FOR PARTICIPANTS ONLY

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UNITED NATIONS ECONOMIC COMMISSION FOR ASIA AND THE FAR EAST
AND
WORLD METEOROLOGICAL ORGANIZATION

Typhoon Committee
Fifth session
15-21 November 1972
Bangkok, Thailand

DRAFT REPORT OF

THE FIFTH SESSION OF THE TYPHOON COMMITTEE

Contents

I. INTRODUCTION

1. The fifth session of the Typhoon Committee, held at Bangkok from 15 to 21 November, was attended by representatives of Hong Kong, Japan, the Khmer Republic, the Republic of Korea, Laos, the Philippines and Thailand; and by observers from Australia, France, the Federal Republic of Germany, the Union of Soviet Socialist Republics, the United States of America, the United Nations Development Programme (UNDP), the United Nations Disaster Relief Co-ordinator, the International Civil Aviation Organization (ICAO), the International Telecommunication Union (ITU), the League of Red Cross Societies (LRCS) and the Committee for Co-ordination of Investigations of the Lower Mekong Basin.

2. The session was inaugurated by His Excellency Air Chief Marshal Dawee Chullasapaya, Director of National Development, Agriculture and Communication in the National Executive Council of Thailand, who welcomed all participants. Reiterating Thailand's staunch support of the Typhoon Committee, he expressed the hope that the detrimental effects of storms originating in the Western Pacific and Bay of Bengal might be mitigated. Thailand had sustained damage to the extent of $200 million during the ten-year period 1961-70 which represented an average annual loss of 0.4 per cent in the gross national product, equivalent to about 10 per cent of Thailand's earnings from the export of rice. Throughout the Central Plain, despite centuries of continuous effort to control floods, damage persisted. In Northeastern Thailand severe floods had

/been experienced

been experienced in recent years. In that locality as well as in the smaller, steeper drainage basins where the possibility of flash flooding existed, the flood hazard was acute. He welcomed the assistance of the Mekong and Typhoon Committees in improving flood forecasting and warning and the steps they had taken to secure additional support from the UNDP. Thailand, he said, supported in principle the proposal for mounting a joint LRCS/WMO/ECAFE mission on community preparedness and disaster prevention. He was confident that the representatives of the developed countries would recognize the heavy responsibility of the Committee and would extend what assistance they could in its efforts to mitigate the effects of typhoons.

3. U Nyun, Executive Secretary of the United Nations Economic Commission for Asia and the Far East (ECAFE), welcomed the participants and expressed his gratitude to the Government of Thailand for the arrangements made for the session and the associated study tour of flood forecasting and warning facilities. Since the last session of the Committee, unprecedented damage had been experienced in the Philippines and the Republic of Korea and severe damage in Japan. It was for the relief of the misery caused by such disasters that the Committee had been constituted. The main thrust of the Committee's activities to date had been towards the improvement of meteorological and hydrological services, and in consequence of the improvement effected it was now possible to envisage action to strengthen national services for community preparedness and disaster relief.

/He thanked

He thanked the League of Red Cross Societies for its active support and co-operation, the World Meteorological Organization, especially the Secretary-General of WMO, Dr. D.A. Davies, for his keen interest in joint WMO/ECAFE undertakings and the UNDP, and the developed countries for their material assistance. He congratulated the Typhoon Committee secretariat on its achievements and noted with pleasure the arrangements made for the preliminary meeting of the WMO/ECAFE Panel on Tropical Cyclones which had been organized to mitigate the harmful effects of tropical cyclones in the Bay of Bengal and the Arabian Sea. He hoped that the Committee would soon be able to contemplate the extension of its activities to embrace the long coastline of the People's Republic of China. With the extension of the Committee's activities and the activities of the Panel about to be undertaken, he hoped that other countries would join with the countries now constituting those bodies in a co-ordinated attack on the reduction of storm and flood damage.

4. On behalf of the Secretary-General of WMO, Dr. A.H. Glaser, Director of the World Weather Watch Department, welcomed the participants to the fifth session of the Typhoon Committee and conveyed the personal regards of the Secretary-General to those participating in the session. Reminding the Committee that its primary objective was to protect people and property from the threat of typhoons, he suggested that more emphasis be placed on community preparedness and disaster prevention. He cited a resolution recently adopted by the United Nations First Committee

/preparatory

preparatory to consideration by the General Assembly, which called upon WMO and the Typhoon Committee to accelerate action directed towards the removal of the harmful effects of tropical storms. Referring to the UNDP request for additional institutional support for the Typhoon Committee, he hoped that the proposal would have the unanimous approval of the Governments of the Typhoon Committee as well as the active support of the developed countries participating in the activities of the Committee. He warned the Committee that UNDP support could not be counted on indefinitely and that alternative means of support would have to be sought in the near future. He outlined recent progress in the implementation of WMO's Tropical Cyclone Project and drew the Committee's attention to the wide scope for action. Thanking the Government of Thailand and the Executive Secretary of ECAFE for the arrangements made for the session, he wished the Committee every success in its deliberations.

5. A vote of thanks was accorded to the Government of Thailand and to the ECAFE, WMO and Typhoon Committee secretariats for having arranged the meeting.

6. Dr. Charoen Charoen-rajapark (Thailand) was elected Chairman of the Committee for 1972/73; Dr. In Ki Yang (Republic of Korea) was elected Vice-Chairman. Dr. Roman L. Kintanar (Philippines) was elected Chairman of the Drafting Committee.

