liaison and Coordination Center whenever major storms are in prospect or progress, or when a state of deep concern or near panic exists in any portion of the country because of recent devastating or severe storms. The service could be extended to include protracted periods of heat, draught, prolonged rains, severe cold waves, floods, etc.
7. Routine forecasts could be issued in the form of a separate prognostic chart or as part of the isobaric and frontal prognostic now being transmitted.
8. Routine forecasts issued in the form of prognostic charts should be prepared four times daily at intervals of 6 hours to cover periods of 12 hours, 24 hours, and 48 hours from the last synoptic hour as follows:

<u>Time of Transmission</u>	<u>For Forecast Times</u>
0200 EST	1330, 0130, 0130 (following day)
0800 EST	1930, 0730, 0730 (following day)
1400 EST	0130, 1330, 1330 (following day)
2000 EST	0730, 1930, 1930 (following day)

The 12-hour forecast would serve as a useful guide to preparation of airway or short period forecasts. The 24-hour forecast would be helpful in preparation of TAFOTS for international operations and in preparation of route forecasts for transcontinental operations, or of outlooks for private pilots.

The 48-hour forecast could be used to good advantage by both District and Airway Forecast Centers. It would be the basis for preparation of operational forecasts for air carriers and as an outlook for private pilots, industries, etc. In order for the forecasts to be of maximum value, they should be available at the field Forecast Centers sufficiently in advance of forecast deadlines for study and, on occasion, a conference call to the Central Forecast Unit.

Mr. Harmantas further recommended that the present Master Analysis, and if feasible, the Prognostic Analysis, include character, direction, and velocity of movement of pressure centers and fronts. Provision for this has been made in the CAC Code.

Realignment of districts and district boundaries towards more homogeneous districts with regard to geographic and climatic features was desirable, Mr. Harmantas stated. He recognized that this might not be feasible in all instances. In such cases, delineation should be made on the basis of population demands.

In the interests of coordination and efficiency and to avoid unnecessary duplication, as many forecast services for a given area as feasible should be housed under the same roof. In addition, it would be desirable to have common boundaries for the various types of forecasts, to attain better coordination.

Mr. Harmantas noted that many terminal forecasts are now prepared for 24-hour periods (for TAFOTS and local needs). Furthermore, industrial demands could be satisfied by extending present aviation forecasts. This points to the need of coordinating State and Airway Regional Forecasts for the same area.

Mr. Harmantas stated that Airway Forecast Centers have had considerable pressure brought to bear from radio stations and the press for a 24-hour aviation forecast. He felt that the general public did not require such forecasts; a general forecast of clouds and weather should suffice. If this portion of the Regional Aviation Forecast were incorporated into the State Forecast, this would provide for wider distribution of general aviation forecasts than could otherwise be attained. However, such forecasts would not completely replace the present Regional Aviation Forecasts.

As an aid to effecting better coordination, improving the confidence of the local Official in the forecasts received, and permitting forecasters to become better informed of the problems facing the local officials, he recommended that strong representation be made by the Weather Bureau toward relaxing the present restrictions in Civil Air Regulations Nos. 41 and 61 so as to permit gratis transportation of Weather Bureau forecasters by scheduled air carriers.

After Mr. Harmantas' presentation, Mr. Tannehill made a few remarks about the establishment of the Analysis Center. The Analysis Center was set up early in 1942, primarily because of military considerations, with a plan to have the Center make analyses of surface and upper air conditions. Central Weather Analysis Centers have since been established to cover practically the whole world. By means of the International Analysis Code, these analyses are equally understood everywhere.

Mr. Tannehill then posed the question: "How far can we go with prognosis without interfering with forecasters' operations in their respective districts?" When the forecaster finds himself disagreeing with the prognosis, he does not always have time to contact the Analysis Center at the Central Office.

After some remarks from the floor, Mr. Tannehill stated that consideration has been given to incorporating weather elements on prognostic charts. There was some discussion of Mr. Harmantas' plan for

a master forecast center. Mr. Tannehill pointed out that the Budget Bureau would have to approve funds to carry through Mr. Harmantas' suggestion and that it was not likely that we would obtain funds in the near future for expansion of this nature. The advisability of issuing forecasts beyond a period of 24 hours was then discussed. Mr. Harmantas expressed the belief that forecasts beyond 24 hours should be as general as possible. Mr. Tenenbaum pointed out that in the interest of coordination the Central Office had repeatedly advised forecasters to call each other by telephone or TWX when their forecasts were not in agreement. He admitted, however, that this might not always result in coordination since some forecasters are stubborn and refuse to change their ideas despite suggestions from neighboring forecast centers. He also indicated that some district forecasters appear to neglect reading bordering state forecasts. He recommended that forecast centers plot all state forecasts on maps. If they did so, they would behold peculiar looking inconsistencies with neighboring districts' forecasts. He cited several instances during the past winter when precipitation forecasts issued by three neighboring districts for the same period showed bordering islands without precipitation. Fortunately for the Bureau, he said, except for the Wagner Forecast Map, which comes out too late to be of much practical value, the public usually is not aware of the inconsistencies between forecast centers. In general, he stated, the public focuses its attention upon the local, rather than the state, forecast. (Ed. Note: This does not reduce the scientific need for better consistency in forecasting).

In connection with Mr. Harmantas' remarks on verification, Mr. Tenenbaum related that during the past two years PFR scores for airway forecasts had been plotted on maps at the Central Office. Based upon the sampling method afforded by the PFR system, it was apparent that forecast verification ranged from slightly under 80% in the region of the Great Lakes to about 95% in the far Southwest. A similar relationship was indicated in the verification of local temperature and precipitation forecasts. The report of the committee appointed to make specific recommendations for attaining maximum coordination of forecasts was as follows:

### FORECAST COORDINATION

#### RECOMMENDATIONS

The Committee recognizes a definite need for improving coordination of forecasts both within the forecast districts and between adjacent districts. The following recommendations listed as immediate and future requirements are submitted for consideration towards achievement of this purpose.

#### IMMEDIATE REQUIREMENTS

##### 1. Prognostic Analyses:

- 1a. The Committee recommends that forecast offices be supplied with amplified progs approximating the

established forecast periods and frequencies as follows: 18 and 30 hour surface prognostic charts 4 times daily at 6-hour intervals.

- lb. The contents of these charts should include:
  - i Isobaric patterns or contours
  - ii Position of fronts and centers
  - iii Areas and types of active precipitation
- lc. In addition, the characteristic of movement, direction, and speed of centers should be indicated for the prognostic time.
- 2a. Local officials should be encouraged to consult with their forecast centers for exchange of ideas or assistance on problems not adequately covered by regularly issued forecasts.
- 2b. Communications facilities being available, forecast centers should consult with the issuing office or with adjacent centers for exchange of ideas whenever there is any question involving the prognostic analysis.
- 3. Subdivisions of district forecast areas for forecast purposes should wherever possible be defined on physical and population areas rather than almost exclusively on political boundaries as at present.
- 4. The airway forecast center will coordinate with the appropriate district center whenever possible prior to issuance of an airway forecast at wide variance with the current district forecast.

#### FUTURE REQUIREMENTS

- 1. Resurvey district boundaries, and whenever possible and desirable redefine them primarily on the basis of similar climatological characteristics.
- 2. Provide suitable communications facilities between the forecast centers and the analysis center.
- 3. Consolidate as many types of forecasting as possible at common centers all having common district boundaries.
- 4. Intensity of precipitation to be included in the prognostic charts.

The Committee notes with gratification the progress made by the Centre Office toward relaxing the existing restrictions in CAR 41 and CAR 61 relative to gratis transportation of Weather Bureau forecasters by scheduled air carriers. It is the belief of this Committee that this

facility will assist materially in effecting better coordination, between forecast offices both within the district and adjacent districts.

L. Harmantas, Chairman (Signed)	
L. T. Pierce	"
W. M. Rowe	"
C. H. Pierce	"

IX - Familiarization Flights and Trips - Mr. D. M. Little

Mr. Little stated that during the war many forecasters made familiarization flights with the military services. Since then, some forecasters have made flights on some of the smaller airlines. Requests for free familiarization flights on larger airlines have been turned down, usually on the basis of legal technicalities. The Central Office wholeheartedly favors familiarization flights for forecasters. When official travel is about to be authorized for other purposes, forecasters should request authority to travel by air, Mr. Little advised. Discussion from the floor about the issue of blanket authority for familiarization flights by regional directors brought out that in some regions such authority does not provide for payment of per diem. Mr. Little indicated that per diem should be paid in all such cases and that regional directors would be notified accordingly.

Mr. Little then presented a review of the latest correspondence between the Weather Bureau and the Air Transport Association about free familiarization trips. The ATA favored familiarization trips for airway forecasters, but thought that the Weather Bureau should seek appropriations for such purposes rather than request the airlines to furnish free transportation. He indicated that there was a possibility of having the CAB change its Economic Regulations in order to permit free familiarization flights by Weather Bureau forecasters. In that connection, a letter had been written to the Air Transport Association asking for a favorable reaction before the Bureau petitioned the CAB for a change in its regulations. Mr. Little read from the CAB Economic Regulations sections authorizing free travel for certain postal employees, including the Postmaster General and his assistants. Air traffic control personnel and certain other CAA personnel, whose work involves safety of airline operations, are also authorized to travel without cost once a year over any one airline.

Mr. Little then called upon Messrs. Norquest and E. C. Johnson to tell about free familiarization trips on steamships crossing the Atlantic. Through the Marine Inspection and Liaison Service, arrangements had been made for round trips across the Atlantic for all of the Forecasters at WNA. Generally, these trips lasted about three weeks to a month, but sometimes, on account of adverse weather and changes in schedule, they might be prolonged. Many of the forecasters at WNA had taken advantage of these trips during the winter of 1947-1948, and it was planned to resume them during the coming fall.

X - Report on WBAN Analysis Center - Mr. J. R. Fulks.

Mr. J. R. Fulks opened the discussion by reading the following excerpt from a report of the Air Forces Meteorological Services on the operations

of WBAN Analysis Center, and the facsimile network:

"In the 43rd meeting of ACC/MET 20 Aug 1946 an AD HOC Committee of ACC/MET was established to study the problems of organization and operation of a joint Army, Navy, Weather Bureau, Analysis Center. It was felt that a joint center operated by the three services could provide a better and more standardized analysis, decrease the amount of duplication in preparation of charts in field stations of each service and between the services, relieve the burden of overtaxed communications facilities, and effect an appreciable saving of personnel. Further, with the concurrent development of facsimile into a nationwide network, to be used as a means of transmitting analyzed charts to the field forecaster, the establishment of a joint analysis center would provide the most efficient means of utilizing the wealth of meteorological material available today, and at the same time furnish the opportunity for field forecasters to increase the accuracy of their forecasts by allowing more time for their preparation.

"In the Spring of 1947 the AD HOC Committee, whose membership consisted of the Chiefs of the Weather Bureau Analysis Center and the Army and Navy Weather Centrals, held a series of meetings in which the details of the operation of the proposed center were worked out as being acceptable to the three services. These recommendations were submitted in the form of a report to ACC/MET along with the target date of 1 July 1947 as the beginning of operations. The report was accepted. On 16 July 1947 the WBAN Analysis Center actually began operations in the Weather Bureau Building at 24th and M Streets, Northwest, Washington, D. C.

"The WBAN Analysis Center is charged with the responsibility of carrying on the following general duties:

- a. Preparation of surface and upper air analyses.
- b. Preparation of surface and upper air prognostic charts.
- c. Preparation of coded teletype and facsimile transmission of analysis and prognostic charts.

"The personnel necessary to carry out the assigned responsibilities are supplied to the Center by each of the services as follows:

Weather Bureau: 26 Professionals (trained meteorologists)  
52 Sub-Professionals  
2 CAF Employees

Air Forces: 13 Officers (trained meteorologists)  
16 Plotters (civilian & Military combined)

Navy: 5 Officers (trained meteorologists)  
20 Enlisted Men (16 plotters & 4 plotting supervisors)

To produce the required amount of work, a total of 44 professional and 90 sub-professional personnel are necessary, making a total of 134 persons involved in the combined operation. Included in the contribution of Weather Bureau personnel are 4 professional supervisors who coordinate the operations of the Center during their duty tour and directly supervise the analysis made in the various sections.

"The Chief and Assistant Chief of the WBAN Analysis Center are Mr. J. R. Fulks and Mr. C. H. Pierce, respectively. A permanent committee composed of the Chiefs of the WBAN Analysis Center and Army and Navy Centrals coordinate on and recommend coordination on the changes in the operations of the WBAN Analysis Center as demanded by field requirements. All military personnel assigned to the organization are under the supervision of the Chief of WBAN Analysis Center for matters pertaining to technical operations of the Center, but are under the Chiefs of the Army and Navy Weather Centrals for administration and discipline.

"The procedures and methods used in preparing the analyses and prognostic charts made at the WBAN Analysis Center are of necessity rather complicated because of the tremendous workload carried, the variable deadlines to be met, and the number of people involved in the preparation and editing of all the charts. A total of 68 analyzed charts are produced daily. At the time of the peak workload in the schedule, there are a total of 8 analysts working together. A Supervising Analyst is on duty at all times to insure that the analyses and prognostics prepared are consistent in time and space and that the deadlines imposed on these charts are met.

"The charts prepared fall into four main groups. These are:

- a. Surface Analysis - 12 per day.
- b. Constant Pressure Charts - 12 per day.
- c. Prognostic Charts - 20 per day. (12, 18, 24, 30, 48-hour surface. 24, 36-hour and 700 mb 24-hour thickness 1,000 mb to 700 mb)
- d. Auxiliary Charts - 20 per day. (surface pressure change charts and height change charts)".

Mr. Fulks then distributed to those present a schedule of teletype, radio and facsimile transmissions from the WBAN Analysis Center. This schedule gave a description of the type of material transmitted, the area covered, the heading, the time of entry on the circuit of origin, the circuit of origin, and the subsequent distribution. Mr. Fulks discussed the use of analyses and prognostic charts and briefly presented an explanation of the basic principles underlying the preparation of prognostic charts.

Mr. Fulks also talked about applications of research in the Analysis Center. He stated that research work in the Center is similar to research work going on at forecast centers. He indicated that there was a need for research on types of weather accompanying certain pressure patterns, but that hardly anything had been done in this connection in the preparation of prognostic charts.

The Central Analysis Unit was making plans for liaison with field offices, Mr. Fulks stated. He pointed out that a start had already been made in this by bringing in field forecasters for temporary training details in the Central Office. Present plans were to send personnel from the WBAN Analysis Center for similar reciprocal details to all field offices.

Discussion was then opened on the use of material emanating from the Analysis Center by the field. Several pointed out that forecast centers do not have time to plot isobars as transmitted either in the M. A. or P. A. Mr. Norquest recommended that the air masses and fronts be transmitted before isobars, inasmuch as forecast centers do not use the isobars, and this would result in making the other material available at the forecast centers somewhat earlier than at present. Mr. Hutchinson wanted to know whether air masses and designators could not be eliminated altogether. There was general agreement among those present that there was little value in continuing to send or plot air mass symbols on surface maps. Recommendation was made that this feature be made optional rather than mandatory. Mr. Tammichill stated that before taking any steps about discontinuing air mass symbols it would be necessary to obtain a general reaction from the entire field service. Mr. Harmantas recommended the transmission of 12, 24 and 48-hour prognostic charts to coincide with forecast periods. There was some criticism that the analyses were transmitted with too many points for isobars and that too many isobars were being sent. Mr. Harmantas suggested the preparation and transmission of sets of 6-hourly prognostic charts instead of a single 24- or 30-hour chart. Mr. Fulks stated that such charts are now available at most forecast centers. Suggestion was made that four 30-hour prognostic charts be transmitted daily instead of two as at present. Mr. Fulks stated that four 30-hour charts are now prepared daily, but that insufficient transmission time on Service "C" accounted for transmitting but two such charts. Some favored eliminating the 30-hour prognostic chart in favor of 24- and 48-hour prognostic charts. Mr. Harmantas suggested the inclusion of character of movement of fronts in the prognoses. There was some discussion about forecast centers submitting preliminary or intermediate prognostic material to the Central Analysis Center, but the consensus did not

favor this, because most forecast centers did not regularly prepare prognostic charts.

The question of having forecast centers grade field station manuscript maps was presented. The majority of those present favored the discontinuance of this program.

A committee was appointed to present specific recommendations for improving the service of the WBAN Analysis Center to the field. The Committee's report was as follows:

RECOMMENDATIONS FOR IMPROVING WBAN ANALYSIS CENTER SERVICE TO  
FIELD STATIONS

Committee Report WBAN Analysis Center

In accordance with opinions expressed during the 1948 Forecasters' Conference, the following recommendations are made for improving the service of the WBAN Analysis Center to the field offices:

For Immediate Consideration:

1. Discontinue transmission of the air mass designators in the MA or at least make entry of these symbols on surface charts optional rather than mandatory.
2. Prepare and transmit both 18-hour and 30-hour prognostic charts four times daily on schedules designed to make them available to field offices near the hours of 0100E, 0700E, 1300E and 1900E. These should be based upon the previous six-hourly synoptic charts and will represent approximately 12-hour and 24-hour prognoses at time of receipt.

