at a coastal station. The method can not be used successfully in regions with high winds or where harbors are icebound for a considerable portion of the year. However, meteorologists, with the cooperation of port or naval authorities might obtain by the captive-balloon method here described, extremely valuable data concerning the temperature and humidity of the upper air in tropic and tradewind regions. Only very meager aerological observations are now available from this vast area.

The writer is greatly indebted to Dr. W. Peppler, director Drachenstation, Friedrichshafen, for opportunity to take part in the daily program of balloon ascents over Lake Constance and for many details of the method given in this article.

No detailed description of the technique and apparatus employed in taking aerological observations with a captive balloon, moored to a moving ship, has yet been published.

Brief notices regarding the method have appeared in Beiträge zur Physik der freien Atmos., Band I, page 1, et seq., and in the MONTHLY WEATHER REVIEW for September, 1908, volume 36, page 284, by E. Kleinschmidt (translation by C. F. Talman). Doctor Kleinschmidt has given a fuller account in the Deutsches Met. Jahrbuch, 1908. Capt. G. Hugo presented a report on the method to the Premier Congrès International de la Sécurité aérienne in Paris, 1930, which will appear in the Proceedings of the Congress.

METEOROLOGY AND SEASONAL WEATHER FORECASTING: ANNUAL PROGRESS REPORT OF THE SCRIPPS INSTITUTION OF OCEANOGRAPHY

By GEO. F. MCEWEN, Physical Oceanographer, and A. F. GORTON, Associate in Meteorology

[La Jolla, Calif., January 1931]

Our efforts during the past year were devoted to a further study of the relation between seasonal rainfall in California and quarterly values of temperatures and pressures in various parts of the world, and to an analysis of cycles in rainfall and run-off by statistical methods, in particular, Streiff's method of successive integration. Correlation coefficients higher than 60 per cent have been established for several indices covering the period 1916–1930, these including La Jolla water temperatures during the upwelling period and July to September, also, Tokyo air temperatures versus Hetch-Hetchy district rainfall and Huntington Lake inflow. The Tokyo index prior to 1916, shows a lower degree of correlation. Other indices, such as August to October rainfall in southern Alaska (with respect to following winter's rain in California) proved disappointing.

Air temperatures, in general, are poor indicators of California precipitation. Groissmayr's correlation between summer conditions in India and following winter temperature departures in central Canada was found to be without much bearing on rainfall in this state, neither was there much connection between winter temperatures in Canada and California. There is some evidence that Scripps Pier temperatures during the upwelling period indicate the trend of temperature departures in southern California during the fall.

A composite index has been worked out which is found to fit rainfall departures in southern California much more exactly than the original McEwen index. This takes into account the rapidity with which the temperature approaches a maximum and the time of occurrence of the maximum temperature, as well as the actual magnitude of the latter. The same procedure applied to the Pacific Grove temperatures gives a good indication of rainfall departures in the north coast region.

As to cycles, the important ones are in order of length, the secular cycle of 50 to 60 years, the Brückner cycle of 22 to 26 years, the double-Wolf cycle of 5 to 6 years, and the Clough cycle of 2 to 3 years. The 5 to 6 year cycle seems to be the most important for forecasting purposes. The Brückner cycle is prominent in the rainfall of Southern California and is found in records of lake levels (Great Salt Lake and the Great Lakes). The next maximum in the 5 to 6 year cycle will come probably in 1933, and a rise in the Brückner cycle now under way, will bring rainfall to a maximum around 1938–40.

The annual forecast was published October 15, 1929, in various newspapers of the State and was distributed through the Associated Press to newspapers outside the State; the same forecast appeared in the Bulletin of the American Meteorological Society and the California Citrograph. A paper prepared by Doctor Gorton on the results of the last two years' work was published in the Electrical West (September, 1930) and much the same material was presented at a meeting of the American Institute of Electrical Engineers in Portland, Oreg., September 5 (published in Journal, A. I. E. E. December, 1930). Doctor McEwen prepared a paper entitled "Our Rainfall: How is it Formed and What Becomes of It?" (published in the Scientific Monthly, November, 1930).

During the coming year we plan to devote our time to the following studies:

a. A further analysis of factors affecting seasonal storm tracks.

b. Surface temperatures off the California coast by 1° squares between latitude 30° and 40°, for period 1900–1930. Data from United States Weather Bureau.

c. Gulf Stream temperatures and their relation to seasonal rainfall in California. (Data by Brooks.)

d. Further study of cycles in rainfall, run-off, sun spots, tree rings, etc.