7. A vote of thanks was extended to the outgoing Chairman (Dr. S. Sakano, Japan) and Vice-Chairman (Dr. G.J. Bell, Hong Kong).

8. The Committee adopted the revised provisional agenda for the meeting prepared jointly by the ECAFE, WMO and Typhoon Committee secretariats (Annex 1).

/II. THE COMMITTEE'S

II. THE COMMITTEE'S ACTIVITIES DURING 1972

(Agenda item 4)

9. Close attention was given by the Committee to the information presented by the Typhoon Committee secretariat in document WRD/TC.5/6 on the scope of its activities in 1972. The action which had been taken by the member countries themselves, by the secretariats of ECAFE and WMO, and by the TCS in meeting the decisions taken at its fourth session were examined in detail. Whilst the Committee recorded its pleasure at the important progress made in several parts of its programme, it also noted that in a number of respects the hopes expressed at its fourth session had not been fulfilled. It therefore called upon all member countries to exert new efforts in the year ahead to speed up implementation of the programme adopted. Further and more detailed comments are given below on each of the four components of the programme, namely (i) improvement of meteorological facilities, (ii) improvement of hydrological facilities, (iii) community preparedness and disaster prevention, and (iv) training and research.

A. IMPROVEMENT OF METEOROLOGICAL FACILITIES

10. The Committee's consideration of the progress made in 1972 in the implementation of the required observing and telecommunications facilities was based on the information contained in the document submitted to it and on reports from a number of member countries on national activities. Noting that these facilities were principally those forming part of the Global Observing System (GOS) and the Global Telecommunication System (GTS)

/of the World

of the World Weather Watch, the Committee recalled that it had stressed at each of its sessions the need to implement these requirements as quickly as possible. Progress in 1972 had been slow and there remained a number of important observing and telecommunication facilities for which there were, as yet, no implementation plans. In that connexion the Committee wished to reiterate the need for each member country to ensure that when only limited resources were available the priorities assigned at each session be given first attention. It pointed out that the priority list was adopted with the full consent of the member countries and therefore formed part of a regionally-agreed programme to improve the typhoon warning system. It was therefore essential that it should be respected by all participating countries.

Global Observing System (GOS)

11. The Committee learned with satisfaction that aircraft reconnaissance flights had been made by Hong Kong into typhoon 'Susan' in July 1972. It was informed that plans had been made to carry out further reconnaissance flights whenever possible. In congratulating Hong Kong on the initiative it had taken in organizing the flights, the Committee expressed its hope that this important addition to the observing system in the typhoon area would continue. It requested Hong Kong to ensure that the meteorological information derived from the flights be made available speedily to all interested countries over the Global Telecommunication System.

/12. The session

12. The session was informed that the installation of the radiosonde/radiowind station at Vientiane in Laos, provided by WMO through its Voluntary Assistance Programme, had taken place in October 1972. In addition to supervising the installation, an engineer from Finland had given further training in the operation of the equipment. Trial observations were being made at the time of the fifth session and it was expected that daily radiosonde/radiowind observations at 00 GMT would begin at the end of November 1972. The Committee noted that plans for setting up an APT station in Vientiane under a bilateral project with France were progressing satisfactorily. The station was expected to be in operation, at the latest, by August 1973.

13. The support to the observing system in the typhoon area provided by Japan in stationing its ocean weather ship "Keifu Maru" at 20°N, 130°E for several periods was again recognized by the Committee. It considered that the continued operation of this vessel whenever possible during the typhoon season would be welcomed by all member countries in furnishing valuable observations from a data-sparse area.

14. The Committee was informed of the Philippines plans to complete the building for the radiowind station at Puerto Princesa by the end of 1972 and that radiowind observations were expected to be resumed at Manila by the same date. It noted with regret that radiosonde/radiowind observations at Laoag had been suspended in November 1971 because of a defective power generator. The Committee wished to stress the need for standby power arrangements to ensure the regular operation of important

/stations

stations such as Laoag, which had been included in the priority list drawn up at its fourth session. It also expressed the hope that the Philippines would soon find it possible to increase the observing programme for the other upper-air station in the priority list, namely, Zamboanga.

15. Since the fourth session the five new 10 cm radars which were to be installed at Baguio, Basco, Cebu, Daet and San Mateo, had arrived in Manila. The Committee noted with satisfaction that the buildings and the installation of the radars at Cebu and Daet had been completed and that these stations were expected to be in full operation very soon. At Basco the installation was scheduled to be completed by the end of the year. The planned completion by 1975 of the radar network in the Philippines was considered by the Committee to be a major step forward in improving national and regional typhoon-warning capability.

16. For the third year running member countries of the Committee had benefitted considerably from observations made by USSR research vessels in the Pacific in support of the typhoon programme. In 1972, for the first time, four vessels - the VOLNA, PRIBOL, PRILIV and OKEAN - had taken part in a programme covering all months of the year. As in earlier years arrangements had been made for observations from these vessels to be received free of charge through coastal radio stations in Japan for onward transmission to Tokyo and broadcast over the Global Telecommunication System. The Committee expressed its appreciation to the Japan Meteorological Agency for presenting at the session detailed statistics of the observations received from the Soviet vessels during 1972. On account of the density of traffic at coastal radio

/stations

stations in Japan, ships sending reports to these coastal radio stations were requested to inform the Japan Meteorological Agency in advance of the name of the ship, the station to which it wished to communicate, the period of the observations and the sea area in which they were to be made. The receipt of this information would greatly facilitate the collection of reports from weather ships and research vessels. The Committee invited the attention of its members to a request made by Japan that all such communications be channelled through the coastal radio stations at Choshi or Nagasaki.