Since circuit time for these transmissions is not readily available on Service "C", it is suggested that the 0100E and 1300E transmissions should be scheduled on Service "O". When this becomes effective the present 12-hour PA transmissions on Service "C" should be discontinued. Both the 18-hour and 30-hour PA should be scheduled on Service "C" for the 0700E and 1900E transmissions if possible; otherwise the 30-hour PA might be transmitted over Service "C" and the 18-hour PA over Service "O" at those times.

3. Plotting of at least the pressure centers and fronts of one of the PA's by forecast centers should be mandatory at each six-hourly interval; plotting of the remaining PA each six hours to be optional.

For Later Consideration:

When facsimile becomes generally available, and transmission speed is increased to approach the necessary working limits for forecast deadlines, various auxiliary charts (such as 12-hour pressure change, etc.) should be scheduled at six-hourly intervals.

P. H. Kutschenreuter, Chairman (signed)  
E. H. Miller                      A. B. Carpenter  
C. H. Pierce                      H. E. Hutchinson

XI - Facsimile and Its Implications - Mr. I. R. Tannehill

Facsimile is no stranger to the Bureau, Mr. Tannehill began. Back in 1926, the Bureau transmitted its first map by radio facsimile to a ship at sea. During the 1930's, the Weather Bureau furnished the Radio Corporation of America daily maps for transmission to ships. In 1939, at the World's Fair in New York, maps were transmitted from La Guardia Field to the Fair Grounds. During the war, both radio and land-line facsimile were used. The Weather Bureau has maintained local land-line facsimile circuits during the past several years, one in the New York area, and the other in the San Francisco area. We are soon to begin a radio facsimile installation in the Chicago area. The Air Force has been maintaining a land-line facsimile circuit across the country, and at a few places the Weather Bureau has drops on that circuit. Before the Weather Bureau can set up a national facsimile network of its own, an estimate of the cost will be needed. We had hoped to have some sort of figures by last September from the New York Times Facsimile Company which could be used as a basis for an estimate, but some changes during the past year have made it doubtful whether we can get valid estimates at the present time.

Before presenting an estimate to the Budget Bureau and Congress for a national facsimile network, Mr. Tannehill stated, the Weather Bureau would have to show some justification for the network. Part of this justification would, of course, be the saving of time in drawing charts. It is doubtful whether there would be much saving in personnel, but the time saved could be used to increase the amount of service to the public. In addition, it will probably be necessary to show a saving of money in other directions.

One of the big problems in operating a facsimile network, Mr. Tannehill stated, is that of servicing equipment. Two years ago there appeared to be enough equipment to set up stations for the Army and Navy, as well as the Weather Bureau. When the Air Force began operating their facsimile circuit they soon found it necessary to have two machines at each installation, one machine to act as a standby in the event that the operating machine did not function properly. As a result of this, practically all of the available machines were taken over by the Air Force. Since then there has been some improvement in the service problem; the Air Force has trained technicians to service the machines, but there still are not enough machines for a Weather Bureau national network.

About 18 months ago a conference was held at New York on the subject of Facsimile Transmission of Weather Maps. Representatives who attended the conference included people from as far distant as New Zealand and Australia. The Weather Bureau, the Air Force, the Navy, and several airlines had representatives at the meeting. The minutes of that meeting were recorded in a mimeographed pamphlet by the New York Times Facsimile Company.

One of the questions which confronts us, Mr. Tannehill pointed out, is who should operate the facsimile circuit. Teletype circuits used by the Bureau, if they are national in character, are operated by the CAA, which has maintenance people for servicing the circuits. If the Weather Bureau set up a national facsimile network the CAA would probably operate it. These are but possibilities; nothing definite can be set up or said at the moment about the establishment of a national facsimile circuit. Mr. Tannehill stated that the expense of local facsimile circuits is not too great. However, great distances involved in a cross-country network might make the system rather expensive. Wire channels for facsimile transmission are more costly than for teletype transmission. Radio facsimile might be even more expensive. Frequencies would have to be obtained and it would probably be necessary to use booster stations across the country.

Mr. Vernon was called upon to say a few words about the San Francisco facsimile circuit. He began by stating that the facsimile circuit in the San Francisco area has been operating for the past three years. To service the circuit, a Weather Bureau man has been trained especially in facsimile servicing. Mr. Vernon stated that despite difficulties with the circuit and the slowness of transmission, it had been found very useful and they would not like to try to get along without it.

Mr. Osmun said a few words about the operation of the facsimile circuit in the New York area. Charts are transmitted from La Guardia Field office to the New York City office. Servicing is not a problem since the Times Telephoto Corporation is close by and technicians are available at all times. The material which comes over the facsimile machine at the New York City office is mimeographed and distributed to diverse interests in the area.

Mr. Schmidt, who had installed a drop on the Air Force circuit at WNA, stated that he was not very enthusiastic about using facsimile at forecast centers, but he expressed the belief that it might be of greater use at other offices.

Summing up, Mr. Tannehill pointed out that facsimile transmission of weather maps was not new, that it had been in the developmental stage for more than twenty years, and that before long the Weather Bureau would be able to make full use of its advantages.

XII - Artificial Production of Precipitation - Dr. Harry Wexler and  
Dr. Ross Gunn

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Dr. Wexler began with a discussion of the theoretical concepts used to explain the natural production of precipitation. "Before we engage in producing precipitation artificially, it would be desirable," he said, "to understand how precipitation is created naturally. Our knowledge of the latter is, unfortunately, far from complete." Dr. Wexler then reviewed several studies of hygroscopic nucleae and the measurement of rain-drop sizes.

Dr. Gunn followed with a brief history of attempts at artificial production of precipitation. He cited experiments carried on in Europe

in the late 1920's and referred to a description of those attempts in American magazines of twenty years ago. He also discussed the project being carried on by the Weather Bureau in cooperation with the Air Force at Wilmington, Delaware during the winter of 1947 and 1948. These experiments were conducted with the aid of certain controls, including radar. Stable clouds were seeded whenever they appeared to offer possibilities of producing precipitation. In general, the experiments gave no basis for extravagant claims about production of significant amounts of precipitation.

#### XIII - River Forecast Program - Mr. R. K. Linsley, Jr.

Mr. Linsley first reviewed the original river and flood forecast service of the Bureau. During the past two years the river and Flood forecast service has been undergoing a program of expansion and modernization. Until recently, river forecasting constituted a sideline of the Official in Charge at river forecast centers. When funds were granted for enlargement of the service the Bureau had one of three choices in its expansion program: (1) Further training of existing river forecast officials, (2) Enlargement of river district staffs by adding extra personnel, (3) Establishment of river forecast centers similar to existing airway and district forecast centers. The Bureau decided to adopt the third alternative. Four district river forecast centers were established, at Cincinnati, Kansas City, St. Louis and Tulsa. Master forecasts are prepared there for distribution to local river forecast offices by TWX.

Mr. Linsley gave a brief summary of forecasting techniques and procedures at the district centers. These included the use of multi-correlation graphs for determining the volume of runoff in connection with known amounts of precipitation. He pointed out that with the aid of accurate quantitative precipitation forecasts, river forecasts could be made for longer periods. At the present time, river forecasts can be made on the basis of expected rainfall, as well as known amounts, but those based on the latter are naturally the more accurate.

#### XIV - Quantitative Precipitation Forecasting - Mr. A. K. Showalter

Mr. Showalter, who had taken an active interest in quantitative precipitation forecasting when the Weather Bureau first explored the possibility of assuming such a project, explained that he had at first opposed the idea. Viewing the results to date, he stated that we are still a long way off from the ideal, but he believed that there had been considerable improvement in quantitative precipitation forecasts during the past winter. He emphasized the need for more study. Pointing out that medical men study case histories as backgrounds for facing new problems, he thought that the Bureau should embark on a case history program for studying quantitative precipitation forecasting.

Mr. Showalter gave a summary of the theoretical basis for quantitative precipitation forecasts. He pointed out the difficulties in evaluating separate phases of the problem, and he listed the principal factors as follows:

- a. Storm movement
- b. Inflow rates
- c. Stability
- d. Moisture charge
- e. Will it rain?

The operational problems of adapting state forecasts for purposes of preparing quantitative precipitation forecasts were also discussed. Drawing upon his experience at Los Angeles, where such forecasts are prepared by parallel objective methods and adaptation of subjectively prepared state forecasts, he was unable to find any clear-cut advantages of one over the other. However, he indicated that he favored objective methods. He stressed the need for additional research. He pointed out the value of climatological data, of individual storm data, and of a synoptic and dynamic approach.

Dr. Fletcher commented on recent developments in research, particularly in the use of a dynamic approach. He presented the U. S. Engineers' published studies of individual storms and stated that the Hydrometeorological Section had been analyzing these storms synoptically with the use of the 40-year Northern Hemisphere Map Series.

Mr. Lloyd was called upon to make a few remarks about quantitative precipitation forecasts in the Kansas City district. He indicated that he thought that within reasonable categories the forecasts at Kansas City had been quite successful. Mr. Schmidt stated that he wished he could say the same for his area. He did not consider the forecasts made at WNA very successful. He thought these forecasts were among the most difficult things that his staff was trying to do. He stated that he did not think the quantitative precipitation forecasts were as good as airway terminal forecasts. One of the factors contributing to the poor forecasts was the fact that originally his staff was required to make forecasts for only three zones, but that now such forecasts were required for twenty zones, without additional assistance for the extra work. Despite that fact, he was very much surprised to learn that the public utilities using these forecasts were apparently satisfied with them.

Mr. Dunn stated that he felt that quantitative precipitation forecasting was a specialized type of forecasting and that it should be done by special forecasters. Further, he thought it should be done at one central locality, rather than at district forecast centers. Mr. Vernon did not consider quantitative precipitation forecasting in his area as too successful, but he thought it should be done by the district forecaster. Mr. Kutschenreuter indicated that he thought quantitative precipitation forecasts had been fairly successful in the Boston district. Mr. Saul Price discussed a project involving objective methods for making quantitative rainfall forecasts in eastern Kansas.

Mr. Tenenbaum agreed with Mr. Showalter about the necessity of building up case histories for the study of past heavy precipitation occurrences. He related how he had undertaken a study at Kansas City

of heavy snowfall using the 40-year Series of Northern Hemisphere charts. The case history study of heavy snowfall at Kansas City had produced a definite improvement in the recognition of typical situations which produced heavy snowfall at Kansas City, and this had brought about better forecasts of heavy snows in the Kansas City forecast district.

The following report was submitted by the committee selected to make recommendations on improving the quantitative precipitation forecast service:

COMMITTEE REPORT ON QUANTITATIVE RAINFALL FORECASTING

By: A. K. Showalter, A. J. Knarr and R. D. Fletcher

The chairman of the quantitative precipitation forecasting committee, Mr. A. K. Showalter, presided during the discussion of QPF Forecasting. A brief summary was given of the theoretical developments which have served as a guide for quantitative forecasting namely a two dimensional analysis of the inflow and outflow patterns of moisture charge. It was stated that the possible significance of variations in moisture charge have been rather thoroughly investigated and that further research must be concentrated on the significance of the variations of the three dimensional flow patterns. Particularly worth of investigation appears to be the horizontal and vertical distribution of temperature which affects the vertical, and subsequently the horizontal wind shear.

In discussion afterwards, Dr. Fletcher pointed out that the Hydro-meteorological Section is now conducting some research on the significance of the horizontal temperature fields, but to date the research has not been too fruitful. Showalter also discussed the significance of variation in storm movement and inflow rates and their effect upon accumulation of rainfall. He pointed out that the most important decision required of the forecaster is determination of whether or not it will rain. If the forecaster decides that it will rain, then he must decide where and how long. In many areas, the forecast of the amount of rainfall to be expected in the subsequent twenty-four hours is largely determined by the total number of hours that rain is expected to occur. It was also indicated that instability of the air mass is quite important for the production of heavy rains particularly in the Southern California area. Fluctuation in

moisture charge may be important in other sections of the country, but in Southern California there is such a high correlation between persistent strong southerly winds and dewpoint that forecasts of wind, speed and direction are much more important than the forecasts of dewpoint.

Size of the forecast zones was discussed by Showalter who reviewed the original plan of making all QPF forecast zones at approximately 10,000 square miles with boundaries, insofar as possible, delineating areas of meteorological homogeneity. There was no comment on the adequacy of the present forecast zones.

The next item discussed was time required to adapt the state forecast to the QPF forecast and whether or not such forecasts could be made by an assistant forecaster. The consensus seemed to favor the idea that the district forecaster on duty should be responsible for the QPF forecast.

The next item discussed was the result obtained to date in quantitative forecasting. It seemed to be generally agreed that QPF forecasting was more difficult than a twenty-four hour airway forecast and that forecasting skill obtained to date is much less than the ideal hoped for several years ago. Many forecasters believe this type of forecasting is so difficult and so specialized that it should be assigned to special units established for the purpose of making the forecasts and conducting necessary research into the problems connected with such forecasting. In the Washington forecast district where QPF forecasts are prepared for a large number of zones, the forecasters feel that little progress has been made in improving the forecasts. In the Kansas City area, Mr. Lloyd feels that the QPF forecasts have been unusually successful. In the Boston area, objective forecasting methods have been developed for winter storms but their techniques apparently are not adaptable to summer rainstorm forecasting. In the Los Angeles area, there has been little opportunity to adequately test QPF techniques during the past two winters because of persistent drouth conditions. However, objective methods of forecasting developed by Mr. J. C. Thompson have shown skill scores of a rather high level of significance for this past winter. The actual forecasts prepared showed still greater skill than by objective methods but in practically all cases, the forecaster on duty had the benefit of computation of rainfall probability using the Thompson objective method.

At the Los Angeles Forecast Center, only three thirty-six hour forecasts of rainfall in excess of one and one-half inches were made this past season. All these forecasts were correct. There were three additional occurrences in excess of one and one-half inches when the forecasters had called for rain in lighter amounts. There was no case of

rainfall in excess of .15 occurring within thirty-six hours on a no rain forecast. By comparison, the objective method forecast one inch or more on six occasions but only two of them fell in the inch or more category. There were also two cases of rainfall in excess of .3 of an inch when the objective method indicated that no measurable rainfall should occur. It was pointed out that there are still a few parameters in the Thompson method which are not completely objective and research is continuing on refining the Thompson techniques.

For further improvement of quantitative forecasting, the committee recommends: (1) Nation-wide surveys of the seasonal trend in frequency of occurrence of rainfall amounts by units of depth observed at point locations and also units of average depth observed over areas.

(2) Dissemination of organized storm rainfall information from the Hydrometeorological Section and development of case histories for study in each forecast district. Synoptic situations analyzed by the Hydrometeorological Section are mainly those associated with flood-producing rainfall. It is therefore necessary that individual forecast centers make similar studies of routine storms which occur much more frequently in their areas.

(3) The Hydrometeorological Section should be encouraged to continue their research into the synoptic and dynamic pattern of storms with particular emphasis on the significance of horizontal and vertical temperature gradients as they may affect the vertical change in isobaric structure. The committee recommends that research forecasters now assigned to many forecast centers should be periodically detailed to the Hydrometeorological Section for research collaboration on storms of their districts.

(4) Results obtained with objective methods to date have been very encouraging and such studies should be accelerated and periodic reports of both success and failure in objective techniques should be summarized by the Short-Range Forecast Development Unit and disseminated to all forecast centers.

(5) There should be close coordination between the Hydrometeorological Section and the Short-Range Forecast Development Unit on all research projects pertaining to the quantitative prognostication of rainfall.

#### XV - Training of Forecasters - Mr. A. V. Carlin

Mr. Carlin discussed the need for training forecasters and field officials in making and adapting forecasts for their localities. He stated that he would like to see the Regional Technical Conferences of 8 or 9 years ago revived. He proposed classes of about 20 Officials in Charge whose forecast experience was limited. Some of the objectives to be accomplished by a conference of this nature were:

1. Help the Official in Charge make better local forecasts.
2. Give him some ideas on rendering better public service.
3. Bring his meteorological knowledge up to date.

Mr. Carlin indicated the desirability of conducting 8-week classes in the spring and fall. With primary emphasis on analysis, local forecasting and the use of processed data, he advocated a refresher course in meteorology and training in on-station problems not directly related to meteorology. The latter would cover Central Office policies and responsibilities of Officials in Charge as supervisors.

Mr. Kutschenreuter stated that field trips in his forecast district had revealed a lack of administrative training on the part of many Officials in Charge. He considered such training more important than formal training in meteorology. Mr. L. T. Pierce stated that during a trip through North Dakota he found local officials apparently unable to use state forecasts and interpret them in terms of the local areas. He proposed that a team of instructors be sent to visit field stations. Mr. Carlin expressed agreement with this idea, but thought that field officials should get prior instruction in an RTC class before the teams went out to the field. Mr. Stevens suggested assigning local Officials in Charge for four-week periods to district forecast centers. This would create a better understanding between the Officials in Charge and the district forecasters. Mr. Lindley, as a new Official in Charge, stated that he found himself uncertain as to his responsibilities. He expressed a belief that administrative instructions should be revised and brought up to date. Mr. Carlin stated that this was being done at the present time. Mr. Carpenter proposed that after the Officials in Charge attended a training conference, they should spend a period of a week or two at a forecast center.

