Operation Hardtack, Phase I. During the operation, daily maps of the trajectories of the debris from each of the shots were prepared, togeth with forecasts of future movement, and transmitted to the AEC. Consult was provided where necessary. Other interests, such as the National As iation of Photographic Manufacturers were notified when significant con ation was expected. Reports of unusual activity received during this p were related to possible trajectories. The Western Pacific upper air s program data were investigated in terms of the debris trajectories.

Finished maps of the trajectories have been prepared, together wit the upper-air wind and temperature data associated with each burst. Ma of the observed air concentration near the ground over the U. S. as mea by the Public Health Service Radiation Surveillance Network, have been prepared, and will be incorporated with other monitoring data, such as gummed-film network, when they become available.

Interpretation of preliminary W-185 data from Hardtack yielded sig new information concerning the movement of trospospheric and stratosphe debris from Pacific tests.

Operation Hardtack, Phase II

As in other test series, daily maps of the trajectories of the deb were prepared and consultation service was provided to the AEC and othe Daily estimates of areas of fallout were prepared and relayed to interes groups as appropriate. Special studies were made in certain cases of reported high fallout.

Stratospheric Analysis and Evaluation. Evaluatin of the results of Project Ashcan was made, together with a meteorological interpretation. A report was presented at the DBM conference in Minneapolis and a paper was submitted to the AEC. This paper was also transmitted to the UN Scientific Committee and has been submitted for publication in the Journal of Geophysical Research. Stratospheric data collected by the HASP program was evaluated.

To better understand the circulation of the stratosphere and stratospheric-tropospheric exchange processes, a study of ozone in the upper-atmosphere was initiated with partial support from the AEC. To utilize this natural atmospheric tracer, knowledge of the vertical and horizontal distribution of ozone is needed. A project to evaluate and compare three types of recently developed ozonesondes was carried out at Lowry Air Force Base, Denver, from April 13 to May 1. The evaluation tests consisted of 11 high-altitude balloon flights. Each balloon carried a train of instruments to heights averaging over 100,000 feet.

Preliminary work connected with the establishment of a new project on stratospheric weather analysis, partially supported by AEC funds, has been completed. The project now occupies ample quarters well-furnished for the job ahead. Three trained analysts and five chartmen have been hired to staff the project.

Drafting and printing of a map base suitable for the analysis and subsequent reproduction of the 100-mb and 50-mb charts was the first task completed. For use in regions of sparse observations and at stations having a short radiosonde flight, scattergrams were prepared for the month of July to extrapolate data from the 100-mb to the 50-mb level. Continental Chinese data have been extracted from Japanese teletype and radio-intercept material

for the months of July, August, September, and October 1957. Daily 100-mb and 50-mb charts for the months of July, 1957 to November, 1957, inclusive, have been plotted with approximately 80% of all the data which eventually will become available. Graphical aids such as solar radiation correction curves, anticyclonic instability shear criteria, and geostrophic wind scales have been prepared to aid in the analysis of charts.

Preliminary analyses for portions of 100-mb charts for the months of July, August, and September 1957 have been sketched. A study is being made to determine whether the thickness technique can be utilized in the analysis of 50-mb charts. Two short series of 100-mb charts over the Eurasian area for several days in July, 1957 and January, 1958 were prepared upon special request. Another short series of four hemispheric 100-mb charts for the period of November 16-19th, 1957, inclusive, were plotted and analyzed for use in connection with an experiment in numerical computer analysis of 100-mb charts, currently being undertaken in cooperation with the JNWP Unit at Suitland.

The Navy Weather Research Facility supported a pilot study in coordination with this Project, Pennsylvania State University, and NWRC at Asheville to develop regression equations suitable for the extrapolation of data to the 100-, 50-, and 30-mb levels. The results of this pilot project were recently evaluated, and the full-scale development of suitable regression equations is now in process at Asheville. The equations will eliminate several months of work in developing scattergrams for the remaining months of the year.

A series of 10-mb charts analyzed 3-times monthly for the first year of the IGY is nearing completion. To make analysis of the 10-mb charts possible, special procedures, including extrapolation of data, plotting of auxiliary data, application of solar radiation correctione and methods of analysis, were developed. Solar elevation charts and a complete listing of radiosonde types used at United States and Canadia stations during the IGY period were prepared by months and by observat time to aid in determining solar radiation corrections to temperature a height.

Logistic and Network Design Support. Administrative support and suppl assistance was provided for the maintenance of the AEC gummed-film and ion-exchange networks and for the AEC-NRL 80th meridian sampling netwc Arrangements were made for Weather Bureau stations to make ion-exchang collections. The Weather Bureau-AEC carbon-14 program for world-wide air and sea water sampling at ocean locations was inaugurated. Arrang ments were made to make quarterly collections aboard Coast Guard Weath Patrols, Ice Patrols, supply ships to arctic and antarctic bases and aboard U. S. merchant vessles in the Pacific, South Atlantic and India Oceans.

Evaluation and interpretation. An evaluation of the AEC ground-level sampling program was made and a report submitted. Many research contr and proposals relating to the meteorological aspects of fallout were reviewed and recommendations made.

Significant contributions were made to the work of the NAS Commit on the Biological Effects of Atomic Radiation. A meeting of the Meteo

Panel of this committee considered the problem of stratospher
and participation in the discussions was most fruitful.

Assistance was given to the Joint Committee on Atomic En
for the May fallout hearings and a major presentation of test
by the Weather Bureau. In addition, there was participation
discussions at these hearings and preparation of reports and

There has been a continuing examination and evaluation o
body of scientific literature on fallout. The question of po
of nuclear detonations on the weather has been examined perio

Miscellaneous programs. The observations of Sr-90 in cloud d
and precipitation were correlated with meteorological observations
been tentatively concluded that within the limits of the impe
techniques employed, the Sr-90 concentration per volume of wa
does not differ significantly from that in falling precipitat
report on the "Investigation of Radioactivity of Rain Water f
Storms" supported by AEC funds is appended.

Funds Breakdown (Estimated for FY 1959)

Personal services	64,000
Other objects	16,000
Overhead	8,000
	88,000