17. The Committee recorded its appreciation to the Soviet authorities for continuing and expanding this valuable aid. It expressed its hope that the USSR would sympathetically consider the continuation of the programme in future years and called upon all member countries to assist the USSR in operating the vessels by providing the necessary port and other facilities. The action taken through the WMO secretariat resulting in the distribution of microfilms of the upper-air observations made by the USSR vessel PRILIV in 1970 to all member countries of the Committee was noted with pleasure.

18. The Committee expressed its gratitude to the Federal Republic of Germany for the contribution made by German vessels operating in the typhoon area. Two research vessels, the JASON and the POLLUX, had again participated in 1972 in providing valuable observations from sea areas. Information on these operations had been notified to all members of the Committee in March 1972 so that the necessary arrangements could be made

/for the reception

for the reception of reports at coastal radio stations. In addition to these research vessels, more than 40 mobile ships had made over 2,000 observations in the typhoon area during 1972. It was hoped that vessels from the Federal Republic of Germany would continue to co-operate in this way. Agreement had been secured for the making of more air reports in typhoon areas by German commercial aircraft. It had been suggested that it would assist crews if special requests were addressed to them to make flight weather observations in typhoon situations. The Committee requested its member countries to make suitable arrangements for this purpose, and to investigate reported shortcomings in the onward transmission of air reports received at designated collecting centres.

Global Telecommunication System (GTS)

19. In assessing the outcome of the year's efforts to improve the telecommunication system in the typhoon area, the Committee was obliged to take into account certain factors which had retarded the planned programme of improvements. At its fourth session the Committee had underscored the need for more rapid implementation; the limited progress achieved in 1972 made it more than ever necessary to speed up action.

20. In its review of the progress made, the Committee noted that in Laos efforts were continuing to complete the regional telecommunication link between Vientiane and Bangkok for which USSR had provided equipment under VAP. An expert from the USSR had visited Vientiane in 1971 to determine what further material and measures would be required to bring the link into operation. His report indicated that to complete

/the project

the project it would be necessary to provide antennae, cabling and some additional equipment as well as expert services. The USSR had subsequently offered to provide the antennae, which would be delivered by the end of 1972, and negotiations were continuing with regard to the remaining equipment. Some financial problems connected with the project had not been resolved at the time of the fifth session. The Committee was informed of the steps being taken by the TCS to assist Laos in obtaining spare parts for telecommunications equipment used in the collection of national data.

21 The fire that had destroyed the Manila International Airport building in January 1972 had been responsible for the absence of progress in the Philippines. The destruction of essential telecommunications equipment used by the Weather Bureau had proved to be a major setback. Discussions with the TCS and the WMO secretariat had led to the formulation of a VAP request which had been circulated for offers. None had been received. The Committee was informed that the second session of the RA II Working Group on Telecommunications held at Teheran immediately before the Typhoon Committee session had recommended the replacement of the former Manila-Bangkok point-to-point circuit by a new link from Manila to Tokyo. It noted that a reliable cable circuit already existed and that Japan had agreed to finance its share of leasing a channel on this circuit, as well as accepting responsibility for collecting data from the NMC Manila, at the Tokyo RTH. The Committee considered that this proposal offered a speedy solution to the problem and warmly supported the recommendation. It hoped that the agreement of RA V and of the Philippines would be obtained before long.

/22. Reference

22. Reference had been made in the report of the fourth session to the bilateral assistance provided to the Philippines by the Government of Australia. Telecommunications equipment worth US$300,000 had been provided under this assistance. The equipment would be used for the improvement of national data collection arrangements. The Committee again recorded its appreciation of this valuable addition to the Philippine telecommunication system.

23. The Committee noted with satisfaction that Thailand had reported the opening of regional point-to-point links between Bangkok and New Delhi and between Bangkok and Rangoon since the fourth session. Further steps in the strengthening of the Bangkok RTH had been taken during the year. Equipment worth US$40,000 had been received as bilateral aid from Australia and installed. The equipment consisted of six radio receivers, antennae, teletype converters and power supply converters. The Committee expressed its appreciation to the Government of Australia for this further practical indication of its interest in assisting member countries. The session was also informed that the equipment to be provided to the RTH through VAP(F) was on order and should be received within a few months.

24. The representative of the International Telecommunication Union (ITU) drew attention to the regional telecommunication network under implementation in South-East Asia. This network is based on modern communication systems such as microwave, undersea co-axial cable systems and satellite systems, all providing a high degree of reliability. He expressed the desire of ITU to assist the Committee in finding suitable communication links based on the regional telecommunication network as an alternative to establishing new links specifically for meteorological purposes.

/Priorities

Priorities for the implementation of observing and telecommunication facilities

25. The considerations which had led previous sessions of the Committee to draw up a list of observing and telecommunication facilities requiring priority in implementation were reviewed during the fifth session. The Committee felt that the two-fold object of the list in providing member countries with guidance as to those facilities upon which they should first concentrate resources, and in giving other countries an indication of their most urgent requirements, was still valid. Experience had shown that countries providing aid took account of the priorities allotted in deciding upon their future programmes of assistance. The Committee accordingly decided to revise the list to bring it up to date.