Mr. Carlin then presented a discussion of the student aid program being conducted at the Bureau of Standards and the Navy Department. Applied to the Weather Bureau, the plan would call for the assignment of a student aid, who had completed his junior year in college, to a Weather Bureau station as an SP-5 for a period of three months during his summer vacation. After the three-month period, during which he would have some chance for study, the student aid would go back to school to get his degree, then return to the Weather Bureau as a P-1.

Mr. Hutchinson thought that the student aid program might create a morale problem among employees who are attending school on their own time while working full shifts at the Bureau. Mr. Vernon raised the question about on-station study by student aids. He stated that there was no time at his station for training anyone during office hours. At the present time there are not enough sub-professional employees to handle the regular work.

Dr. Reichelderfer added a few words on the value of Weather Bureau scholarship assignments to universities. "The Bureau is extremely fortunate in being able to send ten promising employees each year to universities for training," he said. It is the Bureau's policy to choose men who appear likely to become outstanding career employees in the Bureau.

XVI - Forecast Research Program - Mr. E. M. Vernon

The discussion on Forecast Research must begin with a definition of the term, Mr. Vernon said. A formal definition could be "a study of past synoptic situations, singly or collectively, for the purpose of gaining knowledge, useful in making forecasts, or for obtaining evidence to support theories related to forecasting". A less formal definition might be "anything that helps to come up with a forecast is forecast research".

Mr. Namias proposed that research be distinguished on the basis of whether it dealt with theoretical principles or empirical knowledge.

Mr. Vernon questioned whether forecasters are qualified to carry on forecast research as defined above, either (a) independently, or (b) with the aid of a trained research forecaster and suggestions from a central research guidance unit, such as the Short Range Forecast Development Section. In the discussion which followed, several were of the opinion that, with few exceptions, most forecasters are not qualified to carry on independent research. Forecasters might be experienced in forecasting, Mr. Hutchinson said, but not in forecast research. Furthermore, because of temperament and insufficient educational background, most forecasters are not qualified to carry on research, said Mr. Knarr. Ability as a forecaster does not necessarily carry over to capability as a researcher. It was Mr. Knarr's experience at several stations where he had been assigned that most forecasters were not qualified to complete a research job that they could be proud of.

Is a forecaster qualified to do forecasting if he is not qualified to do research work?, Mr. Vernon asked.

Mr. Knarr replied that most forecasters study to improve their forecast technique, but very few actually write down anything that can be passed on. In order to be able to do the latter, he stated, a forecaster must have some training in research methods.

Would the assignment of a trained research forecaster to each forecast center encourage and stimulate useful on-station research?, Mr. Vernon asked. Such a research forecaster would devote about 75% of his time to research and 25% of his time to forecasting. Mr. Knarr thought that the assignment of a research forecaster would be helpful, but that all forecast

offices did not have adequate libraries nor easy accessibility to maps and other data. He thought that the assignment of research forecasters should be limited to a few centers where research materials are available. In his opinion, research should be a major project at a few centers, rather than a minor project at many centers. Mr. Vernon replied that material could be made available at all centers.

Research was difficult at the Billings office, said Mr. L. T. Pierce, because of physical inconveniences. That office has a good file of back maps, but the maps are located in the basement. When the forecaster has a few hours to do some research work he has to carry the maps to the office and spread them out in a limited space. By the time he does this, most of his spare time is used up, and he has to return to his regular duties. Mr. Vernon agreed that to encourage research it is important to have map files easily accessible.

Mr. Showalter felt that only those who are interested in research should take part in the program. A central implementation unit is necessary to provide data for research purposes without delay and in a form that would make such data easy to use, he said. Mr. Showalter thought that research work should be done at the station. Mr. Haynes pointed out that much valuable time is being wasted by forecasters in merely compiling data. He indicated that clerical assistance should be made available to help the research forecaster. Mr. Namias stated that the Extended Forecast Section was aided by clerical help in its research work.

A research forecaster had been working at San Francisco for more than a year, Mr. Vernon stated, and as a result, a considerable amount of research work had been accomplished there that could not otherwise have been done. He felt that because of this, the forecasts there during the past year had improved about 10% to 15% over preceding years. Mr. Showalter pointed to improved timing in precipitation forecasting at Los Angeles as a result of objective methods developed there through research efforts.

Mr. Vernon then asked: "Where a research forecaster is assigned to a center, and research is to be on official time, should the subjects undertaken be selected from a list approved by dependable local authority or should each research forecaster be permitted to go his own way, choosing any subject which pleases him, regardless of whether or not it has any important application to the district?" Mr. Carpenter recommended that research forecasters deal with forecast problems pertaining to the district or locality. This was also the consensus of those who participated in the discussion. The majority agreed that the Official in Charge should have control of the direction of the research program at the Forecast Center.

Should all forecasters on the station be encouraged to take part in the program?, Mr. Vernon asked. It was his experience,

he said, that where one or two men on a station engaged in research work, this inspired the others to do likewise.

The next question presented by Mr. Vernon was whether the research program should include participation by local officials at service centers away from the district forecast center. He indicated that the San Francisco research program encompassed other stations as well as the forecast center.

Mr. Vernon then listed and discussed the following forms of synoptic research:

- a. Collective studies, or type situations.
- b. Study of individual case histories, or specific synoptic series.
- c. A combination of (a) and (b).

Mr. Vernon stated that he preferred collective studies. Mr. Tenenbaum, on the other hand, felt from his experience that individual case histories gave better results. The number of available case histories of outstanding phenomena at a locality is usually limited, he stated. Mr. Tenenbaum thought that collective studies tended to mask or average out abnormalities; and abnormal situations give us the greatest difficulty and the worst forecasts. Mr. Showalter considered it desirable to approach research initially through a study of individual case histories, to be followed by collective studies of type situations. Mr. Roger Allen stated that special attention should be given to outstanding exceptions in the file of case histories. and Mr. Vernon agreed with this.

Mr. Carpenter spoke in behalf of a digest of the latest articles and books in the field of meteorology. He considered it a hopeless task to read and study all the material now being published. The majority agreed that such a digest is needed for the benefit of all forecasters. Mr. Tenenbaum stated that SR&F Division, with the cooperation of the Special Scientific Services Section, had been obtaining and distributing copies of articles of practical value to forecasters.

Mr. Showalter expressed a need for coordination of field research projects by a Central Office unit. This unit could help those engaged in research in the field and might prevent impracticable or duplicate projects. Mr. Allen stated that Special Scientific Services Section was trying to do what Mr. Showalter suggested. He stated that it was planned to obtain a monthly report from research forecasters advising what they were doing and what they planned to do. He stated that such reports would be circulated among the research forecasters.

Mr. Vernon concluded by pointing out ways in which the Short Range Forecast Development Section could be of assistance in a forecast research program. He listed the following:

- a. Publishing specific studies to serve as examples of the use of various research methods.
- b. Making suggestions on the selections of projects.
- c. Giving advise on research procedures.
- d. Reviewing and publishing completed studies made by field research forecasters.

XVII - Forecast Verification Program - Mr. A. W. Cook.

The present verification program of the Bureau, particularly, the airway portion, does not satisfy a great many forecasters, Mr. Cook began. The chief defects of the airway verification are the following:

- a. "All or nothing" feature.
- b. Lack of credit for trends or "near misses".
- c. Present system merely shows who made a forecast during bad weather and does not give true comparisons between forecasters' abilities.
- d. Differences in forecast periods do not permit true comparability.

Relatively few forecasters criticized the district forecaster's system of verifying rainfall and temperatures forecast, Mr. Cook stated.

Complete agreement on a desirable verification system is impossible; the most important consideration is to evolve something that is better than the current system. The large majority of forecast centers agree that some method of forecast verification is necessary, Mr. Cook said, but some of the forecasters do not favor verification of official forecasts.

Mr. Cook stated that any system of verifying official forecasts should be for the following purposes:

- a. To measure the ability of forecasters.
- b. To aid in improvement of forecasts by pointing out weaknesses.
- c. To determine the value of the forecast to specific clientele and to obtain a "promotion" picture of public dissemination.
- d. To keep forecasters on their toes.

Then Mr. Cook listed the desired purposes of a practice verification program as follows:

- a. To measure the ability of prospective forecasters.
- b. To provide means of comparisons between forecasters and to set up standards for comparisons and promotions.
- c. For self-analysis of forecasters and as an aid in improvement.

When Mr. Cook asked for a vote of those favoring the continuance of the present system of verifying airway forecasts, there was not one affirmative vote. Mr. E. H. Miller wanted to know what the purpose of the present verification program was. Mr. Tenenbaum indicated that as far as he could tell the purpose of the present system was three-fold:

- a. To show who are making the official forecasts each month,
- b. To obtain a record which would indicate to others how accurate our forecasts are, and
- c. To keep forecasters on their toes.

Mr. Tenenbaum did not believe that the present system gave any index of comparative abilities of forecasters. To illustrate the second purpose, he cited a recent incident in which the Weather Bureau was requested to furnish airway verification figures to the Non-Scheduled Flying Advisory Committee of the CAA. Using our present verification scores, the Bureau responded that our airway forecast accuracy ranged from slightly under 80% in the Region of the Great Lakes to about 95% in the Far Southwest.

Mr. Norquest was asked to remark about the temperature and precipitation verification study which he had made several years ago at WNA. His analysis was not useful in comparing forecasters, Mr. Norquest replied. A fair comparison between forecasters can only be made when forecasters make forecasts from the same maps.

Mr. Carney stated that Dr. Reichelderfer was greatly interested in what the public thought of our forecasts. He related an experiment at Baltimore in which cards were sent out to users of Weather Bureau forecasts and to cooperative observers. These surveys indicated that the cooperative observers considered our forecasts about 96% accurate, while the users thought the forecast accuracy rated about 84%.

Mr. Tannehill spoke on the need for and requirements of a practical verification system. He emphasized three essential considerations:

1. To satisfy requests from non-Weather Bureau sources about the accuracy of our forecasts, we must have some verification system.

2. To keep our personnel from spending too much non-productive time in maintaining the system, it must be simple.

3. Since the public has become accustomed to grading our forecasts on the basis of percentage, with 100% indicating perfection, it must be a system which is comparable or similar to past systems, i.e., it should produce a percentage of accuracy near 85-90%. Although skill scores may be of value in comparing

forecasters' ability, they fail to give percentages familiar to the public.

Verification scores should be compiled according to forecast staffs, rather than individuals, Mr. Schmidt recommended. There was some discussion as to the desirability of using the same system for practice as well as for official forecasts, and there was also some talk about whether all forecasters should be required to take part in a practice forecast program. Mr. Cook thought that a practice program should be restricted to those not making official forecasts. The desirability of verifying the home station or a station selected at random from day to day was discussed. The majority favored verifying the home station. Many favored verifying state forecasts rather than local forecasts by district forecast centers. Mr. Lloyd recommended verifying states by selecting a number of important cities in each state and averaging the score of each to give a verification for the state as a whole. Mr. Rowe suggested utilizing the punch card system for making and grading practice forecasts.

Mr. A. W. Cook was appointed General Chairman of Committees to formulate:

1. A practice forecast program, and
2. An official verification program for local, district, and airway forecasts. Sub-committees were appointed as follows:
  - a. Practice Forecast Program - Mr. G. E. Dunn, sub-chairman; Messrs. E. M. Vernon and Roger Allen, members.
  - b. Official, Local and District Forecast Program - Mr. J. R. Lloyd, sub-chairman; Messrs. L. T. Pierce and Kenneth Norquest, members.
  - c. Official Airway Forecast Program - Mr. W. L. Thompson, sub-chairman; Messrs. H. E. Hutchinson and E. C. Johnson, members.

The Reports of the Committees were as follows:

#### A PROPOSED PRACTICE FORECAST PROGRAM

Under this program, practice forecasts would be conducted on a regional basis. To simplify verification procedures, the forecasts should be for specific points rather than for areas. About four points should be selected in each region and these should be so selected to present a diversity of forecast problems. All practice forecasters in the region should make forecasts for

the same points. Each employee participating in the program should make a forecast for all four points at at least one of the four major synoptic periods on each day he is on duty.

Forecasts should be completed before the beginning of the synoptic period next following that to which they are to be credited. To avoid charges of falsification, all forecasts should be entered in ink on the forms provided for this purpose (Form 2 for temperature and Form 3 for precipitation) and these should be kept conspicuously posted and open to inspection by all Bureau personnel.

The suggested program will include forecasts for precipitation and for maximum and minimum temperatures. The periods and elements to be covered by practice forecasts are shown in Form 1. As indicated by this form, maximum and minimum temperature forecasts will be for specific periods and each forecast will include two separate precipitation forecasts, each for a specific 12-hour period. It will be clear from the picturization of periods covered that no attempt should be made to compare forecasts made from one map time with those made from another. This is due to the variability in period covered and to total elapsed time between forecast map and end of forecast period. Comparisons should be made only between forecasts made at the same time of day.

#### Alternate plan:

There was objection by some committee members to the use of four periods daily. The use of four forecast periods would mean that the time interval would not be uniform at all periods because only two elements are forecast, maximum and minimum temperature. An alternate suggestion was that forecasts be made at only the 0730 and 1930 EST periods.

Objection was raised to this proposal on the grounds that some personnel would be unable to participate in the program because shifts in use at some stations would not permit the making of forecasts from the 0730 and 1930 EST charts. A counter suggestion was made that spot temperatures be forecast instead of maximum and minimum. This would give four temperatures daily and the length of all forecast periods would be the same. Support for this suggestion comes from the Pacific and Mountain time zones where maximum and minimum temperatures often occur after the end of the forecast periods and therefore verification would be based on spot temperatures for half or more of the year.

It is obvious that no system will fit all conditions and committee members agreed to accept any compromise proposal.

Maximum and minimum temperatures will be forecast to the nearest degree F. Provision will be made on a punch card form for entry of both the forecast and observed temperatures as well as the 24-hour change in the latter. This will permit the sorting and

tabulating machines to verify on the basis of: (a) mean difference between forecast and observed temperatures regardless of the amount of 24-hour change in the latter; (b) mean difference in forecast and observed temperatures for selected degrees of 24-hour change in the latter; (c) percent of changes of certain dimensions forecast within certain limits.

Precipitation will be forecast in the amount expected up to one inch. Forecast and observed amounts (up to one inch) will be entered on the punch card form. This will permit verification on the basis of: (a) percentage of hits on a rain or no rain basis, or, (b) quantitative accuracy of forecasts. A possible punch card form is enclosed.

An alternate proposal was for the use of class limits in precipitation forecasting with the limits set as follows:

0	- 0 or T	3	→ .16 to .50
1	→ T - .02	4	→ .51 to 1.00
2	→ .03 - .15	5	→ 1.01 or more

The chief objection to class intervals is that they do not have the same significance for all parts of the country. Moreover, one committee member expressed the opinion that the forecasting of actual amounts would permit a wider degree of freedom in measuring the skill shown in the forecasts. Either system would be acceptable.

Prior to entry of data on punch cards, forecast and observed data will be entered on Forms 1 and 2. The forecast, "F" column, will be filled out in ink at the time the forecast is made. The observed "O", and change "C", columns will be filled in after the official data are received from the stations for which forecasts are made.

To provide uniform data for verification, Forms 1 and 2, "observed" and "change" columns only, will be filled out at stations for which forecasts are made and copies will be mailed each week to all stations at which there are employees taking part in the practice forecast program. After receipt of these, the practice forecasters will enter "observed" and "change" data on their own forms for each of their forecasts. This will then be transferred to punch cards, checked and mailed to the verification office. Forms 1 and 2 will be retained at the station. Tabulations will be made at the verifying station of the following data:

\*For Maximum and Minimum Temperature Forecasts

- (a) Mean difference between forecast and observed for all cases.
- (b) Number of cases in which 24-hour change was 6° to 10°F and mean difference for these.
- (c) Number of cases in which 24-hour change was 11° to 15° F and mean difference for these.



PRECIPITATION VERIFICATION DATA

Form 3.

Station (for which forecast is made) \_\_\_\_\_

Month \_\_\_\_\_ Year \_\_\_\_\_

Date* (GCT)	00		06		12		18	
	P12,24	P24,36	P06,18	P18,30	P12,24	P24,36	P06,18	P18,30
	F	O	F	O	F	O	F	O
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\*Date refers to GCT time of map on which forecast is made. "F" is forecast precipitation for period indicated by notations at top of column. "O" is the observed precipitation for the period of forecast.

Example: 00

P12,24 refers to precipitation during the period 12 to 24 hours (indicated by subscript) after the 00Z Map (indicated by superscript).

