TYPHOONS ORIGINATING IN THE CHINA SEA

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INTRODUCTION

There are at present two great, outstanding difficulties in the study of typhoon origins, remoteness of origin in regions very poorly supplied with ships and land weather stations, and the lack of adequate upper air data. Most typhoons affecting the Philippines start far to the east of us, in the vast area covered by the Caroline Islands, or in the territory between the Carolines and the Philippines, regions in fact where weather stations are very few and far between and ship reports meagre and desultory. It is disappointing also from a scientific standpoint that no typhoons and but very few depressions have ever been definitely known to arise in the Philippine Islands themselves. Hence the rather close network of stations we possess is of comparatively little use in the study of origins. Only one class of typhoons at present offers some encouragement in this regard, those originating in the China Sea. True, these storms are usually of rather small dimensions, but we are convinced that this is due, not to any essential difference between them and other typhoons, but to the fact that they very soon run into land and are consequently promptly dissipated. It is also fortunate that the China Sea is traversed by many more ships than the vast "No Man's Land" to the east of our Islands. Hence a modest study of these typhoons has been possible.

Offhand we may enumerate the following as possible causes or occasions for typhoon formation: (*a*) frontal phenomena between air streams of different temperatures at the surface; (*b*) pressure gradient changes on either or both sides of a front; (*c*) topographical influence; (*d*) convergence of air streams; (*e*) relative humidity differences at the surface; (*f*) upper air changes or differences of various types; (*g*) convection in a single, homogeneous air mass. It will be the endeavor of the present paper to give data suitable to shed some light on the feasibility of some of these possible causes.

Three typhoons are presented in quite some detail with many weather maps; four additional are more briefly discussed and a single map given to illustrate the general air mass situation during the storm. There then follows a general table of China Sea typhoons with information concerning the air masses involved and the places of origin. The list extends back to 1912, i. e., as far as our weather maps permit. The China Sea *depressions* are not here discussed, though they are quite an interesting phenomenon in themselves. However, they may be distributed into two main types: (*a*) those which resemble the typhoon and are apparently very similar in origin and formation to the typhoon, but which do not have either the wind intensity or barometric depth enough to dignify them with the latter name; (*b*) stationary depressions, often quite deep, which form around the Gulf of Tongking.

Perfect simultaneity of observations is not found on the weather maps, but it is felt that the observations are close enough in time for our limited scope. For instance, the land stations of certain regions may be one hour ahead or behind the time given for the chart. Furthermore, ship data may not be even as near synchronism as this, but whenever time discrepancies are rather marked, the time of observation is appended.