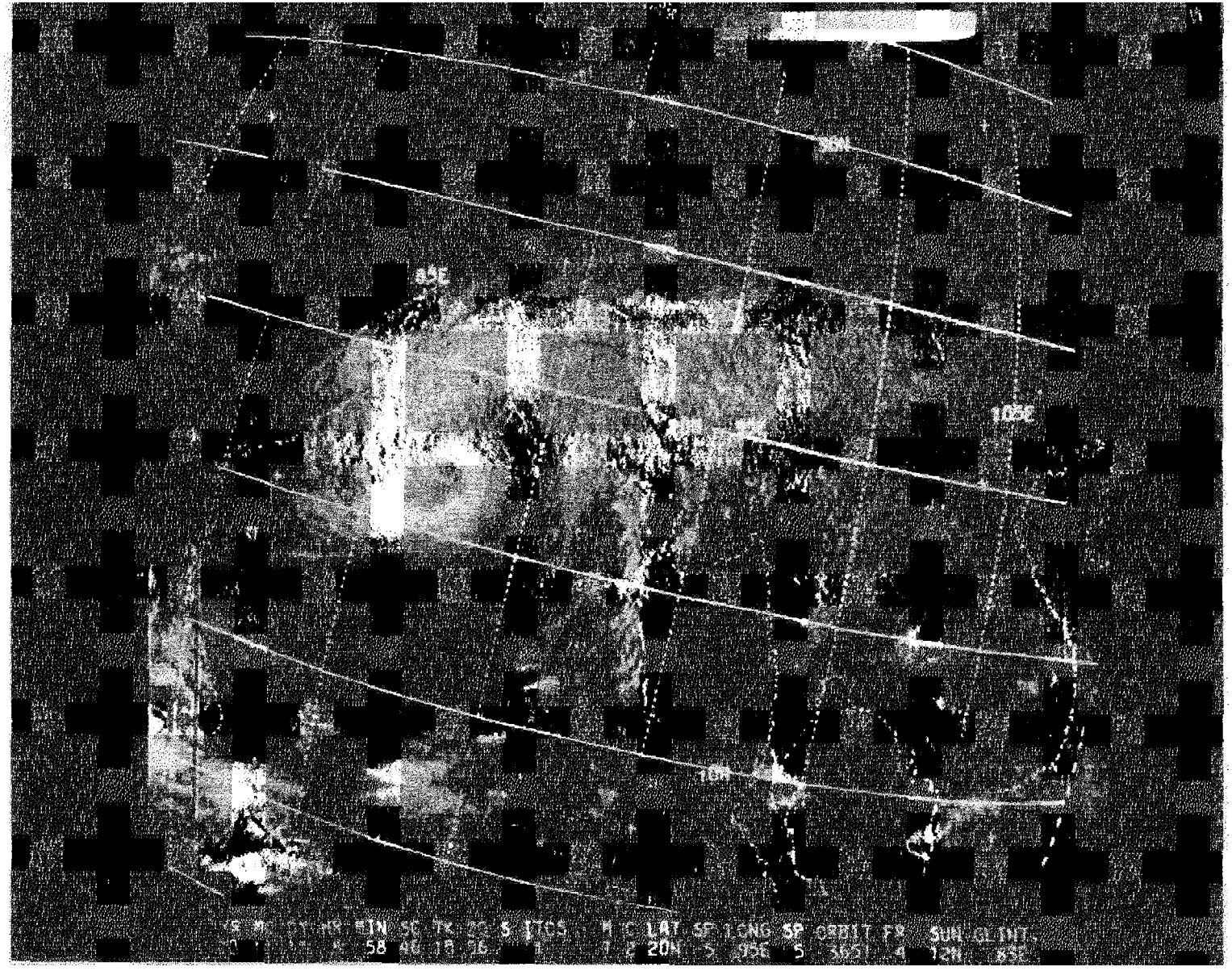

Plate 1 – A satellite view of a tropical cyclone. Little more than 24 hours later this severe tropical cyclone struck Bangladesh in November 1970. The death toll exceeded 200,000, mostly caused by the storm surge. *(Photo: NOAA, U.S.A.)*