Station at which forecast is made \_\_\_\_\_

Practice Forecaster \_\_\_\_\_ (Name) \_\_\_\_\_ (Number)

TEMPERATURE VERIFICATION DATA

Form 2.

Station (for which forecast is made) \_\_\_\_\_

Month \_\_\_\_\_ Year \_\_\_\_\_

Date* (GCT)	00	00	06	06	12	12	18	18
	Max 12,24 F O C	Min 24,42 F O C	Max 06,18 F O C	Min 18,36 F O C	Max 24,36 F O C	Min 12,30 F O C	Max 18,30 F O C	Min 06,24 F O C
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2								
3								
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\*Date refers to GCT time of map on which forecast is made.

"F" is the forecast temperature for period indicated by notation at top of column. "O" is the observed Max or Min temperature for the period of forecast. Example: 00

Max 12,24 refers to Max during the period 12 to 24 hours (indicated by subscript) after the 00Z Map (indicated by superscript).

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"C" is the 24-hour change in "O".

Station at which forecast is made \_\_\_\_\_  
Practice Forecaster \_\_\_\_\_

(Name)

(Number)

PRECIPITATION VERIFICATION DATA

Form 3.

Station (for which forecast is made) \_\_\_\_\_

Month \_\_\_\_\_ Year \_\_\_\_\_

Date* (GCT)	00		06		12		18	
	P12,24	P24,36	P06,18	P18,30	P12,24	P24,36	P06,18	P18,30
	F	O	F	O	F	O	F	O
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\*Date refers to GCT time of map on which forecast is made. "F" is forecast precipitation for period indicated by notations at top of column.

"O" is the observed precipitation for the period of forecast.

Example: 00

P12,24 refers to precipitation during the period 12 to 24 hours (indicated by subscript) after the 00Z Map (indicated by superscript).

Station at which forecast is made \_\_\_\_\_

Practice Forecaster \_\_\_\_\_ (Name) \_\_\_\_\_ (Number)

punched-card machines in the verification process. However, it would give results that would fall short of the level of verification desired over a large portion of the country, particularly, in connection with verification for precipitation. To arrive at the verification figures desired for precipitation we must necessarily verify by areas, in such a way that will not be as rigid as with the spot system. The only reason we can see for the use of a spot system of verification is rigidity and amenability to the use of punched-cards. Punched-card machines might be used to advantage in verification of practice forecasts, but subjecting our official District and Local forecasts to the rigidity of punched-card verification is considered both unnecessary and undesirable. Unnecessary, as shown by the fact that under the old system of verification one verifier did all of the verifying of District, Differing, and Practice forecasts for the whole country involving some 60 practice forecasters, which shows that verification of District forecasts by areas does not require much manpower; and, undesirable, due to the fact that the rigidity of verification made mandatory by a punched-card system, because of its lack of flexibility, would be very detrimental to the forecaster, both in connection with expressing himself in his forecasts, and in obtaining the verification that is his due. The spot system of verification invites forecasting for stations, while the public for which we forecast lives in all parts of the states. This would be particularly bad where topography plays a major role in forecasting for stations. The forecaster would be inclined with a spot verification system to pay for the stations that are being verified and not pay enough attention to the areas in between. Furthermore, with regard to a spot verification system, if one takes a map of the United States, divides the States into halves and quarter portions, and considers the geographical distribution of weather stations with respect to the size of the States and their divisions for forecasting purposes, the unrepresentativeness of spot verification will become readily apparent. Spot verification would have to be done by selecting either five or ten stations in each State or designated forecast area. In large states like Montana the stations would be far apart, even with ten to a state. In states like Ohio, which is relatively small, the stations would be close together, even with five to the state. Moreover, ten stations in some states would be impossible to achieve. Five stations in some of the smaller states would be closer together than ten stations would be in the large states. There is, therefore, no way that verification stations could be selected that would give a fair and equitable distribution of them over one State compared with others, or one district compared with other districts. In view of the foregoing considerations, therefore, it appears that verification of weather and temperature forecasts by areas offers the only

satisfactory solution, and our recommendations for verification by areas is based on these fundamental considerations. It is our assumption that the Central Office desires our own independent and unbiased ideas in our recommendations, and that is what is presented here, after consulting with, and obtaining the opinions and suggestions of, the Forecasters at Kansas City, Washington and Billings. Following are our recommendations:

## VERIFICATION OF DISTRICT FORECASTS

### GENERAL

1. District forecasts will be verified by States, or portions of States designated as official forecast areas, such as, Upper Michigan, Lower Michigan, western New York, eastern Texas, etc.
2. Only the precipitation and temperature elements of the State forecasts will be verified officially.
3. Only the forecasts issued from the 7:30 a.m. and 7:30 p.m. EST maps will be verified officially.
4. The 7:30 a.m. EST forecasts will be verified for the 12-hour periods ending at 7:30 a.m. and 7:30 p.m. of the following day. The 7:30 p.m. forecasts will be verified for the 12-hour periods ending at 7:30 p.m. of the following day and 7:30 p.m. of the second day in advance.
5. District forecasts for both precipitation and temperature will be verified by areas. In verifying by areas all Schedule "C" and Schedule "A" reports of precipitation and temperature will be charted and used.
6. Verification of District forecasts will be done by a Verification Section in the Central Office, which will prepare suitable precipitation and temperature change charts for verification purposes.

### PRECIPITATION

7. A trace or more of precipitation will verify a forecast for precipitation. A trace of precipitation will not break a "fair" forecast. .01 inch or more of precipitation will break a "fair" forecast.
8. "Definite" forecasts for precipitation, i.e., forecasts that indicate definitely that precipitation is expected to occur over a given area during a given 12-hour period, will be considered fully verified if precipitation of a trace or more occurs over three-fourths or more of the given area within the period specified.

9. It is recognized that it is sometimes impossible to tell whether precipitation will begin or end shortly before or after the end of a given period or the beginning of a given period. In such cases the forecaster has the privilege of making an "or" forecast. However, an "or" forecast will be considered fully verified only if precipitation occurs over the area specified in one of the periods indicated. If precipitation occurs in both of the periods specified when an "or" forecast is made the forecast will verify only 80% over that portion of the area covered by precipitation during both periods.
10. Precipitation forecasts falling in the "or" category will be such as the following:
  - (a) Showers late this afternoon or early tonight.
  - (b) Rain beginning (or ending), late this afternoon or early tonight.
  - (c) Showers beginning (or ending) this afternoon or early tonight.
  - (d) Rain late tonight or Tuesday morning.
  - (e) Snow beginning late tonight or Tuesday morning.
  - (f) Thunderstorms ending late tonight or Tuesday morning.
  - (g) Showers beginning (or ending) Tuesday afternoon or early Tuesday night.
11. Forecasts covering 36-hour periods such as "rain this afternoon or tonight", "snow tonight or Tuesday morning", and "thundershowers tonight or Tuesday", are considered too indefinite, and are not encouraged. 48-hour forecasts such as "rain Tuesday or Wednesday" are prohibited.
12. Forecasts of "scattered" showers, thundershowers, or thunderstorms will be considered fully verified if a trace or more of precipitation occurs over half or more of the area given during the time specified. However, if .01 inch or more of precipitation occurs at all stations in the given area during the time specified the forecast will verify only 80%.
13. A "dry" thunderstorm at a station will verify a forecast for precipitation at that station, but will not break a "fair" forecast, since it may be assumed that thunder heard indicates the occurrence of precipitation nearby.
14. It is recognized that there are times when it is very difficult for the forecaster to be sure in his own mind whether precipitation will or will not occur. At such times he is privileged to use the terms "possibly" and "probably" to convey to the public the thought that the forecast indicating precipitation carries with it a degree of uncertainty. Although such forecasts are more or less indefinite in character they will nevertheless be verified in the same way as "definite" forecasts.

### TEMPERATURE

15. When temperature change is indicated in a forecast it will be verified as warmer or colder without regard to the magnitude of the change that has been indicated. When no temperature change, or little temperature change, is indicated in the forecast the temperature forecast will be considered as "stationary" and verified as such.
16. Temperature change forecasts will be verified on the basis of change from minimum to minimum occurring during the 12-hour period ending at 7:30 a.m. EST, and maximum to maximum occurring during the 12-hour period ending at 7:30 p.m. EST.
17. A temperature change of 1 degree or more will fully verify a forecast calling for a change in temperature.
18. The "stationary" limits for temperature forecasts will vary with the seasons, as follows:

June, July, August, September	6 degrees.
April, May, October, November,	8 degrees.
December, January, February, March	10 degrees.
19. When temperature is not mentioned in a forecast it will be assumed that the forecaster considered the temperature change to be of so little consequence as to be not worth mentioning, and the forecast will be verified as a "stationary" forecast with respect to temperature.
20. In the continental United States temperature will always be mentioned in District forecasts during the period from September to May, inclusive, regardless of geographical location. However, mention of temperature may be omitted in District forecasts during June, July and August at the discretion of the forecaster. All local forecasts will mention temperature, regardless of season.

### VERIFICATION OF LOCAL FORECASTS

1. Verification of local forecasts will be done in accordance with the instructions outlined for the verification of District forecasts, applied to a point rather than to an area.

J. R. Lloyd, Chairman (Signed)

K. S. Norquest (Signed)

L. T. Pierce (Signed)

Committee on District and Local  
Forecast Verifications

AIRWAY FORECAST VERIFICATION

Since 17 of the 18 Supervising Airway Forecasters voted to "verify" the mid-hour only" of the airway terminal forecasts and all 18 voted to verify ALL terminals issued, the Committee on Airway Forecast Verification submits the following plan:

The current WB Form 1212 and 1213 will be used for airway terminal verification but the hourly column will be used for terminal designators. On the back of Form 1212 - 6 terminals can be placed and on Form 1213 - 12 terminals. Two or more of the forms will be necessary for each forecaster.

The present rules for verifying "hits or misses" will continue to be used but only the 4th and 5th hours will be verified. If either or both of these hours comes within the limits a hit will be scored except in the case where the forecast is broken between the 4th and 5th hours when the 4th hour only will be counted. For example, if CAVU is forecast for the 4th hour and zero-zero for the 5th hour the hit or miss will be based on the actual conditions at the 4th hour.

This system will result in only slightly more work since a current record is being kept of all terminals on the "hourly verification sheet". The additional work will be in summarizing for the most part.

Until methods have been developed for using punch cards and the IBM machines for verification, it was the opinion of the Conference of Forecasters that this system would be preferable to the existing system.

W. L. Thompson (Signed)  
WBAS, Miami, Florida

H. E. Hutchinson  
WBO, Albuquerque, N. M.

E. C. Johnson  
WNA, Washington, D. C.

XVIII - International Meteorological Organization - Mr. I.R. Tannehill

Beginning, interspersing, and concluding his talk with an apparently limitless store of humorous stories and witty remarks, Mr. Tannehill touched on significant aspects of the International Meteorological Organization and the Weather Bureau's participation in the Organization. He dealt briefly with recent meetings of the I. M. O., the establishment of a World Meteorological Organization, and agreements on new codes and numerous resolutions. The World is looking to the United States for leadership, and the U. S. Weather Bureau is looking to the forecasters to maintain its reputation for good forecasts, Mr. Tannehill stated. Dr. Reichelderfer added a few pertinent remarks. Mr. Tenenbaum acted as Toastmaster of the evening.

XIX - Specialized Forecasts - Mr. Eckley Ellison

Specialized Services are not a new enterprise for the Weather Bureau, Mr. Ellison began. Outstanding among the established Special Services are those rendered by fruit-frost forecasters. Other special services are FAWS and Airway Forecast Services. During the past year, five new Specialized Services centers were established by the Weather Bureau at Portland, Des Moines, Harrisburg, Houston and St. Louis.

The Specialized Services program was planned to provide specific forecast services for agricultural, commercial and industrial users on a nation-wide basis, said Mr. Ellison. He then listed some of the distinguishing features of the Special Services unit:

1. Liaison between the unit and the agencies using the specialized forecasts.
2. Timely understanding by the Special Services forecasters of the special operations involved.
3. Special preparation by Special Services forecasters to cover the special needs of forecast users.
4. Mutual arrangements in supplying technical information by groups served to forecasters.

Mr. Ellison turned his attention to adaptive forecasting as a function of field stations. There is a strong demand by field stations for guidance material, he said. Some district forecasters insist that it is the function of the field stations to adapt state or district forecasts to meet the immediate field demands. District forecasters, who are specially selected for their work, spend most of their time in forecasting. In theory, at least, state forecasts become the master guidance forecasts for the field.

He then discussed the shortcomings of the state forecast as a vehicle for guidance. Contact with the field stations by means

of state forecasts and special warnings alone are inadequate. The elaboration of forecasts such as is now being provided by some district forecast centers is not on a high enough level to give to the field stations much of the data which they require. Some district forecast centers are much more specific in areas close to the home station than they are for areas farther away. As an illustration of the adaptation process, he related how the district forecast may state, "cloudy, with showers", while the field station may consider this inadequate and may even make a differing forecast. He indicated that forecasters must know what is going on in their areas and must obtain an understanding of basic facts by keeping themselves fully posted. They are thus in a position to reply to questions concerning public needs and they are thereby enabled to serve a larger public interest.

Mr. Ellison then discussed the kind of guidance field stations require. He illustrated this by discussing fire-weather service in Oregon. Special fire-weather forecasts require statements specifically pointing out what areas will be affected by thunderstorms, time of starting, direction of movement, and the duration of such storms. Wind direction and speed and humidity are other important elements in fire-weather forecasts. Precipitation is of particular importance. Forecasts must be made 36 hours in advance and must indicate the time of beginning of precipitation as well as intensity and duration. He summed up by stating that all of this pointed to the need for two things:

1. District forecast centers should make more information available to the field.
2. District forecast centers should give more intensive coverage on all types of information.

Some of the forecasters defended the adequacy of discussion material supplied by district forecast centers. Mr. Dunn stated that the Specialized Service centers should point out to the district forecast centers as soon as possible when forecasts were inadequate so that immediate remedial action might be taken.

Mr. Schmidt agreed that more detailed state forecasts would be desirable, but pointed out that there is neither sufficient communication time nor forecasters' time to provide as complete a forecast to the service centers as Mr. Ellison desired. Specialized Service units were established for just those reasons. The desirable thing, Mr. Schmidt stated, would be to have a Specialized Service unit in each state.

Fire-weather forecasters are qualified to issue original forecasts, said Mr. Hanna. He believed that there should be coordination between fire-weather forecasters and district forecast centers. Our forecast centers now have more qualified men than they ever had before, and this affords greater opportunity for coordination. There is a need for liaison between the forecast center and the Specialized Service units, he concluded.

Mr. Osmon attempted to explain the methods employed by the New York Public Service Unit in forecasting for the variety of industrial interests in the New York area. He gave numerous illustrations of how these industries are guided by specific details of weather forecasts.

Mr. Warren O. Johnson discussed the fruit-frost forecast program at Lakeland during the winter season and the way the forecasts were used for the protection and shipment of perishable goods to northern markets.

The final item which Mr. Ellison discussed was the question of whether Specialized Service units invade the domain of private meteorologists. He stated that there appeared to be very few, if any, private meteorologists in the Far Northwest. He asked whether there was any definition of what constituted a program for the Weather Bureau as distinguished from a program for private meteorologists. Mr. Tannehill responded to this by stating that there had been a conference with a number of private meteorologists in the Central Office about a month before. It is the policy of the Weather Bureau to cooperate with the private meteorologists as far as possible, he said. He realized that there were private meteorologists operating in some areas while they had not gone into other areas. Under any circumstance, he pointed out, there is a grist of requests for weather information that keep coming to the Weather Bureau. Mr. Tannehill indicated that the Weather Bureau is unable now to serve adequately all the needs for weather service which could be used by the country.

The Committee, appointed to make recommendations for the future development of the Specialized Forecast Service, submitted the following report:

#### REPORT AND RECOMMENDATIONS

##### FORECASTERS' COMMITTEE ON SPECIALIZED FORECASTS

Authority. The following committee was appointed by the Chairman of the Forecasters' Conference during the sessions in the Central Office, May 24-28, 1948 and instructed to study the specialized service project and submit specific recommendations for the future development and growth of specialized services within the Weather Bureau:

Eckley S. Ellison, Chairman  
J. W. W. Osmon,  
C. B. Carney.

The committee report is organized into 4 tabs:

Tab 1. Orientation on specialized services as a major project of the Weather Bureau. Existing confusion

on the subject within the professional ranks of the bureau. Need for criteria to determine when specialized services are being rendered necessary to establish a common ground for understanding and discussion. Development of criteria based upon committee study of fruit-frost, fire-weather, and other established services to establish the essence of specialized services. Recommendation to adopt criteria.

- Tab 2. Use of specialized services centers as a proving ground for the specialized services project. Importance of evaluation to the bureau on a proper sized sampling basis. Adherence to criteria in selection of qualified personnel. Recommendations affecting course of development of present special service Centers.
- Tab 3. Adaptation principle as applied to specialized services forecasting. Need for a new and better type of guidance forecast material needed by specialized services centers.
- Tab 4. Resolution of opinion on proposal placed before forecasters conference by Mr. L. T. Pierce for revision of forecasting program within the bureau. Suggestions from committee.

