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A Brief History of the  
Extended Forecast Division

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This is an informal unreviewed manuscript  
primarily intended for the exchange of  
information among NMC staff members.

In tracing the history of the Extended Forecast Division, we need go back no further than the "dust bowl" years of the 1930's. As a direct result of this near disaster to American agriculture, Congress passed the Bankhead-Jones Act of 1935, which allocated special funds to the Department of Agriculture "to conduct research into laws and principles underlying basic problems of agriculture in its broadest aspects."

Dr. Charles F. Sarle, then Principal Economist with the Bureau of Agricultural Economics of the Department of Agriculture, realized that to achieve this goal a fresh attack had to be made on the problem of long-range weather forecasting; because at that time the only forecasts beyond 1 or 2 days in advance were in the form of weekly outlooks, prepared with too little time to spare by the Weather Bureau forecasters at the Central Office in Washington, and consisting largely of climatological probabilities.

Under Dr. Sarle's leadership, and with the aid of the Bankhead-Jones funds, combined government and university research groups were organized for the purpose of getting underway a broad research program in basic meteorological problems. He had no trouble obtaining the enthusiastic support of Professor Carl-Gustaf Rossby, then head of the Department of Meteorology at the Massachusetts Institute of Technology.

In 1935, a committee consisting of Dr. Sarle, Professor Rossby and a few others planned a multi-pronged attack; including a review and evaluation of previous efforts in long-range weather forecasting, the

organization and analysis of global data sources and the preparation of experimental extended-range forecasts. As pointed out by Professor Rossby in 1938: "The ultimate objective of these investigations is to develop a sound physical model of the general circulation of the atmosphere, in the hope that an improved understanding of this process eventually may furnish valuable clues as to how the time range of our present daily weather forecasts may be extended and their quality improved."

After lengthy preliminary trials, a forecasting experiment was set up at MIT in November 1938, under the direct supervision of Professor Hurd C. Willett, with Jerome Namias, then an instructor at MIT, as his principal research and forecasting associate. Thus were born the "5-day" forecasts of mean Northern Hemisphere circulation and surface temperature and precipitation, with daily prognostic charts out to 7 days; prepared at first once and later twice and then three times each week.

Other aspects of the project were carried out at Harvard College, New York University, the Weather Bureau, and at the Bureau of Agricultural Economics, where in 1937-38 this writer had the opportunity to work with Dr. Sarle, Larry F. Page and Roger A. Allen on part of the studies of the prior "state of the art."

From its earliest beginning the project at MIT was under the inspirational guidance of Professor Rossby, and so it is not surprising that it employed a physical-synoptic approach, with emphasis on Rossby's own ideas on the motion and spacing of the long waves in the westerlies, based

on his theories of the conservation of absolute vorticity and potential temperature. This emphasis on fluid dynamics and thermodynamics was responsible not only for the direct studies of the behavior of long waves and their energy exchanges with the environment, carried out at MIT and later at the Weather Bureau by Jerome Namias, Dr. Harry Wexler, Jay S. Winston and the writer; but also was reflected in the primarily statistical studies of long-range lag correlations by Namias, of teleconnections linking the centers of action by Donald E. Martin and James F. O'Connor, and of orthogonal functions by Dr. Donald L. Gilman.

The development of new climatological normals, frequency distributions (or class limits) of mean temperature and precipitation, and relations between the general circulation and weather by Namias, Kenneth Smith and Dr. William H. Klein were all linked to the primary goal of forecasting the anomalous behavior of the centers of action.

Because of their statistical backgrounds, Dr. Sarle and Larry Page insisted from the start on a strong statistical base for the experimental forecasts, and this resulted in the most stringent verification system ever imposed on any forecast group, as well as to the intensive organization of observational data in special probabilistic forms needed in evaluation and in further research. Roger Allen and Glenn W. Brier played important roles in this statistical effort.

Returning to a chronological history of the Division, it became apparent that the experimental 5-day forecasts displayed considerable skill,

and on July 1, 1940, a cooperative agreement was set up among MIT, the Agricultural Marketing Service, USDA, and the Weather Bureau, whereby the forecasts prepared at MIT were transmitted twice a week to Weather Bureau field forecast offices for dissemination to the public. On May 1, 1941, much of the personnel was transferred to the Central Office of the Weather Bureau in Washington, D. C., where the unit became the Extended Forecast (and Research) Section attached to the Office of the Chief of Bureau, Dr. Francis W. Reichelderfer. At the same time Dr. Sarle was named Executive Assistant for Scientific Services, with the budding Extended Forecast Section placed under his jurisdiction. Jerome Namiás was named its Chief on December 19, 1941, and retained that position until his retirement in 1972. Able forecasting assistants have come and gone, but perhaps the better know of these (in order of joining the Section) are Kenneth Smith, James F. Andrews, Robert R. Dickson, William H. Klein, and James F. O'Connor. Also, it is important to note that just prior to and during World War II the Army and Navy assisted greatly with funds and collaborators; for the Section was called upon for special extended forecasts in the areas of military activity.