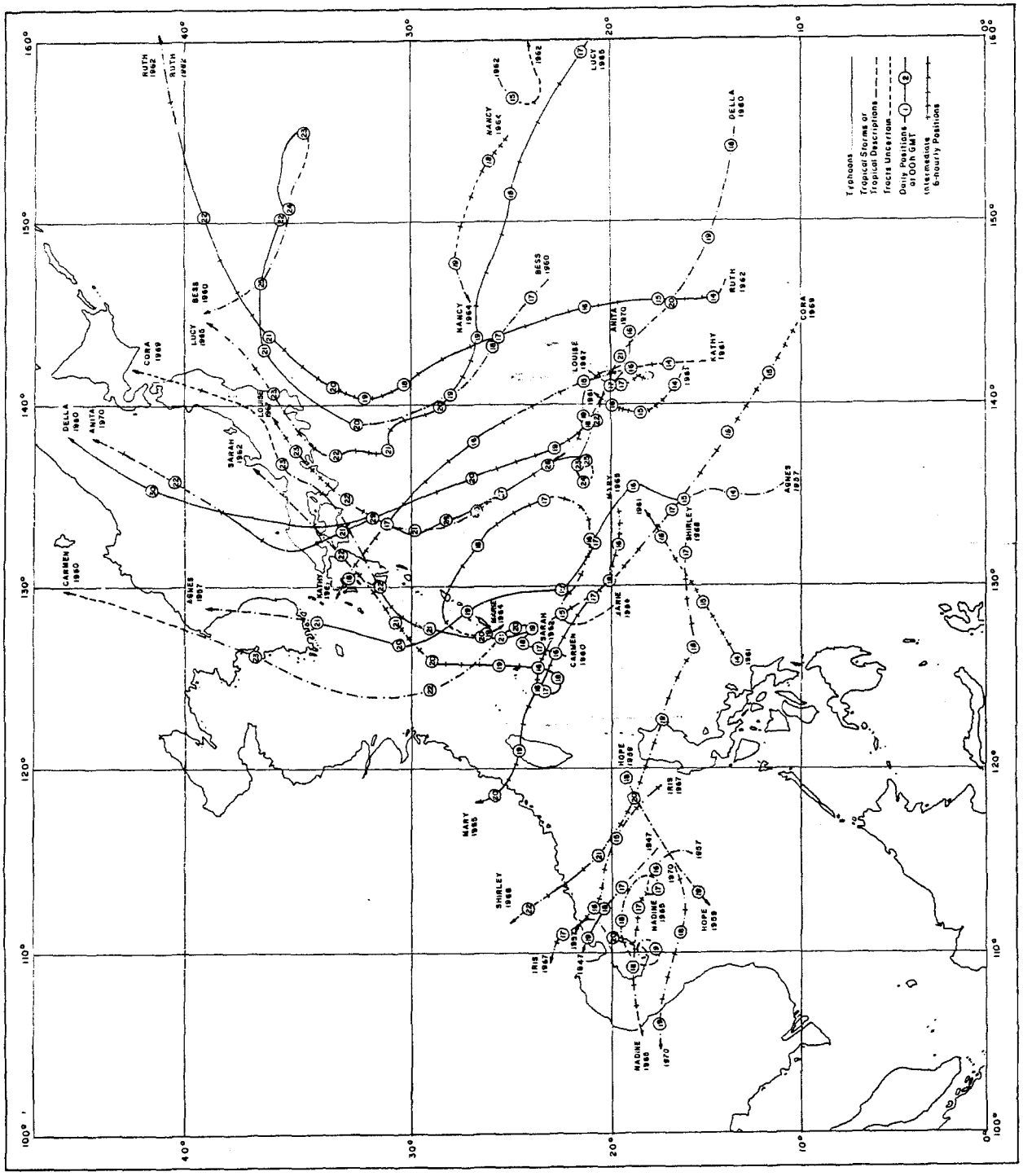

Figure 4 – Tropical cyclones over the China Seas and western Pacific. Five-day tropical cyclone tracks: 1947 to 1970, August 14-18

warning of flood and storm surge. Such preliminary warnings would be confirmed or amended in due course by the Hydrological Service in the case of a flood warning and by the forecast centre in conjunction with hydrographers in the case of a warning of storm surge.

The whole organization for disaster prevention and preparedness is complex and is dovetailed in an intricate manner. Throughout this organization meteorological advice will have a significant impact. Forecasters should therefore try to familiarize themselves with as much of the organization as possible so that they will appreciate the application of their forecasts, warnings and advice all through a tropical cyclone occurrence. Essentially the same pattern of responsibility and zeal as prescribed for the Meteorological Service is also required of the hydrological and hydrographic services.

Tropical cyclone modification

It is inevitable that much scientific study and discussion should be devoted to the possibility of reducing even by a small extent the destructive power of tropical cyclones. An efficient disaster prevention and preparedness organization, including the construction of buildings that are proof against all except the most extreme tropical cyclones, can do much to limit the effects of these storms. However, there would be much to gain in terms of a reduction of damage potential if it became possible to weaken a tropical cyclone before it reached land.

Any possibility of modifying a tropical cyclone must be mainly concentrated on one or both of two energy sources:

(*a*) The heat in the top layer of the warm sea which may be transferred by evaporation of moisture to the overlying atmosphere;

(*b*) The heat released by condensation in strong convection currents in the circulation which has developed round the eye of the storm.

A tropical cyclone forms in an area of the ocean where the sea is relatively much warmer than the adjacent air. It does not seem practicable to prevent the evaporation processes that must take place. Many ideas have been put forward but it is generally accepted that any device for inhibiting evaporation might be effective for a short time but would then be broken up by the wind, waves and swell.

Tropical cyclone modification therefore reduces to the question: Can the condensation processes in the convection currents of a tropical cyclone be controlled or damped down so that the vigour of the storm is reduced? Answers to this question are being sought in an experiment conducted by the United States of America since 1960 and called Project STORMFURY. Clouds just within and surrounding the eyewall are heavily seeded with freezing nuclei, usually silver iodide crystals. The effect aimed at is to expand the ring of wall clouds, and incidentally of maximum winds, so that the total energy of the tropical cyclone is distributed over a larger volume of atmosphere, thus producing a reduction of maximum wind speed.

The method of attack used in Project STORMFURY is supported by theoretical considerations. Limited field trials on hurricanes approaching the U.S.A. have demonstrated the possibility that the efficient application of freezing nuclei may achieve a reduction of about 15 per cent in the speed of the strongest winds There are no indications as yet of any significant effects on the amount of rain falling over land. Indeed the desirability of reducing tropical cyclone rainfall is questionable because agriculture in many countries is dependent upon the water brought by these storms.

Countries affected by tropical cyclones will watch with considerable interest the results of future experiments carried out in Project STORMFURY on actual hurricanes and may be prepared to consider the possibility of similar experiments in the different areas of the world mentioned in Table I above.

However, it must be emphasized that these experiments contain no hint or promise that a programme of disaster prevention and preparedness may ultimately be unnecessary or could be approached in a half-hearted manner. A successful outcome of Project STORMFURY might help to make the task facing the safety organization somewhat less formidable but the best prospect for the safety of a people and for reducing damage in a tropical cyclone is an efficient disaster prevention and preparedness system which is carefully and enthusiastically organized by the responsible authorities and which has the confidence and support of the population.