#### TAB 1

#### CRITERIA ON SPECIALIZED SERVICES

Specialized services definitely are not a new endeavor in the Weather Bureau. The most outstanding examples of well established specialized services are those rendered by Fruit-Frost and Fire-weather. Considerable valuable experience has been accumulated during the past 25 to 30 years by the operation of these specialized for agriculture weather forecasting services. It is difficult to draw the line of separation wherein the operation of fruit-frost and fire-weather differs from that of other established forecast services which at first glance appear also to be specialized, such as the Hurricane Service, Airways Service, FAWS, River and Flood and Ocean Weather Service. Some of the general weather service special warnings appear also to be of the essence of specialized services, such as Storm Warnings, Small Craft, Livestock, Cold Wave, Heavy Rain, Heavy Snow, Fruit-spray, Harvest, Frost, and the like. Most Weather Bureau Offices, including District Centers, give on occasion individual or group services in forecasting based upon adaptation of district guidance to meet specialized needs.

Are all of those services specialized forecast services in the same sense as fruit-frost and fire-weather are specialized forecast services? The point needs to be resolved since within the Bureau there is confused opinion as to what constitutes specialized

services. When the subject is discussed or programs are to be formulated there is need for a common ground of understanding. There is need for some to know the full story on specialized services and to have available some criteria from which it will be possible to determine whether a given forecast service contains the essence of specialized services.

Fruit-Frost and Fire-Weather forecasters fulfill a multiple role. They are expert weather forecasters and versatile meteorologists, qualified by training and experience to undertake the special studies and construct objective aids from which emerge the techniques for preparation of the specific weather forecasts calculated to meet the exacting needs of their clients. The touch that is added in critical situations always transcends the scope of the guidance forecasts furnished by higher echelon forecasters; the specific values in the specialized forecasts are original forecasting work. These forecasters also are expert in their knowledge of the operations for the regulation of which the special weather forecasts are supplied. An additional role they must fulfill is that of liaison which in these cases means the ability to make favorable impressions and get along well with the people they meet. These men also perform related services along the line of the main endeavor; for example, the testing of thermometers used in orchard heating work, calibration and servicing of hygro-thermographs, special studies into critical temperatures for various kinds and varieties of fruits and produce; such work as would tend to increase their usefulness in the service field and create good will for the Weather Bureau.

Over the years Fruit-Frost, Fire-Weather and other specialized services have done much to increase the prestige of the Weather Bureau in the field of public weather service. The specific nature of the forecasts issued by these services to exactly meet complex operational needs coupled with the consistent high degree of accuracy in the predictions has met with enthusiastic response from those receiving such services. This response is especially significant when it is considered that a substantial part of the expenses for operating Fruit-Frost and Fire-Weather comes from cooperative funds, or from equipment and facilities supplied by the cooperator. The response clearly shows that the general public as an entity contains many groups associated in common enterprise who have specific weather problems the solution of which is to them a vital matter. The expressed will of such groups is for more intimate contact with the official forecasters of the Weather Bureau than is possible under the district forecast system as it presently is organized. Some of these groups, notably those concerned with the weather risks assumed in preparing crops for market have a legitimate claim for special forecasting attention from the Weather Bureau; others should be served by private meteorologists. Specialized weather services as a project of the Weather Bureau as herein discussed related only to such groups as may be publicly served under policies of the Chief of Bureau.

It is the understanding of the committee that the Chief of Bureau intends the Specialized Services Project to serve groups considered eligible with a type of weather service of more intense and personalized nature than obtainable from the general weather service under the district forecast system. The objective is to render weather services patterned as far as possible along the lines of the established specialized services. Such services through many years have demonstrated the formula for public weather service of highly successful nature when viewed both from the position of the groups receiving service and the Weather Bureau.

To clarify the confusion previously mentioned as existant within both forecast and administrative ranks of the Weather Bureau, a careful study of Fruit-Frost, Fire-Weather, and other specialized services has been made to determine the particular pattern or formula responsible for the outstanding success of such services. We arrive at a schedule of criteria which contain the essence of the successful formula. Specialized services, as a major Weather Bureau project, should contain all items enumerated as criteria. Insofar as these principles are met, specialized services are being rendered according to the basic pattern of such services. This applies regardless of the source from which the service originates, whether from field stations of all classes, from a district forecast center acting in the capacity of a field station within the local area, or from specialized service centers organized to devote their entire time to such projects. Use of these criteria should enable a common ground of understanding to be reached when specialized services are considered.

#### CRITERIA FOR DISTINGUISHING SPECIALIZED SERVICE PROJECTS

1. There is established intimate and frequent continuing liaison between the forecasters and the agencies or groups served. This liaison provides a personalized service.

2. The forecasters through training and experience have a thorough expert understanding of the special operations or problems involved and make the effort to keep fully posted on current situations and trends. On the other hand the agencies or groups served know that special forecasts to meet their exact needs are prepared by capable, fully informed forecasters.

3. By virtue of special study, including the preparation of objective forecasting aids and execution of pertinent research projects, the special service forecaster is prepared to contribute an accurate, dependable weather forecasting service beamed directly towards existing specific needs.

4. The agencies or groups served act in the role of cooperators, either financially or in the supply of equipment, services and technical information. The special service enterprise is a mutual affair.

Essential to the successful accomplishment of specialized services projects is the selection of supervising personnel fully indoctrinated in the special techniques and procedures entailed in meeting objectives of the service. Proficiency in forecasting alone is by no means the total prerequisite to such assignment. If the schedules set forth in the criteria are not fully met, specialized services in the true sense will not be given and the project will surely bog down into a routine, impersonal inadequate weather reporting service, accepted as such without enthusiasm by those on the receiving end. If the proven formula for rendering specialized service is disregarded, the Bureau cannot hope to obtain proportionate public response that has been and is now being secured by the established fruit-frost and fire-weather projects, and such of the newly organized specialized service centers as have survived the ordeal of successfully extending the field of specialized services.

#### COMMITTEE RECOMMENDATIONS

In the matter of orientation on specialized services and clarification of existing confusion on the subject, which will establish the basis for a common understanding so essential for the formulation of a development program the committee recommends:

1. Adoption of criteria as set forth herein to enable determination as to when specialized services, as a major project of the Weather Bureau, are being rendered.
2. Publication within the Bureau, through the medium of Topics or in some other manner, of the criteria and the text (or abridgment thereof) submitted herewith in justification of the criteria.

#### TAB 2.

#### RECOMMENDATIONS AFFECTING COURSE OF DEVELOPMENT OF PRESENT SPECIAL SERVICE CENTERS

Although Specialized Services is not a new endeavor for the Weather Bureau, what is new is the attempt to use the specialized services principle to expand service into the field of agriculture, commerce, and industry on a much larger scale than has ever been accomplished in the past. The newly established specialized service centers are to be regarded as proving projects and from them it is understood the bureau hopes to obtain catalog of experience that will take the expansion out of the field of intangibles and pave the way for ultimate expansion into the total field. This is a highly important matter since it may involve the reorganization of the bureau along totally different lines than those that have been traditionally followed for many decades. In this matter the bureau should first assure itself that it has a new pattern of

service that will work both for bureau interest and serve the needs of the general public on the scale visualized but not yet actually being done.

It is the understanding of the committee that the bureau looks to the operation of the experimental specialized services centers for the answers necessary to make these important decisions. The committee feels that the presently organized experimental specialized services centers are not yet of proper sampling size to provide the operating experience so vitally needed for the important decisions that must be made. At some centers only token staffs have been provided and the efficiency of the centers have been kept to a scale too small to deal with the positive answers. The committee considers that all experimental service centers should be brought to full strength so that evaluation of the operating principle can be intelligently made. The bureau has much at stake.

#### COMMITTEE RECOMMENDATIONS

The committee recommends as necessary for future development and growth that all presently operating specialized services centers be brought up to original full strength to accomplish:

1. Creation of a small pool from which adequately trained and experienced specialized services forecasters can be drawn to assist in the establishment of new centers.
2. Establishment of the presently operating "proving ground" specialized services centers on a proper sized sampling basis so that evaluation of program can be made.

#### TAB 3.

#### FORECAST GUIDANCE MATERIAL FOR SPECIALIZED SERVICES

Existing policy in the bureau requires specialized services forecasters to adapt forecast guidance from the district center to meet the needs of the specialized services. The principal vehicle for guidance from the district center is the state forecast issued and frequently changed every six hours. In addition district centers supply guidance agricultural forecasts as a daily routine and twice a week, on Tuesdays and Fridays, a guidance five-day outlook is furnished. All of these mediums for guidance are in general terms for wide areas and more frequently are incomplete as a framework upon which to build the detailed specific forecasts needed to accomplish the objectives of the specialized services program. The principal burden of many of the experimental service centers is related to the needs of agriculture where the forecasts are required at a

very early hour in the morning so that the day's operation can receive the benefit of specific weather advice. Distribution of agricultural forecasts by the specialized services center goes forward principally between the hours of 6 and 7 a.m. In some cases the guidance forecasts available in the early morning have largely expired since new guidance material will be furnished within an hour or so after the agricultural forecast deadlines have been met. Where this applies this requires on the part of the specialized forecaster the expenditure of time on independent lines analysis and some exercise of independent forecast judgment in anticipation of the guidance forecast not available at deadline hours.

Forecast guidance of the kind especially needed and of greatest utility in meeting the varied specialized services demands is that of timely prognostic material. The prognosis should include pressure patterns, significant changes in air mass structure, frontal movements and developments. It is understood from the transactions of the Forecasters' Conference that the district forecasters themselves need exactly this same type of guidance from the map analysis center and that some consideration will be given to augmenting and rescheduling the guidance from the map analysis center. This suggests that the type of guidance forecast material most urgently needed by the specialized service centers is exactly the same kind as furnished to district forecasters.

#### COMMITTEE RECOMMENDATIONS

The Committee recommends that the type of guidance material for specialized services should be of the prognostic type and that the specialized services centers are prepared to use to greatest advantage the same prognostic guidance material emanating from the map analysis center and supplied to district forecast offices. Under this arrangement it would be presumed that when the District Forecast Center in agreement with the map analysis prognosis that specialized services also would be in agreement. With either or both of these agencies differing with the Map Analysis prognosis, however, significant differences should be resolved via TWX or telephone under the existing plan. This arrangement would provide coordination between the district forecaster center and specialized services center on difficult situations.

#### TAB 4.

#### REORGANIZATION OF FORECAST SERVICES

Prior to the plenary sessions of the forecasters' conference in Washington beginning on May 24, 1948 a paper on the subject of specialized forecasts for agriculture, commerce and industry prepared by District Forecaster L. T. Pierce of Billings, was

distributed to forecast centers and selected weather bureau stations for written comment. Much pertinent comment was submitted which clearly defines the opinion on the subject from various groups within the bureau. The proposal submitted by Mr. Pierce was considered too broad for discussion during the limited time available in conference. Also, the proposal is one of vital concern both to field stations as well as forecast centers. Such field stations had only token representation in the membership of the conference, which was almost wholly composed of staff members of the several forecast centers. The chairman for specialized services, therefore, felt that the proposal could not well be resolved under such circumstances.

The multilateral proposal by Mr. Pierce deals not with a simple subject but presents an esquisse for sweeping changes in the forecast services of the bureau. These changes would involve a major reorganization within the bureau, a revision in policy and is contingent upon the allotment of additional moneys. In circulating for comment among field stations and forecast centers the uncensored proposals by Mr. Pierce, it must be presumed that the bureau is earnestly seeking an answer to the means for providing a better and more adequate forecasting service than has been found possible with the district forecast system as it presently exists. At least the proposition can be scanned even though the bureau may not now be in position to activate more than a proving project in the event that the plan in its essential features should prove attractive.

Broadly summarizing from the written comment available in the files of the forecaster's conference it appears there is unanimity in opinion among all groups regarding the desirability of developing and expanding the project for specialized services on a larger scale. The objectives are considered sound. Consensus is that the bureau will move firmly in the right direction to exploit our legitimate interests in the public service field. The committee feels constrained, however, to point out that this apparent unanimity of opinion was not reached from a common level of understanding since the concept of specialized services; its function, plan and procedures, stems not from the same informed level. This is evident from the context of the comment. In the judgment of the committee no firm agreement on this matter has been reached.

From the peaceful state of agreeing on a single subject, the bombshell of the proposal explodes with a loud noise into fragments of assorted sizes flying in all directions like a shrapnel burst. The largest fragment, representing majority opinion broadly supports at least a part of the basic proposal. The majority position takes its authority from the comment from practically all field stations and a reasonable representation of district and airway forecasters. This group expresses various degrees of dissatisfaction with the total public service made

possible by the existing district forecast system; the urgent need for more reliable and specific guidance forecasts from analysis centers is stressed; and the fact is brought out that professional forecasters would be more useful to the public if they would speak more specific language from contact position on the "firing line". The point is made that district forecast centers are of necessity forced to supply more specific forecasts to smaller areas adjacent to forecast office, simply because they find it necessary to meet the public pressure close to home. Distance alone protects the center from hinterland pressure. The committee urges the clarity with which the above position has been expressed by the majority group and feels that the following elements of the basic proposal has been resolved within this group:

1. Dissolution of the present district forecast centers as being too small for the type of area forecasting now being accomplished and too large to engage in specialized services after the accepted pattern.
2. Establishment of forecast centers of average state size (State Forecast Centers) to carry on all the present function of the district forecast centers plus specialized services over the smaller state area.
3. Coordination of forecasting activities at state centers by guidance in the form of prognoses from a master map analysis center whose sole function would be to supply guidance prognostic material to meet forecast deadlines.
4. Distribution of the present concentration of professional forecasting personnel now at district forecast centers to posts of duty in the several state centers nearer to the "firing line".
5. Preparation by each state center of localized vicinity forecasts for all important communities within the area not directly served by a regular weather bureau office; also, supply of guidance forecast service to all regular weather bureau offices in the area so that they also may engage in the expanded forecasting service.

The above is the majority position not reached by unanimous consent. Minority opinion emanating entirely from a few district and airways centers views with some concern the proposal to dissolve forecast districts into smaller units and distribute forecast authority into many hands. The minority group asserts with positive conviction that present forecast districts are not too small; that there is no concentration of forecasting personnel at district centers over and above that required to handle the tremendous work loads; that smaller centers are not desirable because of the difficulty in coordinating forecasts across state lines; that sufficient

qualified forecasting personnel is not available to staff numerous state centers; that specialized services should first be proven before being adopted on a large scale re-organization; that the true position of specialized services is that of retailers wrapping the product of the district centers into attractive packages for public consumption; that specialized services should not be spoken of as forecasting but as public contact work.

There are many problems to be solved in the establishment of State Forecast Centers for handling all forecast and warnings for a given area, including specialized services. This means integration of the staff to handle forecast services of varied nature. Present thinking among forecasters appears to be separation of district and airways forecast staffs owing to the differing natures of forecast material required. At present separate staffs are maintained for district and airways centers, even though such centers be located within the same office and using the same synoptic maps. There is at least as much difference between specialized services and district forecasting as there is between district and airways forecasting. River forecasters employ considerations and techniques vastly different than those used by weather forecasters. In the case of each specialty there is the requirement for special background. Obviously, it would not be practicable to establish forecast centers on the smaller state basis and provide separate staffs for each kind of forecast. The difficulty might be bridged, however, by providing on the forecasting staff of each State Center so established, at least one professional specialist in each specialty important to the center so as to provide leadership, with the entire work of the center integrated into a consolidated schedule in which all on the station would participate.

The committee feels that the heart of specialized services will lie in the center organized to cover any given area. At the center will be specialized services forecasters and the area project leader. From the center the leader will coordinate services through all weather bureau offices in the area and control the liaison so essential for success. From the center will emanate guidance forecasts to field offices not otherwise equipped to prepare the maps and charts required for resolving specific forecast problems. From the center direct to the users will go specialized forecasting services to groups or communities not served by other weather offices. At the center surveillance will be maintained on the trend of events within the smaller sphere of jurisdiction so that the service forecasts can be shaped to meet the needs of the ever-changing requirements for weather services. The work of the specialized services center can be combined economically and efficiently with the work of a State Forecast Center handling all forecasts and warnings for the given area.

The system sketched above differs little from the present district forecast system except in these essential respects:

1. The area coverage is much smaller. The forecasters know the terrain more intimately.
2. The social and economic pulse of the domain beats strongly so that the changing needs for weather services can be followed from day to day and the general as well as special forecasting services are in position to meet public requirements in adequate manner.
3. The forecasters are brought into more intimate contact with the public they serve. In turn, the public are in position to reach the forecasters more easily. Liaison is less troublesome and more frequent in the smaller area.
4. Coordination of forecasts takes care of itself since all forecasts for the area emanate from the state office, which in turn receives guidance from the map analysis center.
5. By concentrating forecasting effort on the smaller area the forecasters are in position to gain skill and proficiency over and above that possible where the effort is divided and dispersed over terrain of wide extent and extensive diversity.