26. Noting that in the past local circumstances had sometimes made it difficult or even impossible for member countries to follow the priority list exactly, the Committee nonetheless emphasized the importance of adhering closely to the list decided upon by the Committee as a whole. It was pointed out that potential donor countries could not be expected to regard the facilities listed as urgent if member countries themselves gave preference to the implementation of other facilities. The Committee felt that increased efforts should be made in 1973 to secure the installation of the facilities included in the priority list. The list of priority requirements adopted by the Committee is given below:

/Observing

Observing facilities

(i) Upper-air stations

No plans

48991 Phnom-Penh (Khmer Republic)
98836 Zamboanga (Philippines)

Already planned

98223 Laoag (Philippines) - 12 GMT radiosonde/radiowind. Partial implementation expected in 1973 from national resources.

(ii) Weather radar

No plans

Bangkok (Thailand)
Cheju (Korea) (or other selected site)
Vientiane (Laos)

Already planned

Basco (Philippines) - National project 1972

(iii) APT stations

No plans

Phnom-Penh (Khmer Republic)

Already planned

Vientiane (Laos) - Bilateral project 1973

(iv) Ocean weather station

No plans (after 1972)

Ship at 16°N, 135°E

Telecommunication facilities

(i) National collection facilities

Already planned

Laos - National project
Philippines - National/bilateral project

(ii) Regional telecommunication

Establishment of the following point-to-point links:

No plans

*Manila - Tokyo

Already planned

Bangkok - Phnom-Penh - National project 1973
Bangkok - Saigon - National project 1973
Bangkok - Vientiane - National/VAP project 1973

(iii) Other telecommunication facilities

Partial implementation planned

Thailand - strengthening of RTH, Bangkok — Will be partially implemer with help of VAP project a national resources.

* Recommended by second session of the RA II Working Group on Telecommunicat

27. The Committee requested the TCS to maintain close contact with those member countries in which the facilities were required and to provide them with advice and, where necessary, assistance in seeking aid from all available sources.

Other meteorological questions

28. In addition to the questions dealt with above, the Committee recorded its view on a number of other matters under this component of its programme. These points are dealt with below.

Exchange of radar fixes

29. The Committee was informed of the result of an analysis made by the TCS of the statistics of radar fix messages exchanged during 1971. The analysis showed that only 40 per cent of the messages transmitted were received by the addressees. The Committee accordingly once again stressed the importance of radar fix messages and urged its members to ensure regular and prompt exchanges in accordance with the agreed schedule. It requested member countries to maintain systematic records of outgoing and incoming radar messages to permit the scrutiny of exchanges. The representative of Japan reported that it was not possible for the Japan Meteorological Agency to maintain such records because the Agency had to handle a large volume of meteorological data through its Automatic Data Editing and Switching System. He assured the Committee however that radar fix messages would continue to be disseminated through broadcasts and point-to-point circuits.

/30. Attention

30. Attention was drawn to the fact that some countries were disseminating radar fix messages through routine synoptic broadcasts only. It was pointed out that the messages were required to be disseminated at interval of three hours, and that, wherever possible, the exchange should be made by point-to-point communication circuits. The Committee noted with satisfaction that no difficulty had been experienced in using Part A of the new WMO code for the exchange of radar fix messages.

Denser network of special observations from land stations

31. The need for a denser network of special observations from land stations, as envisaged by the WMO Executive Committee Panel of Experts on Tropical Cyclones, was reviewed. Since, however, the majority of the member countries had indicated that they did not consider it necessary to establish additional stations in their respective countries at the present time, the Committee agreed to leave this question for future consideration at the national level as and when appropriate.

Observations from mobile ships

32. The Committee was informed of the action taken by WMO in consequence of a request made at its fourth session regarding the inadequacy of ship reports from the typhoon area. WMO members and the member countries of the Committee had been approached separately with suggestions for the improvement of the present arrangements for the making, collection and exchange of ship observations, and had been asked to notify WMO of any special difficulties. In general, the response to this approach had been disappointing although it was hoped that many of the countries which had not replied would nevertheless take up the suggestions made.

/Aircraft reports

Aircraft reports

33. In response to a request made at the fourth session of the Committee, the Secretary-General of WMO had taken up with IATA and IFALPA the need for pilots to comply with the agreed procedures for the making of air reports. Surveys made by ICAO in Southeast Asia in August 1971 had shown that only 34 per cent of the number of in-flight reports expected in accordance with the procedures had been received at collecting centres. For post-flight reports the figure was even lower - 30 per cent. ICAO had also been able to confirm from its surveys that the main weakness in the system lay in the failure of pilots to comply fully with the agreed procedures.

34. IATA had subsequently informed WMO that that question had been brought to the attention of member airlines concerned. IFALPA referred to the difficulties experienced by pilots in making air reports as a result of the increase in the cockpit workload in jets and the reduction in crew complements. In view of the importance of the subject it proposed to bring the WMO letter to the notice of IFALPA member associations and also to publish an article in the IFALPA News Bulletin.

35. The Committee noted with appreciation the action taken by IATA and IFALPA to encourage their members to comply fully with the agreed procedures for the making of air reports and expressed the hope that WMO members and ICAO contracting states would continue to make every effort to ensure the rapid collection and distribution of reports. It requested the Secretary-General of WMO to advise the Committee of the results of any further surveys carried out by ICAO in Southeast Asia in order that it might assess what progress was being made in increasing the number of reports available.

Role of the Typhoon Committee

36. The fourth session agreed to look beyond WWW requirements in order to identify other deficiencies in the basic systems needed for typhoon prediction and warning. Based on the suggestions made by the TCS, in consultation with the WMO secretariat, the Committee considered a list of deficiencies in areas not covered by GOS and GTS of the World Weather Wa It reviewed the measures already under way for removing some of these deficiencies and considered further steps that might be taken to remedy them. The salient points emerging from the Committee's deliberations are summarized below:

(i) The need for additional radar stations had already been reflected in the revised priority list drawn up by the Committee.