The portion of the project left behind at MIT prospered under the guidance of Dr. Willett, but emphasis there shifted to the analysis and statistical studies of historical global surface and upper air data in the form of 5-day, monthly and seasonal circulation patterns; and to the

preparation of experimental seasonal forecasts. Indeed, studies of the possibility of preparing monthly and seasonal forecasts had started long before the move to Washington; so it is not surprising that in addition to Dr. Willett's efforts, Jerome Namias continued this work independently at the Weather Bureau, and started the preparation of experimental monthly forecasts covering the Northern Hemisphere in March 1942, and seasonal forecasts in the winter of 1958-59. The monthly forecasts (prepared twice a month) have been officially distributed to the public through the field forecast offices, and by subscriptions to the well-known Monthly Weather Resume and Outlook (later Average Monthly Weather Outlook) since 1947. Routine public release of seasonal temperature outlooks began with the winter of 1973-74 after 14 years of experimental preparation and a favorable recommendation by a NAS/NRC Panel on Long Range Forecasting.

In 1963, monthly forecast experiments using numerical "mean motion" models, based on surface-to-air energy exchanges, were initiated by Namias and Dr. Julian Adem, on loan from the University of Mexico. These experiments were among the first attempts to prepare long-range forecasts and to study climate changes by numerical methods. This approach did not produce skillful forecasts and was discontinued at NMC, but work continues on it at the Institute of Geophysics in Mexico City under Dr. Adem.

In 1946, Dr. Harry Wexler became Chief of the Scientific Services Division (which replaced the Office of Scientific Services, and later became the Office of Meteorological Research) on his return from serving as

instructor in meteorology with the armed forces during World War II. The Extended Forecast Section prospered under his understanding protection for the following 12 years.

In 1955 the Section moved from its long-held stand in the old Central Office building at 24th and M Streets, N. W., Washington, to the Census Bureau complex in Suitland, Maryland. On March 9, 1958, an important organization change took place as well; when the Section was transferred from the Office of Meteorological Research to become one of the three major units (along with the Joint Numerical Weather Prediction Unit and the National Weather Analysis Center) of the newly formed National Meteorological Center under the direction of Dr. George P. Cressman. Both of these changes were designed to reflect the growing service responsibilities of the Section, and to take advantage of the increasing reliance on high-speed electronic computers in data-processing, analysis and forecasting. The former Joint Numerical Weather Prediction Unit, under the able leadership of Dr. George Cressman (now Director, Weather Service), and later under Dr. Frederick Shuman (the present Director of NMC) was making rapid strides in developing operational short-range numerical weather predictions.

In the 6 years following the organizational switch to NMC, the Extended Forecast Section underwent concomitant structural changes; from Section to Branch to Division (completed in July 1964). However, the rapid

development of numerical techniques, which led to these organizational changes, was the prelude to the termination of the existence of the Division as an independent unit. It had become increasingly evident that extended forecasts out to a week in advance must eventually be based on a logical extension in time of the day-to-day forecasts by "primitive equation" (PE) numerical models, which are more sophisticated quantitative expressions of the fluid mechanics and thermodynamics which had been the foundation of the earlier extended forecasting techniques. This transition was accelerated by the requirement of the field forecast offices for extended forecasts every day, rather than three times a week; and in February 1970, the change was made from emphasis on mean 5-day forecasts to detailed predictions over the U.S. of daily maximum and minimum temperatures and precipitation for days 3, 4, and 5 after forecast day. Numerical guidance was in the form of 6-layer PE predictions to 84 hours with barotropic extension to 144 hours. This basic change in methodology followed a massive effort of planning and experimentation on the part of several researchers and forecasters in NMC, with Namias, O'Connor, Gilman, and Robert H. Gelhard bearing the major responsibility.

This transition was soon followed by the end of the Extended Forecast Division as a separate unit in October 1972, but its great stockpile of experience lives on in separate units of NMC: The preparation of extended forecasts under O'Connor's direction was carried on in the Extended Forecast Branch of the Analysis and Forecast Division, and a separate Long-Range Prediction Group, headed by Dr. Gilman, prepares



The monthly and seasonal forecasts, and plays an important role in current efforts to monitor the World's climate.

The Extended Forecast Branch was merged into the Basic Weather Branch of the Forecast Division in May 1974 and O'Connor became Deputy Chief, Forecast Division, at that time. Manual preparation of daily maximum and minimum temperature forecasts, precipitation probabilities and surface pressure and frontal progs continues, using the primitive equation and barotropic model forecasts as guidance out to 144 hours.

Once a week, experimental forecasts of 5-day mean temperature and precipitation for days 6-10 are also being prepared using 3-Level global P.E. forecasts as guidance. The experimental results look promising for future operational implementation.

Editors Note: Next to Jerome Namias, now a researcher with the Scripps Institution of Oceanography, Phil Clapp enjoyed the longest career in extended forecasting, starting with his association with Dr. Sarle in 1937-38 and ending in 1972, when he retired as Chief of the Research Branch. He continues to contribute to a long list of research reports and to the advancement of the science of meteorology.