#### COMMITTEE RECOMMENDATIONS

The committee recommends, therefore, that the course of development and growth of specialized services will best be served by the establishment of state forecast centers preparing all forecasts and warnings, including specialized services, over an area not exceeding average state size.

(Editor's Note: While this study contains some valuable conclusions, the circumstances were such that the subject could not be fully discussed and these conditions and recommendations do not necessarily represent the consensus, nor the proposed program, of the Bureau in this respect).

XX - Forecast Terminology - Mr. Welby Stevens

Referring to his experience of many years ago when he was stationed in the Central Office, Mr. Stevens began the discussion on Forecast Terminology by relating what he had learned through a study of written forecasts issued by foreign countries. He stated that, strange as it might appear, German forecasts tended to be rather brief. He distributed samples of forecasts issued by the Mexican Meteorological Service. He cited one forecast which read "Winds from the usual direction", as an example of unusual brevity.

Mr. Stevens requested the forecasters to indicate their opinion as to the desirability of compiling a standardized glossary of forecast terms for national use. The majority favored such a glossary.

"Should definitions of forecast terms be general or specific?" Mr. Stevens asked. Forecasters have been advised to use a dictionary in order to obtain the meaning of certain forecast terms, he stated. But the trouble with using the dictionary is that there are frequently many definitions given for a single term; to follow the dictionary always might give ambiguous results. Mr. Tenonbaum replied that if the Weather Bureau published a glossary of forecast terms, the glossary could be given to dictionary publishers for incorporation in their publications.

Should definitions be restricted to certain terms or should there be some latitude in the scope of meaning, Mr. Stevens inquired. The value of using the phrases "below normal" and "above normal" produced some discussion. Mr. Namias stated the word "normal" should never be used in a forecast issued to the public because the public does not understand what "normal" really means at any particular time.

When Mr. Stevens asked, "What should be the definition of 'fair'?", several opinions were offered on the definition of this term. One opinion was, "As long as the sun shines, it is fair". Mr. Dunn wanted to know how much cloudiness was permissible with a fair weather forecast. He pointed out the impracticability of stating the various degrees of cloudiness within a single state forecast and indicated that he thought that "fair" was a good catch-all. There was some discussion as to the use of the word "pleasant", instead of "fair". The undesirability of using subjective terms in forecasts was brought out.

Mr. Stevens' next item concerned the definition of the term "partly cloudy". He considered the term much overworked. He cited instances where "fair" would have been better than "partly cloudy". Mr. Day admitted that "partly cloudy" was frequently used as a hedging forecast. Mr. Harmantas wanted the term "partly cloudy" to have a definite meaning so that users of the forecast would know the limits implied in forecast phraseology. There was also some discussion

as to the possible ranges, both as to area and length of the day, which should be considered in the use of the term "partly cloudy".

Then Mr. Stevens asked, "Should the term "unsettled" ever be used?" Mr. Tenenbaum stated that this term appeared to mean that the forecast was "unsettled" in the forecaster's mind. "Threatening", he thought, might be used when the sky would lead one to believe that precipitation was imminent but the fall was expected to be negligible. A state forecast containing the words "partly cloudy", said Mr. Tenenbaum, should be adapted by the local stations to describe varying degrees of cloudiness anticipated during the different times of the day, as well as degrees of cloudiness expected over various portions of the state. He thought it desirable to make distinctions in terminology as the terms apply to local or state forecasts.

There was some discussion on the use of the qualifying term "somewhat". In view of the considerable difference of opinion as to the meaning of this term, Mr. Tenenbaum suggested that any glossary issued by the Weather Bureau should first be tried out on the public.

Mr. Stevens then turned the discussion to the expected weather in the mind of the forecaster in using the various terms: "rain", "occasional rain", and "showers". After much discussion about distinguishing between these three terms, there was general agreement as to their definitions.

Then Mr. Stevens presented the terms "generally fair" and "mostly fair". There was some opinion that the qualifying phrase before the word "fair" should refer to a large area, such as a state.

Mr. Stevens concluded the discussion by asking about the value of the words "probably", "possible", and "or". Mr. Osmon tried to define these terms quantitatively. Other phrases, such as: "likely", "risk", and "some chance" were cited as similar examples in the realm of hedge forecasts. Mr. Tannehill considered some of these terms useful until they become overworked.

Mr. Tenenbaum closed the discussion by bringing up a matter which was indirectly related to the topic at hand - the psychology of stating forecasts to people with varying backgrounds and temperaments. When people called the Weather Bureau for forecast advice it was possible to reply to such inquirers in one of several ways. If all the possibilities were stated when a single "yes" or "no" answer was desired, the inquirer might be discouraged from ever calling again. Mr. Tenenbaum indicated that the inquirer might have considerable influence on the Weather Bureau's future and that it was not wise to risk discouraging or antagonizing him. When the forecaster went to great lengths to point out all the varying possibilities in the weather, it might give the impression that the forecaster was preparing an "out" in the event that the forecast failed. The public usually did not want to hear all the possibilities; they wanted a definite and specific answer.

In conclusion, Mr. Tenenbaum stated that his remarks were aimed at having the forecaster leave a good impression with those requesting forecasts.

XXI - Standardized Forecast Terminology - Mr. A. B. Carpenter.

Since the previous discussion had already shown that the conferences favored a glossary of standardized forecast terminology, Mr. Carpenter began this discussion by introducing the question of the desirability of coordinating terminology for state, local, fire-weather, fruit-frost, etc., forecasts. If terms could be evolved which would be recognized as meaning the same thing in airway forecasts as in other forecast services, he said, it would simplify the process of evolving routine Weather Bureau phraseology. At Salt Lake City he had found the forecasters in disagreement about the meaning of terms which all were using. A standardized terminology should be available to assist new forecasters, as well as others who may have different ideas about the significance of the same terms.

Mr. Tenenbaum stated that a glossary of the proposed forecast terms should aim at objectivity. He recalled the "moonlight and roses" forecasts issued by the staff at WNA several years ago, which had received nationwide publicity because of the departure from the old routine phraseology. Not all of the forecast offices were as delighted and impressed with the WNA forecast terms as the newspapers appeared to be. A pleasant day for one person might be unpleasant for another; it depended upon the physiological make-up of the two people.

Mr. Carpenter discussed various terms found in forecasts and sought opinions as to definitions. He pointed out that words like "sunny", "partly cloudy", etc., might have different definitions, although there would be some similarities. The use of the same term repeatedly might be annoying, he thought, and it was advisable to substitute words of similar significance in order to avoid the monotony of repetition. Mr. Vernon thought that such substitution might prove confusing. There was some discussion as to the meaning of "mostly fair". Frost-forecast phraseology and the variety of local possibilities were discussed at some length. Some suggested the use of such phrases as "local frost", "light frost on low ground", "scattered frost", to indicate diverse possibilities in the local area. It was recognized that state forecasts using similar phrases might carry different connotations. The desirability of uniformity in frost-forecast terminology, whether the terms applied to state, local or fruit-frost forecasts, was brought out.

Mr. Hanna stated that the fire-weather forecasters had arrived at an authorized fire-weather terminology. There was some criticism that this terminology was too complicated. Mr. Hanna stated that many forecasters felt a need for a forecast terminology that could be understood without making reference to dictionaries or Weather Bureau reference books.

Mr. Carpenter asked the Conference whether the contents of state forecasts prepared at different centers should be uniform or similar. As an example, he stated that in the West there was a demand for specific temperatures in state forecasts. While there was general agreement that such temperatures were desirable, several forecasters pointed out that such detail would be undesirable in certain areas. Mr. Dunn stated that this was particularly true in the Great Lakes Region. As an example, he stated that due to Lake influences there might be a difference of at least 20 degrees in minimum temperatures within 20 miles of the City of Chicago. Mr. Vernon stated that he did not favor specific temperatures in the state forecasts for northern California. To describe adequately the variety of temperatures in that area would make the forecast too long and involved, due to such orographic differences as mountains, valleys, lakes, hills, etc.

Mr. Carpenter thought that many agricultural users of forecasts are able to interpret specific temperature forecasts to suit their own needs. They are experienced enough to make allowances for their locality when given a specific temperature for the nearest city. Mr. Tannehill took a vote on whether the forecasters wanted temperatures included uniformly as part of the state forecast. The majority indicated that this matter should be left to the discretion of the District Forecast Centers. Mr. Carpenter asked about the desirability of including humidity and wind in the state forecasts. Mr. Ellison thought that such elements should be handled on a local basis.

Mr. Dunn stated that the word "some" has been used too frequently in state forecasts. Mr. Vernon indicated that he thought the term should be thrown out of the forecasters' vocabulary.

There was discussion about summarizing the neighboring state forecasts for local broadcasts, and there was some opinion that such summaries would make the forecasts more easily understood.

A committee consisting of Mr. W. Stevens, Chairman, and Messrs. A. B. Carpenter and P. A. Kutschenreuter, member, was appointed to compile a glossary of forecast terms for national use. The first report submitted by this committee was as follows:

#### RECOMMENDATIONS FORECAST TERMINOLOGY

1. The consensus of the Conference was that a glossary of forecast terms should be prepared by the Committee. The Committee is at work on such a glossary, and it is recommended that the list be submitted to all Forecast Centers by the Central Office for additions, deletions, or changes as appear necessary or advisable. It is further recommended that such a list be suggestive rather than restrictive.

2. Fire-weather, Fruit-frost, Airway, and State forecasters should coordinate their various terminologies as far as practicable.

3. Many long forecasts can be condensed to some extent without loss of meaning. All of us should strive to say what we mean in as few words as possible. This makes the forecast easier for the listener or reader to understand and remember.
4. Forecasts should be phrased in such a way that they may be readily understood without punctuation.
5. When winds are expected to reach 25 mph and continue that strong for half the period or longer, terms such as windy, strong winds, or gusty winds should be included in the forecast. Usually it is desirable to indicate the direction, particularly if a shift is expected.
6. When a cold wave or snow is forecast, the strength and direction of accompanying winds should be included. It is important for the public to know whether it will be cold with strong winds or with light winds. Likewise, when snow is expected, it is important that winds be included, as strong winds will probably cause drifts across the highways.

#### XXII - Five-Day Forecasts - Mr. G. E. Dunn.

The slight reaction from the field to the Chicago paper on this subject, said Mr. Dunn, made him assume a fairly general satisfaction with present procedures for preparing of five-day forecasts.

Suggestions for changes were being made by him with no intention of restricting freedom of action previously exercised by District Forecast Centers in preparing or distributing five-day forecasts. The first suggestion concerned the desirability of eliminating such terms as - "light", "moderate", and "heavy", and stating definite amounts instead. In some sections of the country such comparative terms were not desirable, he felt. Some forecast centers do not state either the amount or intensity of precipitation, which detracts from the value of their forecasts.

The desirability of including temperature normals and means in the forecasts was Mr. Dunn's next item. He pointed out that unless the user of the forecast knows what the "normal" actually is, a statement that: "Temperatures will average 4-8 degrees above normal" does not have much significance. Furthermore, in areas like the Dakotas the temperature range during a five-day period may be great. In such areas he thought it advisable to forecast the maxima and minima expected in the five-day period.

Mr. Showalter stated that in southern California people are more concerned with maximum than with minimum temperatures. He thought there was little interest in five-day forecasts in that area. Mr. Dunn thereupon asked for an expression of opinion as to the extent that five-day forecasts are used. Mr. Welby Stevens stated that the New Orleans District Forecast Center distributed such forecasts by mail. Mr. Ellison also stated that such forecasts are mailed from his office. Mr. Kutschenreuter indicated

that there was considerable use of the five-day forecasts in New England.

Mr. Dunn did not consider it desirable to prepare five-day forecast in terms of day-to-day occurrences. He thought that the forecast should be in general terms.

Mr. Dunn then talked about subdividing some of the five-day forecast districts in order to permit more specific forecasts for smaller areas. Mr. Showalter thought that this might aggravate the problem of coordination. Some of our offices are located on the border between two districts, and they sometimes receive conflicting five-day forecasts. We have not yet solved the problem of coordination of short-period forecasts in such borderline situations. Furthermore, he pointed out, local Weather Bureau offices do not have much time nor background material for coordination of five-day forecasts. Mr. Namias stated that in general not many inconsistencies between neighboring districts were evidenced.

Should the five-day forecast be in the form of a whole weather picture from day to day, or first a forecast of temperature, then for the weather, for the period as a whole?, Mr. Dunn asked. Mr. Osmun favored the first alternative. Mr. Vernon thought it desirable to place first that portion of the forecast which was most certain to verify. Mr. Namias cautioned against giving publicity to the five-day forecasts. They are far from perfect and still very much in the experimental stage, he said.

Mr. Dunn then presented the question of issuing five-day forecasts daily. Mr. Vernon stated that many offices were doing this, although without the official blessing of the Central Office. There was some question as to whether the Five-Day Forecast Section should prepare forecasts for the last three days of the period and not the first two days. To a proposal that the Extended Forecast Section prepare five-day forecasts daily, Mr. Namias replied that this could not be done without additional staff. Mr. Tannehill did not think that we would be able to obtain additional appropriations for that purpose at the present time. Mr. Dunn explained that the daily preparation of five-day forecasts at Chicago was handled by adding an additional day's forecast each succeeding day.

Mr. Dunn recommended that newspapers and radio stations should be discouraged from publishing five-day forecasts instead of short-period forecasts. He also advised the forecasters to consider the matter for another year or so before going on record in favor of the issue of five-day forecasts by the Five-Day Forecast Section on a day-to-day basis.

The next question Mr. Dunn presented was whether the five-day forecast should be issued on Monday and Thursday instead of on Tuesday and Friday. He stated that there was considerable demand for week-end forecasts on Thursday. Mr. Clapp's recent trip to the field had revealed that different stations wanted five-day forecasts on different days of the week, Mr. Namias

pointed out. If guidance material were to be sent out Sunday night instead of Monday night this would require staffing on Sundays, and he thought it difficult to get people to work on Sundays. However, arrangements might be made to prepare a guidance forecast on Wednesday for the week-end.

Then Mr. Dunn took up items of additional information which might be helpful to forecast centers in either regular and/or extended forecasts. The items were as follows:

- a. Early detection of blocking,
- b. Reasons for location of mean troughs in the United States and adjacent areas.
- c. Changes in prevailing type of weather and similar information,
- d. More information concerning the development and movement of major centers of action.

Mr. Namias said that it might be possible to implement some of these suggestions.

Then Mr. Dunn asked whether any guidance material now distributed could be discontinued. A suggestion was made that the first day could be eliminated, since forecasts are prepared at the district centers with the aid of several 6-hourly synoptic charts available after material has been released by the Five-Day Forecast Section. Mr. Dunn then presented two recommended items for research:

- a. Running five-day mean charts for a period of two years.
- b. Either 500 mb. mean charts or prognostic 500 mb. mean charts.

Mr. Namias stated that he did not favor the second suggestion because of the insufficiency of pibals at that level.

Mr. Namias wanted to know whether any use was being made of the daily trend map. There was some indication that it was being used. Referring to the previously-expressed desire of some forecasters for longer-period prognostic charts from the Analysis Center, he posed the question: "Where do the functions of the Analysis Center cease and the functions of the Extended Forecast Center begin?"

The Committee appointed to make specific recommendations for improving the five-day forecast service submitted the following report:

RECOMMENDATIONS  
FORECASTERS' CONFERENCE IN CONNECTION WITH  
EXTENDED FORECASTS

The precipitation class limits as defined by the 5-day forecast section should, as a rule, be redefined by the forecast center before the 5-day forecast is released to the public in order that terminology consistent with public understanding be used. When



XXIII - Policy with respect to private practice of meteorology

Dr. F. W. Reichelderfer

Dr. Reichelderfer opened his comments by indicating that he had great confidence in the future of applied meteorology and stated that the development possibilities in this field were practically unlimited as regards extension to the multitude of individual plans and operations. He then asked whether the Weather Bureau could do all of the job that applied meteorology would be called upon to render. He pointed out that the Weather Bureau did not have staff enough to make the detailed and specialized forecasts now required by business. An example of where Weather Bureau facilities fall short of the demand can be seen in the meteorological services which many of the airlines carry on for themselves. "The Government cannot possibly handle all the applications of meteorology for aviation and industry. Is it to be left undeveloped because the Government cannot handle it?" he asked.

Obviously, there is a field which should be handled by the private meteorologist. Americans believe in private enterprise. Recognizing that the dividing line between the fields of private and Government activities in the field of meteorology is not a sharp one, he attempted to distinguish between the two fields. Where a service is desired for a particular corporation or agency which is engaged in private enterprise, a service in the nature of private consultation, then the job should be done by private meteorologists. If it is obviously a public service, like agricultural weather forecasts for farmers, then it may be a function of the Government. He realized that his statement of policy might be interpreted differently by different individuals. Elaborating with specific examples, Dr. Reichelderfer indicated that if the service desired did not involve intensive study to meet the needs of a particular industry, that service would probably fall in the domain of Weather Bureau activities, but if a personalized service were requested, it should be our policy to inform the inquirer that the information he desired could be obtained from a private meteorologist.