(ii) The Committee emphasized the usefulness of aircraft reconnaissance flights and welcomed the action taken by Hong Kong in that regard.

(iii) In view of the inadequacy of observations from ships in the typhoon area, the possibility of establishing marine-type weather buoys in the Western Pacific was considered. A note on ocean data acquisition systems prepared by a WMO expert on meteorological instruments at the request of the TCS was considered in that connexion. The Committee welcomed the news that Japan would establish a medium-sized buoy near 25°N, 135°E in 1973 and recommended that the possibility of setting up other buoys for the acquisition of additional data be explored.

1/ Activities of the Typhoon Committee during 1972 (WRD/TC.5/6)

(iv) The Committee noted with satisfaction the plan of the Japanese Government to put a geostationary satellite in orbit in 1976/77. The details presented indicated that member countries would derive substantial benefit from the increased data-acquisition capability provided by the satellite.

(v) There was an urgent need to review the existing facilities for dissemination of typhoon warnings within participating countries with the object of identifying deficiencies and suggesting remedial measures. The Committee noted with satisfaction that a pilot study had been undertaken by the TCS in the Philippines and recommended that the study be continued.

8. IMPROVEMENT OF HYDROLOGICAL FACILITIES

37. The Committee noted with interest the progress made in developing comprehensive plans for the establishment of pilot flood forecasting and warning systems in selected river basins. Significant development in member countries included the following:

Japan

38. The Committee was informed that flood forecasts were currently being issued jointly by the Ministry of Construction and the Japan Meteorological Agency for eighteen major river basins; the Ministry of Construction issues flood warnings for ninety-seven river basins. By the end of 1971, the Ministry had installed 301 rainfall telemeters and 316 water level telemeters; sixty additional rainfall telemeters and seventy

/water level

water level telemeters were due to be installed in 1972. Assistance being provided to Korea and the Philippines in the establishment of pilot flood forecasting systems. As in previous years, the Government of Japan had organized group training courses in flood forecasting and warning for the benefit of member countries of the Typhoon Committee.

Republic of Korea

39. In response to a request from the Republic of Korea for assistance in setting up a pilot forecasting and warning system in the Han river basin, the Government of Japan sent a team of six experts to Seoul in June 1972 for a period of three weeks. The interim report of the team was expected to be submitted to the Government of the Republic of Korea by the end of December 1972 and the final report by August 1973. The minimum equipment requirements for a workable flood forecasting and warning system were assessed by the Typhoon Committee secretariat as five telemetering water level gauges, four telemetering raingauges and two relay stations. These were included in the draft request for UNDP assistance. The possibility of estimating precipitation by means of the 10 cm radar at Seoul was explored.

Laos

40. A tentative scheme for pilot flood forecasting and warning in the Se Bang Hieng river basin, prepared by TCS for inclusion in the draft request for UNDP assistance, had been agreed upon by the Government of Laos. The representative of Laos reiterated the importance of flood forecasting on the Se Bang Hieng river basin to which the Government

/had assigned

had assigned the highest priority in view of its development programme for the southern region of the country. Security conditions in the Se Bang Hieng river basin had improved during the year to the extent that about half of the basin was now accessible for hydrometeorological observations. A note on flood forecasting in the Se Bang Hieng river basin prepared by the secretariat for use in connexion with the development of the forecasting and warning system was accepted by the Government of Laos with appreciation.

Philippines

41. The representative of the Philippines expressed satisfaction with the progress made in the implementation of pilot flood forecasting in the Pampanga river basin. The Flood Forecasting Center of the Weather Bureau had undertaken several case studies of floods in collaboration with the secretariat and had concluded, on the basis of an analysis of runoff of the 1972 flood made by the secretariat, that there was a possibility of extending the forecast time beyond 24 hours.

42. In response to a request from the Philippine Government, the Government of Japan had sent a team of three experts in February 1972 to carry out detailed topographic surveys and transmission tests of radio wave with the object of selecting sites for telemetering equipment to be installed in the Pampanga river basin. Equipment used in the survey and valued at US$6,800, was donated to the Philippine Government on conclusion of the survey. The final report, including detailed design and specifications for the equipment to be installed, was under preparation in Japan.

/43. The Committee

43. The Committee learned with appreciation that the Government of Japan had appropriated US$260,000 in its 1972 budget for equipment and training required for the implementation of the Pampanga forecasting system and that the Government of the Philippines had approved an allocation of 500,000 pesos in counterpart funds for housing and other facilities. Construction of some of the facilities had already been started by the Bureau of Public Works. The training of two hydrologists from the Forecasting Center had been arranged with the Government of Japan. In view of the unprecedented damage caused by the flood of July 1972 the Government of the Philippines attached high priority to all possible means of mitigating flood damage including the establishment of flood forecasting and warning facilities. As soon as the pilot flood forecasting system for the Pampanga river basin had been established, the Government planned to establish similar systems in other important river basins.

Thailand

44. The Meteorological Department and the Royal Irrigation Department carried out case studies of the floods that had occurred in the Kwae Yai river basin between 1967 and 1971 with respect to the discharge at Station K 10 on the Kwae Noi and at Station K 6 on the Kwae Yai by means of the proposed stream simulation method. In addition, the Royal Irrigation Department had conducted observations and studies of the flood characteristics of the Mae Klong river as a result of the flood events that occurred in July and September 1972. Trial flood forecasting was carried out in 1972 using temporary SSB communication facilities between Bangkok

/and selected

and selected stations, but results obtained were not completely satisfactory due to insufficient data. A tentative flood forecasting system for the Mae Klong river basin was drawn up by the secretariat and the cost of necessary equipment was estimated for the purpose of inclusion in the proposed draft request to UNDP.