During the war, the Weather Bureau encouraged field offices to furnish as much service as possible in order to aid in the war effort. Now we are apparently asking our field stations to turn a cold shoulder to those asking for service. This must be done in such a way as not to offend anybody. He cited an example of one utility company, which was getting special service from the Weather Bureau, but which was now being asked to take the services of a private meteorologist instead of the Weather Bureau. Dr. Reichelderfer expressed the belief that certain private concerns ought to hire meteorologists who could give 50-100% of their time to individual interests of the company.

In response to questions asked about the outlook for certain industries which claim that they can not afford the services of

a private meteorologist or that there is no private meteorologist in their area, Dr. Reichelderfer replied that private meteorologists are willing to adjust their fees according to the amount of service rendered, and that rapid communication facilities, such as TWX, telegraph and telephone, are available for the transmission of private meteorological forecasts to firms located at a considerable distance from the office of the private meteorologist, although he did not endorse such "mail-order" service as the best form of meteorological advice any more than long-distance medical prescriptions.

Dr. Reichelderfer concluded his talk by expressing his belief that the private practice of applied meteorology is bound to grow. "It behooves us to cooperate with, rather than to be indifferent to, or obstruct it", he stated.

#### XXIV - Radio Broadcasts - Policy - Mr. C. B. Carney

(a) In some respects, Mr. Carney began, present policies with respect to direct radio broadcasts from Weather Bureau offices constitute a departure from the past. Until recently, local offices had been permitted to assume new direct radio broadcast programs without Central Office authority. Rapid growth in the number of programs since the ending of the war had brought requests for additional personnel, and since funds were limited, it became necessary for the Central Office to establish procedures which would control the continued growth of the direct radio broadcast program. Mr. Carney summarized recent circular letters which dealt with direct radio broadcasts, particularly Circular Letter No. 124-47. He explained that authority for new direct radio broadcasts must be obtained from the Central Office, through the Regional Office. The Regional Office is thus enabled to make comments and recommendations. Requests should indicate whether or not a proposed broadcast program can be handled with present staff and whether the Official in Charge thought the program should be assumed. At places where broadcasts are already being made, a statement is desired as to whether a serious attempt has been made to arrange simultaneous broadcasts.

Then Mr. Carney briefly listed the factors considered by the Central Office in authorizing new direct radio broadcasts. Among these are: Size of present staff, number of broadcasts now being made, whether or not the Official in Charge has tried other means of satisfying requests for additional broadcasts which would effect some savings of time and personnel; e.g., simultaneous broadcasts, recordings, bulletins, etc. He indicated that the Central Office has determined that the limit in number of broadcasts should be four, one for each 6-hourly synoptic period. Transcriptions, simultaneous broadcasts, and the preparation of bulletins for studio broadcasts would be additional to the limiting number of direct radio broadcasts. He indicated that many Weather Bureau Offices have been successful in arranging simultaneous broadcasts. With respect to transcriptions and re-broadcasts by a radio station of a direct

weather broadcast made from another station, it was indicated that this matter had been taken up with the Federal Communications Commission. The Commission had stated that there was no objection to such procedure provided the radio station that originally made the broadcast gave permission. Mr. Carney indicated that it was necessary to have the re-broadcasts made within one hour after the direct broadcasts to keep the re-broadcasts from becoming stale.

Then Mr. Carney discussed sponsorship of broadcasts. He indicated that there was no objection to sponsorship provided that the "commercial" was kept out of the body of the broadcast. Further, he cautioned that radio stations should avoid giving the impression that the Government was endorsing the sponsor's product.

Turning his attention to the content and length of direct broadcasts, he stated that the broadcast material should be factual and informal; it should be informative and interesting, but should not become mere entertainment. Broadcasts should be interesting, he pointed out, in order to enable the Bureau to hold an audience whenever there is vital or important weather information to broadcast. In general, a routine daily broadcast should not exceed five minutes in length.

In the discussion that followed, there were some inquiries about television programs. It was indicated that the Bureau is not in position at the present time to go into television, primarily because television makes greater demands upon our personnel than direct radio broadcasts; travel to and from television studios consumes considerable time. Mr. Carney stated that the Bureau had been successful in furnishing scratch maps and copies of weather summaries to some television studios; additional art work is done by the studio. One of our offices has been considering an experiment involving the showing of a weather map at the same time that the Weather Bureau broadcaster is making a direct radio broadcast from the Weather Bureau Office.

Turning to aviation broadcasts, Mr. Carney pointed out the necessity of avoiding broadcasting sequence of "spot" weather reports. In this connection, Mr. Downs stated that aviation broadcasts should indicate that the information is intended for light aircraft, so as not to impair commercial airline operations.

When radio stations demand exclusive broadcast rights, they should be tactfully advised. Mr. Carney stated, that direct radio broadcasts are a public service and that we cannot give exclusive rights to anyone.

Mr. Tannhill related that some Members of Congress had questioned the preparation of "scripts" by Weather Bureau offices. In order to avoid the impression that the material prepared at our offices constituted entertainment, the Central Office has decided to avoid using the term "script". He indicated that the material furnished for studio broadcast is expected to be factual and in the nature of a press release.

There was some discussion about the desirability of having the forecaster, rather than other personnel on the station, make the broadcasts.

Many Weather Bureau employees had requested authority to accept payment for putting on television broadcasts outside of office hours, Mr. Carney stated, but the Central Office considered such authority improper.

The length of broadcasts was discussed. The majority indicated that a one-minute broadcast did not permit giving more than state forecasts, which could be handled just as well by radio station personnel. Mr. Knarr recommended that the length of the broadcast be tailored to fit the weather; when the weather is good, the broadcast could be limited to about a minute and a half, and when bad, to about five minutes. Mr. Chapman inquired as to the necessity of preparing, and the use made by the Central Office of, written copies of broadcast bulletins. Mr. Tannehill indicated that this was necessary to serve as a check on the type of material being put out by the Weather Bureau. In addition, use was sometimes made of such copies as examples to new offices embarking upon direct radio broadcast programs.

(b) Radio Broadcast Training - Mr. J. Fidler

Mr. Fidler explained some of the plans of the Training Section in assisting Weather Bureau broadcasters. He stated that it was planned to provide each region with a type recorder. Someone well trained would carry the recorder around to the local offices and give local personnel a chance to hear themselves talk. The recording would be forwarded to the Central Office for comment. This would give the Central Office a file of broadcasters' voices. On the basis of their respective experiences at Fort Worth and Kansas City, both Mr. Knarr and Mr. Lloyd expressed themselves in favor of this program. Mr. Fidler stated that forecasters coming into the Central Office would have opportunity to improve their broadcast techniques. No attempt would be made to have the broadcaster sound like a professional announcer, but he would be shown how to convey the feeling of sincerity and confidence. When Mr. Fidler stated that he thought that radio broadcasts should be made only by the forecasters, Mr. Dunn expressed disagreement.

Mr. Fidler closed the discussion by presenting a sound movie of a television weather broadcast recently made at Washington.

XXV - Weather Summaries - Mr. J. C. Ballard

Mr. Ballard listed the dual purpose of weather summaries as transmitted on Service "C" as follows:

1. To give Weather Bureau offices not preparing maps the material needed for broadcasts.
2. To furnish data in broadcast form to busy offices and at the offices with inexperienced personnel.

He then discussed the content of the summaries. A Weather Summary should be so written, he said, that any station can use a portion or all of it, and by adding appropriate forecasts, have a bulletin for broadcast purposes. Stations making broadcasts have need for different types of information. As an example, some broadcasters emphasize pressure distribution, while others do not. To serve the needs of all insofar as possible, Mr. Ballard thought that the summaries should contain a synopsis of the pressure, wind, precipitation and temperature conditions, covering appropriate times and areas. These items should be summarized separately to enable our offices to extract only those items needed. In addition, he thought that a paragraph on unusual weather of general interest should be included.

Mr. Ballard then turned to the matter of time of issue of the summaries. Many city offices which do not prepare an afternoon map schedule afternoon broadcasts. Such offices need an afternoon summary, which is not prepared at the present time.

Mr. Ballard stated that at Atlanta the 0930 EST weather summary is usually the same as the 0430 summary because personnel there do not have time to prepare a new summary, and because, in general, no new weather occurs between 0430 and 0930. He felt, therefore, that the 0930 summary does not serve any useful purpose.

In order to increase the value of the present summaries, he made the following proposals:

1. That each District Forecast Center prepare a weather summary for the use of stations in its district. (He considered it impossible for one Forecast Center to write a summary that would serve the needs of all offices located over a large portion of the country; for example, from southern Florida to northern Maine).
2. That the summaries be given the same distribution as state forecasts. If this was impracticable over Service "C", the summary should be disseminated by telegraph or otherwise from the forecast centers to the stations.
3. That the 0930 summary be discontinued and that a 1630 summary be substituted, provided distribution could be made by teletype. If teletype distribution is not feasible, each forecast center should make local arrangements for distribution of the summaries.

Mr. Dunn thought that it would be better to have the summaries prepared on a circuit, rather than on a Forecast District basis.

Mr. Namias suggested that the weather summary be prepared on a national basis in the Analysis Center. Mr. Tannehill stated that a national summary had been tried about 13 or 14 years ago and had proved unsuccessful because of its extreme generality. He thought that preparation of the summary on a circuit basis would be helpful. Some of the forecasters indicated that it would be impossible for their centers to prepare weather summaries at certain times.

Mr. G. Stephens thought that since each forecast center had to prepare material for radio broadcasts, it would be easy to prepare a summary. Mr. Osmun favored preparation by the Analysis Center of a compilation of data which could be expanded by individual stations into a summary. The majority did not agree with this suggestion. Mr. Ballard said that listeners who heard broadcasts wanted to hear about unusual weather conditions. Mr. Osmun considered it unnecessary to broadcast such information since it appeared in the daily press. There was some talk about conducting a survey to ascertain what field stations wanted in a summary. Mr. Tenenbaum directed attention to the survey conducted for that purpose in the Kansas City forecast district several years ago.

The Committee, appointed to make specific recommendations for improving the program of summaries submitted the following report:

#### REPORT OF COMMITTEE ON WEATHER SUMMARIES

The purpose of the WS is to furnish material to stations needing it for radio broadcasts. Some offices are closed at night and need a bulletin for an early morning broadcast. Others have insufficient data, inexperienced personnel and not enough time to prepare good broadcast bulletins. To serve this purpose the WS must be timely and the content and style must be such that a receiving station can use all or any part of it without rewriting or editing, add appropriate forecast and local information and have a broadcast bulletin of the required length. Some of these points are discussed briefly below and followed by recommendations.

Time of Issue: It is believed that the time of greatest need for the WS are in the early morning and late afternoon - i.e., about 0600 and 1800 local time. Most city offices prepare a morning map and thus have some data for preparation of their near-noon broadcast bulletins. However, many of them do not make an afternoon map but do have a late afternoon or early evening broadcast and need an afternoon WS. On the other hand, many airport stations have broadcasts between ten and midnight, local time, and have little data for preparation of a bulletin - few have, for example, a maximum temperature chart. An afternoon summary would not contain much of the most appropriate data for such broadcasts. While issue on a local time basis would seem to best serve the needs of the users such a procedure has two disadvantages: (1) it is difficult to arrange communication schedules on a local time basis and (2) the WS must essentially be based on the 6-hourly synoptic data - surface map, maximum and minimum temperature charts - and relatively little additional data are readily available for writing a WS between maps. It therefore appears that the most practicable solution of the problem of making the summaries timely is to write a WS every six hours. This is a partial solution of the problem of providing for local needs due to differences in time between the two coasts and a practicable solution of the writer's problem of having data on which to base the WS. It would provide for timely coverage

of elements having a diurnal variation.

Content and Style: The content and style of the WS should be such, as stated above, that the user can use all or any part of the WS without rewriting or editing. The writer should bear in mind the fact that he is preparing a broadcast bulletin and if he would be unwilling to go on the air with it himself it is not fit to send out for someone else to use. The various elements of the WS must be rather complete in themselves, summarized separately and contain few if any cross references or the user cannot cut out parts of it without rewriting. The WS should contain general remarks about the weather over the country as a whole plus additional detail of interest to the people in the particular section of the country in which it is to be used. Emphasis should be placed on weather conditions of special news interest such as floods, cold waves, etc. affecting widespread national economic conditions. The need for sectional detail could be met better if the areas were smaller. The purpose of the WS could probably best be served if each Forecast Center prepared and transmitted a WS for use in its forecast district. However, this plan is rather impracticable because of lack of sufficient teletype time. Another basis for division of the country into areas is in accordance with the coverage of "C" Service Circuits. Such a division would facilitate transmission because no relays would be necessary. The areas covered by Circuits 30, 31, 32 and 33 could be served reasonably well by one WS each. The areas covered by Circuits 34 and 35 could not be handled as easily but at least the situation in the west would be no worse than it is now.

No forecasting is involved in writing the WS and it is not essential that it be prepared at Forecast Centers if there are other offices with the facilities and time to do it. It could be written in the WBAN Analysis Center, for example, one WS for each section of the country, and transmitted to key points for entry on appropriate circuits. Some details of local interest would probably be overlooked if the WS were prepared at one point, but, on the other hand, more pertinent comparative data could be gathered and filed at one point than is now practicable and better overall summaries should result.

Consideration of the merits of having the WS prepared at one point led the committee to a discussion of Denver as a possibility. Denver prepares the  $T_x T_x$ ,  $T_n T_n$  and RR bulletins and this is part of the current information needed to write the WS. A certain amount of time is lost by stations going through the synoptic reports to get maximum and minimum temperatures and rainfall data for newspaper bulletins. This is caused by the fact that the Denver bulletins are incomplete. If these bulletins were complete and were transmitted earlier they could be used by Forecast Centers as well as other stations as the source of this type of information rather than the synoptic reports. To make them complete it would be necessary to expand the list to include all stations and to provide for supplemental bulletins. A supplemental  $T_n T_n$  bulletin is needed to show lower minimum temperatures reported at 1330E than were reported at 0730E and a supplemental  $T_x T_x$  bulletin

is needed to show stations having a higher maximum temperature at 0130E than at 1930E. It would also be a help to have four RR bulletins daily. The committee feels that it would be definitely worthwhile to increase the Denver bulletin material as indicated but does not so recommend unless additional personnel are furnished Denver to do the job. If that is possible, then we feel that Denver would be the logical place to set up a unit to write summaries for the whole country. The main advantage in writing all the summaries at one place is that such a special unit could do a better job of collecting climatological data for reference and setting it up in usable form than is possible when the WS is written as an extra duty at a number of Forecast Centers. Writing the WS would then become a specialist's job, the summaries would be better and field stations would use them more. Our local office broadcasts would thus become more uniform in style and content and, on the average, better.

However, it appears unlikely that a special unit will be set up in the near future to write the WS so the following additional recommendations are offered by the committee for immediate consideration. Recommendation 3 is favored by two of the committee members at stations now preparing a WS and 3A by the third member. Mr. Osmun is not on a station preparing a WS and did not vote on this point.

Alternating preparation of the WS each six hours should result in better summaries because of the spirit of competition that will result and because a different person will write each summary this assuring freshness and difference of viewpoint. The alternate recommendation would provide for a continuation of the three present areas but would partially eliminate some of the bad features of the present arrangement. It would have the advantage of providing for a greater cross-section of ideas and presentation of facts - each station would have a chance to write about unusual weather in its section not previously mentioned by one of the other Forecast Centers. It would distribute the workload equitably and would probably be preferred by most Forecast Centers because of the smaller amount of work involved. It would have the disadvantage of requiring relays. In connection with these proposals it should be mentioned that Denver is more a part of the area served by Circuits 34 and 35 than the area served by Circuit 33. However, Denver now prepares the WS for the central section and their situation would be no worse than it is now. If some station other than a Forecast Center in the area covered by Circuit 33 can alternate on preparation of the WS for that area it would be well to have them do so.

It is recommended that:

- 1) A WS be prepared for each of the six areas covered by the six Service "C" Circuits four times a day;
- 2) One unit be established to prepare the summaries for all areas - preferably at Denver;
- 3) Until such a unit is established the WS for each section be prepared as follows:

<u>Time EST</u>	<u>Station</u>	<u>Circuit</u>
0425 and 1625	Boston	30
1025 and 2225	Washington	30
0425 and 1625	Atlanta	31
1025 and 2225	Miami	31
0425 and 1625	New Orleans	32
1025 and 2225	Kansas City	32
0425 and 1625	Denver	33
1025 and 2225	Chicago	33
0425 and 1625	Seattle	34
1025 and 2225	Billings	34
0425 and 1625	Los Angeles	35
1025 and 2225	San Francisco	35

(3 alternate) until such a unit is established the present three sections be retained, the WS for each section to be written and distributed as follows:

<u>Time EST</u>	<u>Station</u>	<u>Circuit</u>	<u>Relay to</u>
0425	Boston	30	31
1025	Washington	30	31
1625	Atlanta	31	30
2225	Miami	31	30
0425	Chicago	33	32
1025	Denver	33	32
1625	Kansas City	32	33
2225	New Orleans	32	33
0425	Billings	34	35
1025	Seattle	34	35
1625	San Francisco	35	34
2225	Los Angeles	35	34

The Committee:

J. C. Ballard (Chairman)  
A. W. Cook  
A. K. Showalter  
J. W. W. Osmun

XXVI - Progress in WRPC Program - Dr. W. C. Jacobs

Dr. Jacobs spoke briefly on the present status of the Weather Record processing Center program. He stated that one of the biggest gains to be obtained from the program was to relieve field stations from the load of summarizing data by professional personnel. The time saved could be used in research and development work, enabling our climatological section centers to perform professional service in their field.

He then discussed the possibility of having the WRPC's assist in the preparation of forecast aids. Forecasters will have to direct

pressure on the Central Office for such aids if they wanted to receive help in some of their forecast problems, he advised. Dr. Jacobs was asked about the kind of material now available for research purposes. He stated that some cards had been punched for a special CAA project for the period of 1934-1939. He also stated that there were available two other decks of punch-cards: a Marine deck, and a deck including data for all stations maintained by the Army or Navy. He indicated that the program was proceeding, and that the Weather Bureau was implementing it as rapidly as proper machines were made available.

XXVII - Filing Weather Maps - Mr. H. A. Downs

The matter of filing the continuous accumulation of weather maps in limited space so as not to interfere with the availability of such maps for study purposes was Mr. Downs' topic for discussion. He first enumerated the advantages in microfilming selected synoptic charts as follows; (1) permanence, (2) convenience, (3) space-saving, (4) economy, and (5) facilitation and stimulation of forecast study and research. Discussion ensued on whether microfilm maps would be satisfactory for forecast study and research. Mr. Vernon suggested that maps could be microfilmed by the WRPC's, then enlarged to letter size. The enlarged copies would be reproduced by ozalid or similar duplicating process, then distributed to forecast offices. When Mr. C. R. Elford asked about the clarity of the enlarged charts, Mr. Vernon replied that the copy was satisfactory for study purposes.

Mr. Charles Pierce described the Central Office-WNA Project for a permanent file of weather charts. The chief purpose of the project is to provide filing of only one copy of each of the various maps being made by the several offices in the area.

Mr. Namias indicated that microfilm maps were being used to advantage by the Extended Forecast Center.

Mr. Downs then queried the Conference as to what maps should be microfilmed. He listed the following as possibilities: (1) surface maps, 6-hourly and 3-hourly, (2) constant pressure charts - 850 mbs., 700 mbs., 500 mbs., 300 mbs., and 200 mbs., charts, (3) winds aloft charts, (4) adiabatic charts, (5) surface pressure-change charts.

Where the maps should be microfilmed was discussed at some length. Mr. Downs asked whether it would be sufficient to have two or three selected centers do the microfilming for the country as a whole. In the event that it was decided to microfilm maps, Mr. Downs thought it would be well to consider how much of the backlog of past maps should be microfilmed.

Discussion followed as to which maps should be permanently retained at the forecast centers and which destroyed. The Committee appointed to make specific proposals for filing, depositing, photographing and disposing of maps at Forecast

Centers submitted the following report:

Report of Committee on Filing Weather Maps

This committee recommends that selected synoptic charts be micro-filmed at at least two centers, namely, Washington, D. C., and San Francisco, California. Since a Central Office-Washington National Airport map microfilming committee is already functioning, it is recommended that the film enlargement-ozalid copy proposal of Mr. Edward M. Vernon be adopted and given a thorough trial at San Francisco.

The advantages of microfilming, such as permanence, convenience, space-saving and economy, are quite obvious, but the question not yet answered to the satisfaction of many forecasters and research workers is whether the microfilming system alone is a convenient enough method for reference and study purposes. Until the committee can be sure that forecast study and research will be facilitated and stimulated, it is suggested that the enlargement copy idea be thoroughly explored. Mr. Vernon's detailed proposal, dated May 11, 1948, is as follows:

"During the past year and a half, use of the northern hemisphere historical maps for research purposes has convinced me that our current surface and upper air maps could be easily filed and conveniently referred to for study purposes if reduced photographically to a sheet the size of the northern hemisphere historical maps, or perhaps a little smaller. This would greatly facilitate their use for forecast studies and at the same time alleviate the map storage and filing problem.

"Our map 1509 could be reduced to 8 x 10-1/2 and still be twice the scale of the northern hemisphere historical maps which I have found useful in forecast studies.

"Last year I considered making a proposal along this line, but at that time I felt that the undertaking would require an expensive enlarging and reducing camera and a lot of space in which to use it. This would have meant an initial expenditure of some two to three thousand dollars. Also, there would have been a rather high continuing expense for film, as this type of camera would use film of the same size as the final print desired. I gave up proposing such a plan because of the expense it would have involved.

"The basic idea was revived recently when I saw some 8 x 10-1/2 enlargements of maps which had been photographed on 35 mm film. This suggested a new proposition which would involve the following steps:

1. Use the WRPC microfilm (35 mm) camera to photograph maps. Do this at hours when WRPC is inoperative in order not to interfere with their work.
2. Enlarge in darkroom (FAWS, Oakland), using a very thin projection paper such as D 592, which can be

used in making ozalid or blue print copies.

3. Make ozalid copies from this enlargement as an economical means of providing copies for other offices.

"Assuming that we would wish to file four surface maps, four pibal, two 700 mb, two 500 mb and two raob maps each day, the steps mentioned above would involve the following expenditure of time and money:

- Step 1. (a) About one man-day per month to photograph maps.  
(b) \$4.00 per month for film and factory development thereof.
- Step 2. (a) Initial expense for enlarger (say about \$150.00)  
(b) About one man-day per month to enlarge and dry prints.  
(c) \$25.00 per month for projection paper (about 5¢ per copy).  
(d) Chemicals (cost not estimated).
- Step 3. (a) About one man-day per month to run three sets of copies. (More than one man-day if more than three sets were required).  
(b) \$3.50 per set for ozalid paper.

"Exclusive of chemicals and man-hours, this would call for the following continuing expense for making an original and three ozalid copies:

For film.....	\$6.00
For projection paper.....	25.00
For ozalid paper.....	<u>10.50</u>
Total per month.....	\$41.50

"This should be worth many times the cost of the undertaking and should pay big dividends for years to come in the form of more forecast research which it would encourage and facilitate. More forecast research means better forecasts".

On July 16, 1948, Mr. Vernon made this additional comment:

"The plan calls for running only three ozalid copies. However, if it were adopted, we would no doubt have many "Urgent" requests for copies for other offices so that the overall cost would no doubt be increased slightly. However, the cost for material would not be over \$3.50 per set per month for furnishing sets for additional stations. By "set" I refer to the complete monthly file of all charts".

Forecast centers and station in the north-central and central portions of the country may not find either Washington or San

Francisco charts adequate. Therefore, if enlargement copies prove satisfactory, the establishment of a third center for similar work at Kansas City or Chicago may be necessary.

Research forecasters and others may occasionally need extra copies of synoptic charts. Therefore, it would seem advisable that the projection paper enlargement of each chart be furnished each forecast center equipped to make extra ozalid or Bruning copies.

WRPC officials agree that the microfilming of current maps is entirely feasible, but filming the backlog of maps will be impracticable for at least a few years.

A drawer filing system will be adequate for 8 x 10-1/2 enlargement copies.

When the 1939-1945 gap in the northern hemisphere maps is filled there will be less need for stations to store back maps. It was the consensus of the conference that the latest ten years of maps would suffice for forecast study purposes. However, no maps should be discarded unless data that may be needed by the research forecasters and others are known to be duplicated by the Washington or San Francisco maps. Central Office permission to destroy maps is, of course, necessary.

A list of charts filmed and retained at the Central Office and the Washington National Airport should be made a part of this report for the guidance of other centers in making recommendation for retaining and destroying maps.

Harry A. Downs, Chairman

Edward M. Vernon

J. R. Lloyd

John A. Copeland

XXVIII - Proposal for Rationalization of Synoptic Network;

Mr. L. P. Harrison.

Mr. Harrison presented a topic which had grown out of a Central Office discussion dealing with the increasing growth or possible decrease of the synoptic network of reporting stations. He stated that a Central Office Committee was exploring the matter, and that the Committee proposed to develop objective criteria for determining the distribution of stations in the synoptic network for forecast purposes. He first outlined the growth of the number of stations in the synoptic reporting network as follows:

Stations rendering Forms 1001, or equivalent, numbered as follows in the given years:

Year - 1880	Number of Stations - 165
" - 1890	" 147
" - 1900	" 174
" - 1910	" 189
" - 1920	" 205
" - 1930	" 204

With the opening of airport and airway stations in 1928 there has been a phenomenal growth in the size of the networks. In 1929 there were 195 city offices; in 1947 there were 384 stations rendering 3 and 6-hourly observations. In 1929 there were 32 airport or airway stations. In 1947 there were 323 airport or airway stations making observations with Weather Bureau personnel or under Bureau supervision, plus 236 with CAA personnel, all rendering hourly reports.

In 1929 there were 47 stations making pilot balloon reports. In 1947 there were 170. In 1929 there were 5 free-air sounding (kite) stations. In 1948 there were 118 radiosonde stations in North America (Weather Bureau, Air Force, Navy). Of this number, 66 were also rawin stations.

The question had arisen as to the density of networks at which the point of diminishing returns in regard to forecast accuracy would be reached. Mr. Harrison indicated that the Extended Forecast Section and the WBAN Analysis Center had furnished opinions of station spacing judged necessary for the network of these sections on geographic as well as topographic bases. He posed the problem as follows: To determine the density of stations in the network and the particular distribution they should have in order to enable forecasters to produce forecasts having prescribed probabilities of realization of weather elements within given class intervals of the possible range. He outlined a list of variables involved in the solution of this problem on an objective basis. Then he gave an example of a possible mathematical method attacking the problem in the case of forecasting the velocity of movement of an isobar. He indicated that the error in forecasting the velocity of movement of the isobar could be expressed in the distance between stations and other variables. He indicated that frequencies of these variables in certain combinations would have to be determined observationally. Mr. Harrison stated that a report would be issued by the Central Office Committee dealing with this problem.

#### XXIX - Forecasting and Regionalization - Dr. F. W. Reichelderfer.

Dr. Reichelderfer had previously asked the Conference to present questions to him which would be of unusual interest or importance to the forecasters in their field operations. The topic which appeared most important to those who submitted questions concerned the respective spheres of responsibility of the Supervising District Forecaster and the Regional Director. The essence of the Chief's reply was that team work is the keystone of successful Weather Bureau operations. The following remarks are from his talk:

The responsibilities of the Supervising District Forecaster under regionalization involves basic questions in administration, and like forecasting, deals more or less in probabilities and generalities. The forecaster knows when he makes a mistake - he knows it today or tomorrow. The administrator may not learn his mistake until a year or two later when it is too late to do anything about it. These invisible things, the intangible consequences, are nevertheless realities and bear directly on the success or failure of the organization. Administration is not the primary objective of any organization. Administration is the means and it should never take the place of the objective. While rules and regulations are necessary in any organization, they should be the instruments of the organization; the organization should not become a slave to the rules. Rules cannot be avoided. Some are hard and fast, but usually rules can be applied so as not to obstruct good administration and good operation.

The organization and form of administration of any bureau or department should be tailored to fit what you are trying to do. In general, the military form of organization is necessary to win a war. Military organization and production lines in business require a certain amount of regimentation. One man puts a bolt in a certain place and in a certain way; and that is all he does. But in the research department of that same corporation, you will find an entirely different form of organization. Individual judgment and pursuit of individual "hobbies" are emphasized. Research and results are often obtained that way, by trial and error. Many important research developments have been by-products of something else. Something happened that was not expected and it led to a discovery very much greater in importance.

The Weather Bureau is unique in many of its features. I do not know of any other organization that combines several hundred field stations with their requirements of routine services, an almost endless amount of data, and an urge to research. In every forecast center, in every large city office, we like to combine a certain amount of research, a certain number of new developments, with the routine things we have to do. We thus combine the research laboratory with the "production line"; in many cases, the Weather Bureau has to combine its activities in this manner when only one man is on watch at a time. We cannot have regimentation and sharp definition of duties. The professional members of the staff work together as a team because they understand each other. Usually, they are the production line, but sometimes they are the research laboratory. In many cities the local forecaster, or the briefer, is called upon with little or no professional training to pass along meteorological information on storm warnings, flight advisories, etc., involving professional judgment. In the Weather Bureau we have a combination of research, professional work and routine.

What kind of organization has been set up to handle this job? We have tried to tailor it to fit. The ideal way to handle pure

administration might be to have a central office large enough to know everything that is needed in the field and to handle all administration. That would make it easy to have coordination.

The anticipated growth of the Weather Bureau led us to establish regions and appoint regional directors in 1941. The job was getting too big for the staff that could be maintained in the Central Office.

Did we give the Regional Directors so-called "line authority"? Are they area commanders? At every conference, I have emphasized that they are not independent regional authorities, but are Central Office representatives in certain lines of work. They have specific responsibilities for certain Weather Bureau activities within their regions. In the phase known as "house-keeping" - that is, fiscal, clerical and administrative services, they have practically direct line authority. They are the direct representatives of the Central Office and Chief of Bureau. In

effect, they are Assistant Chiefs of the Bureau for certain phases of our activities in the field. In the Central Office for example, we have an Assistant Chief for Operations. He is a specialist in operations. We have an Assistant Chief for Administration. He is a specialist in administration. Neither of these has line authority over all phases of the Bureau. In effect, we have Assistant Chiefs of Bureau for geographical districts in the field and we call them Regional Directors. The Assistant Chief for Administration does not have any great difficulty in avoiding interference with the Assistant Chief for Operations. They do not have geographical boundaries, but they do have functional boundaries. The Regional Director, although he has a geographical district for which he is responsible, has functional boundaries also, and a different degree of responsibility in different functions. In housekeeping functions, he has direct line authority.

On the other hand, where we need to preserve research and scientific aspects, the best leadership comes from a technical man, ideally the best qualified technical man in that specialty. We cannot staff regional offices with the best qualified men in each special branch of the Bureau's work. There just are not enough top experts in each branch, so we try to staff the Central Office functional divisions with the best qualified men in the U. S. in their fields and they are the technical leaders in their respective fields for field personnel and field officials. Our form of organization works elsewhere and it should work best here.

Some have asked why we have not defined our duties in the field more sharply. It is not yet time to define them rigidly. Perhaps it never will be. The forecasters should work with the Regional Directors, each as a member of a team. If there are points where you think the Regional Director is getting into your field, talk it over with him. If necessary, we will have

to back up the Regional Director, but that does not detract at all from the responsibility and importance of the Supervising Forecaster in his sphere.

This type of organization is not necessarily confusing and "disorganized". On most of the things you do, there will be no question. Almost everyone has been cooperative and we have gotten along without any serious difficulties. I would not want a Regional Director to have any more authority than the form of organization I referred to justifies; neither should we issue a circular which would define limits arbitrarily or tell a District Forecaster that he has executive authority in some point which borders on administration; nor would I want to tell a Regional Director he has executive authority in matters which a District Forecaster could perform better.

Regarding the proper channels of action, if a District Forecaster or Official in Charge wants to write about a purely scientific or professional matter, he can write directly to the Central Office. It would be better to send the letter through the Regional Director unless time is pressing. In any event, unless there is some very good reason why not, he should send a copy to the Regional Director for information. As we learn to work better under this dual relationship, I would like to see more direct contact on professional matters between the Official in Charge in the field, the District Forecaster and the Central Office, with information copies to the Regional Office. If he wants to, the Regional Director can also write a separate letter, and if not he can file it. However, if the Regional Director wants you to write everything through him, there is no need to make an issue of it. Let him do it his way and later on we will try to convince him the other way is better if it saves time and clerical work and loses little or nothing in regional advice. You should be professional leaders in the field of forecasting with respect to field officials in your district. We certainly do not want regionalization to divide us into eight regional Weather Bureaus.

XXX - Administration Problems - Mr. W. F. McDonald.

Mr. McDonald discussed several administration problems of interest to the Conference. His main topic was the Bureau's budget. He elaborated upon the procedures involved in securing appropriations and pointed out some of the limitations which confront the Bureau as a governmental agency. Then he described the allotment structure and explained its operation. In response to questions, he pointed out that the Bureau must keep its expenditures within the limits of its appropriations. He also explained how it was difficult to estimate expenditures so there would still be some margin for unanticipated items.

XXXI - Forecasting and the Future - Dr. F. W. Reichelderfer.

Dr. Reichelderfer closed the Conference with an optimistic note. After a brief discussion of the Bureau's trend toward smaller forecast areas, he indicated that forecasters could look forward to higher grade allocations within the next several years. Mr. Tenenbaum and Mr. Tannehill also made a few remarks, thanking the forecasters present for the fine spirit of cooperativeness in the conduct of the Conference.

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