45. The observer from the Mekong Committee secretariat described the flood forecasting system employed in the lower Mekong river basin.

C. COMMUNITY PREPAREDNESS AND DISASTER PREVENTION

46. At its fourth session the Committee requested its members to send the TCS further information on the organization in their countries of community preparedness and disaster prevention measures against typhoons and floods. The fifth session was informed that the material received by the TCS during 1972 had been used to prepare a revised summary of these measures which had been distributed to all member countries in September 1972. The Committee recorded its appreciation of the action taken to make the additional material available.

47. The Committee noted that a regional seminar on disaster preparedness and relief had been organized in Manila from 7 to 16 May 1972 by the Philippine National Red Cross, and that WMO and ECAFE had been represented by two experts from the TCS.

48. The main conclusions of the Committee as to the action to be taken to promote community preparedness and disaster prevention, specifically in relation to the proposed joint LRCS/WMO/ECAFE mission, are reported under agenda item 7.

D. TRAINING AND RESEARCH

49. In pursuance of an offer made at the fourth session, the Government of Japan organized three training courses in flood forecasting and warning for the benefit of member countries. A six-month course in hydrology commenced in mid-September 1972; a four-month course in radar meteorology commenced in mid-November 1972; and a course in hydrometeorological telecommunications was due to commence soon. The Committee recorded its appre of the action taken and welcomed a statement made by the representative of to the effect that Japan would consider organizing similar training courses in 1973.

50. Recalling the offer of assistance made by France at the third session of the Committee to meet the training requirements of Laos for the next five years, it was reported that three trainees had taken advantage of the offer. The representative of Laos informed the Committee that arrangements were being made to send several more trainees in 1973.

51. In response to information presented at the fourth session, the TCS had obtained details of the training courses and awards available in Australia and had circulated this information to member countries. The observer from Australia at the fifth session confirmed that the facilities would continue to be available and that his country would be prepared to assist if member countries wished to avail themselves of them. He informed the Committee that Australia had provided twenty-nine fellowships to Southeast Asian countries during the last three years.

/52. The observer

52. The observer from Germany stated that his country was willing to accept trainees under WMO fellowships and other aid schemes. He mentioned that short training courses of three months duration could be offered on selected subjects such as the numerical computation of storm surges and the measurement of precipitation by radar.

53. The Committee was informed that it had been decided to hold a training seminar on tropical cyclone forecasting techniques and warning services in Asia and the South-west Pacific at the University of Queensland, Brisbane, from 14 to 26 May 1973. In response to an enquiry regarding the desired standard of trainees for the seminar, the representative of WMO informed the Committee that the broad subjects to be covered by lectures at the seminar had already been communicated to meteorological services and that the detailed programme for the seminar would be worked out by specially-appointed consultants. It was expected that meteorological services would select trainees primarily from among meteorologists engaged in weather analysis and forecasting or in teaching those subjects.

54. The observer from ITU informed the Committee of the telecommunication training facilities available in the region. A number of training centres established with UNDP/ITU assistance, including those in the Republic of Korea, Philippines, Laos and Thailand are well equipped for basic training in telecommunication.

55. The observer from the Mekong Committee referred to training courses on basinwide flood forecasting organized for the benefit of riparian countries. Laos, the Khmer Republic and Thailand could avail themselves of fellowships offer under the Committee's training programme.

/56. The representative

56. The representative of Hong Kong reported that the computerisation of operational meteorological data for tropical cyclone forecasting by objective methods was in progress. The tropical cyclone tracks for the period 1884 to 1970 had been up-dated and published in Royal Observatory Technical Memoir No. 11, Volume I, copies of which were distributed at the session. The Committee regarded the publication as a significant contribution to the steadily growing fund of information on typhoon forecasting and recorded its appreciation.

57. The Committee noted with satisfaction that the UNDP/WMO project establishing a meteorological research and training institute in the Republic of Korea had been approved and was expected to be initiated in the very near future. Provision had been made for typhoon forecasting and hydrometeorology with particular emphasis on flood forecasting and warning.

58. Typhoon research activities undertaken in the Philippines under the auspices of UNDP were outlined by the representative of the Philippines.

59. Reference was made to the proposed transfer of the United States Stormfury Project to the Pacific. At the twenty-eighth session of the Econ Commission for Asia and the Far East, held in March 1972, the United States representative had reported that it would not be possible to proceed with the transfer in 1972 as anticipated. The Committee was informed that, owing to difficulties experienced in keeping the project's fleet of planes operational and commitments to the WMO/GARP Atlantic

/tropical

tropical experiment, it was unlikely that the transfer could take place in 1973 or 1974. The results of experiements carried out in 1971 were reported. There had been no opportunity for experiment in 1972 but research had continued on the development of improved hurricane models.

60. The Committee was informed that the Government of the Philippines had recently approved the establishment of a national typhoon moderation and flood control research and development project. In recognition of the fact that other countries would be interested in the project, the Under-Secretary of the Department of Foreign Affairs had been included in the council governing the project. The representative of the Philippines described some of the steps already undertaken by the Government, including the establishment of an expanded weather radar network, procurement of appropriate aircraft and training of personnel in the United States.

61. Noting the possibility of inadvertent effects of storm moderation experiments on surrounding countries, it was hoped that consultations between the Philippine Government and other Governments concerned would take place on a bi-lateral basis before experiments were undertaken.

62. The fourth session had recommended that the suggestions offered by the Meteorological Research Institute of the Japan Meteorological Agency on the possibility of joint collaboration in typhoon research activities be pursued. In following up this recommendation, the TCS had issued a detailed circular letter to member countries with suggestions on possible approaches and inviting their comments on the subject. Replies had been received from three members, one of whom offered detailed comments and suggestions for further action. The TCS was requested to examine the matter further in consultation with the members with a view to making specific recommendations for consideration by the Committee.

/III. PROGRAMME

III. PROGRAMME FOR 1973

(Agenda item 5)

63. After reviewing its activities during 1972, the Committee gave consideration to its anticipated work programme for 1973 on the basis of document WRD/TC.5/7. The draft request to UNDP for assistance, which was considered under agenda item 6, contained a programme of work for three years. The Committee recognized, however, that the draft request could not become operational before 1974 and accordingly restricted its programme to 1973. In drawing up the programme, items of work which had already begun and on which progress had been made were taken into account. The specific items of work on which the Committee decided to concentrate during 1973 were accordingly listed as follows:

(a) to take further steps to accelerate the provision of meteorological and telecommunication facilities included in the priority list as revised during the session;

(b) to provide on-the-job training, where appropriate, in the operation and maintenance of weather radar, APT and telecommunication equipment;

(c) to study deficiencies in the existing system of dissemination of typhoon warnings in the Philippines and to suggest remedial measures;

(d) to assist the Philippines in the implementation of its pilot flood forecasting system for the Pampanga river basin with assistance from Japan and to continue the hydrological studies already undertaken;

/(e) to continue

(e) to continue experimental flood forecasting the Mae Klong river basin in Thailand and to continue studies for the improvement of the basic plan for flood forecasting;

(f) to assist the Republic of Korea and Laos in further planning and preparations for pilot flood forecasting in the river basins selected;

(g) to advise national authorities on the improvements needed in disaster planning and community preparedness with the assistance of a consultant in these fields, taking into account the recommendations of the proposed joint LRCS/WMO/ECAFE mission;

(h) to consider the requirements of the Khmer Republic for inclusion in the draft request to UNDP for institutional support and to initiate action as appropriate within the framework of the Committee's programme;

(i) to assist in the procurement of assistance from external sources, where necessary;

(j) to assist in the exchange of information on the results of research studies relating to typhoons;

(k) to finalize the draft request to UNDP for assistance and to take further steps for its submission to UNDP.

/IV. REQUEST

IV. REQUEST TO UNDP FOR ASSISTANCE IN SUPPORT OF THE TYPHOON COMMITTEE

(Agenda item 6)

64. At its third session the Typhoon Committee decided to seek expanded assistance from UNDP to accelerate the pursuit of its objectives. Accordingly, the outline of a tentative request was presented to the fourth session which considered that the expert staff of the secretariat should remain at the level of three experts. Provision for consultants was made to permit greater flexibility in obtaining the services of highly-qualified experts. An equipment component was agreed to at a level lower than required in order to secure some probability of support. The TCS was directed to prepare a final draft request to UNDP on the agreed basis, and after consultation with ECAFE and WMO secretariats, to circulate the request to member countries of the Typhoon Committee for their concurrence.

65. The Committee noted that the draft request had been circulated and that favourable replies had been received from all members. The representative of Japan stated that although the Japanese Government was not in a position to become a signatory to the proposal, it fully supported it. He expressed the anxiety of his Government in that while it was endeavouring to increase its contribution to the UNDP, the share of East Asia in the Inter-country Programme of the IPF was disproportionately small in relation to other areas. The valuable work of the Typhoon Committee could be jeopardized by the mechanical application of a phase out rule. He informed the Committee that the Japanese Government would raise this matter matter in the Governing Council of the UNDP.

66. At its fifth session, the Committee was informed by the representative of the United Nations Development Programme that UNDP support of the activities of the Typhoon Committee was expected to continue through 1973 at the current level. He outlined UNDP views on further UNDP support to the Committee, stating that emphasis was likely to be placed on provision of technical support rather than institutional support. UNDP considered

/that institutional

that institutional financial support should come from countries which had established such institutions and that such support should be considered as evidence of their interest and willingness to contribute to their existence. He stated that UNDP would consider favourably a request which showed a definite plan for the orderly introduction into the TCS of counterpart personnel. It is desirable moreover that the request should show adherence to certain basic criteria and themes established by the UNDP for regional projects.

67 The Committee decided that, in view of the information presented by the UNDP representative, it would be necessary to revise the draft request. It was considered in any event that the requirements of the Khmer Republic ought to be incorporated into the request. A working group was accordingly appointed by the Chairman to define the basis on which the request should be revised. The group was composed of representatives of the Republic of Korea, Laos, Philippines and Thailand together with members of the WMO, ECAFE and TCS secretariats and the representative of the UNDP.

68. The Working Group arrived at the following basis for the revision of the request:

(a) In view of the requirement for showing a definite plan for the assumption of institutional support by members, the request should outline a five-year plan for the project, on the understanding that initial UNDP support would cover the first four years of the plan.

/(b) The plan

(b) The plan should include a scheme for the secondment of counterpart personnel so that the TCS would at all times have a staff of at least three officers. The UNDP-supported secretariat staff during the five years of operation of the plan should be 3, 2, 2, 1, 1 during consecutive years. In addition, UNDP-supported technical experts may be added to the project as distinct from the secretariat as required.

(c) The equipment requirements of the Khmer Republic should be introduced into the request. The representatives of Laos, the Republic of Korea, Philippines and Thailand unanimously agreed that their portions of the equipment component could be proportionately reduced to introduce a suitable amount for the Khmer Republic, the total sum in the equipment component remaining unchanged.

(d) The draft request should be revised to highlight the principal criteria and themes desired by the UNDP to secure regional project support.

69. The recommendations of the Working Group were accepted by the Committee. The TCS was requested to modify the request accordingly and to take the necessary steps to assure its early submission. It was agreed that the TCS should be authorized to make such amendments to the draft request as were required without additional consultation with the members affected.

/V. DISASTER

V. DISASTER PLANNING AND COMMUNITY PREPAREDNESS

(Agenda item 7)

70. The Committee began its consideration of this item by examining the report prepared by Mr. James R. Hickey, consultant on disaster planning and community preparedness, who had carried out a survey in member countries during the last four months of 1971. During this survey the consultant had visited each member country and had prepared a report which included recommendations for further action.

71. It was the opinion of the Committee that the consultant had carried out a valuable first step in this part of the programme by examining the state of present arrangements for disaster planning and community preparedness. The Committee accordingly recorded its thanks to Mr. Hickey for the survey he had performed and to the League of Red Cross Societies (LRCS) for their help in securing Mr. Hickey's services. The report had brought to light a number of shortcomings in the organization of community preparedness and disaster prevention and had clearly indicated the advisability of stepping up the Committee's activities in this part of its programme. The Committee therefore concentrated its attention on the ways in which appropriate action could be taken to follow-up the results of the survey and thereby best help member countries in improving their national arrangements for alleviating the loss of life caused by typhoons and the serious impact of typhoon damage on national economies.

/To assist it

72. The Committee had before it a proposal made jointly by WMO and ECAFE which called for a joint LRCS/WMO/ECAFE mission to visit three member countries (Hong Kong, Korea and Thailand) in the first instance. The main task of the mission would be to strengthen the national co-ordination of community preparedness and disaster preventio measures in these countries by fostering closer contacts between meteorologi and hydrological services on the one hand, and the various agencies with responsibilities for community preparedness on the other. A second importa object of the mission would be to draw up an agreed programme of the action that should be taken over the next few years in each of the countries visited. Such an action programme would form the main lines of the Typhoon Committee's activities in this field.

73. The Committee was of the opinion that the proposed mission would constitute a logical start step towards overcoming some of the shortcomings revealed by the consultant's report and provide an important indication of the lines along which the programme in community preparedness and disaster prevention should develop over the next few years. It therefore supported the proposal. Each of the three countries to be visited by the mission welcomed the proposal and gave their agreement in principle to the visit taking place in March 1973 as proposed. The Committee noted that more detailed information on the purposes of the mission and guidelines for its conduct were contained in the annex to a letter already distributed by WMO to all member countries. It agreed that these guidelines should serve as a basis for the further planning of the mission.

/In this

74. The Committee wished to stress the need for careful planning of the mission's activities in each country to be visited. It felt that the objectives of the mission could only be realized if detailed arrangements were made with each of the countries concerned beforehand and noted that the time available for making these arrangements was severely limited. The Committee therefore called upon Hong Kong, Korea and Thailand to send their formal acceptance of the visit of the mission to ECAFE and WMO as soon as possible. In the meanwhile, it suggested the planning of the mission could proceed to avoid any waste of the limited time available. In addition, it requested LRCS, WMO and ECAFE to ensure that their participation in the mission was closely co-ordinated.

75. The Committee was informed by the observers from the League of Red Cross Societies and of the United Nations Disaster Relief Office of their full support of the community preparedness and disaster prevention activities being undertaken by the Typhoon Committee and, in particular, of their belief that the joint mission was a positive initial step to speed up these activities. The Committee expressed its satisfaction that closer and more active co-operation with these bodies had been established since the fourth session. Their help was felt to be of prime importance in advancing community preparedness measures in the typhoon area. It therefore requested ECAFE, WMO and the TCS to continue and strengthen their collaboration with LRCS and UNDRO in order that the maximum progress might be made in speeding up this part of its programme.

VI. DAMAGE

VI. DAMAGE CAUSED BY TYPHOONS, CYCLONES AND ACCOMPANYING STORM SURGES

(Agenda item 8)

76. The Committee was informed of a survey of flood damage undertaken by the ECAFE secretariat covering the period of the first United Nations Development Decade (1961-70) and the detrimental effects of such damage on the economies, of the countries affected, the preliminary results of which had been communicated to the Committee at the fourth session.

77. In all, twenty-one countries of the region had sustained damage to the extent of $9,885 million of which $6,779 million had been sustained in typhoon-affected areas and $3,106 million in cyclone-affected and other areas. These figures indicated the magnitude of the problem facing the Committee, especially when it was realized that the cummulative worldwide financing of the World Bank during the period of interest ($9,416 million) had been less than the damage sustained in the areas surveyed.

78. By far the greatest monetary damage ($5,867 million) had been sustained by Japan, in spite of the advanced degree of protection provided by that country. Altogether some 74,000 lives had been lost, 224 million people had been affected, 96 million hectares had been inundated and/or damaged and 14 million houses and other buildings damaged. The annual *per capita* damage had varied according to country from zero up to $13.49, averaging $1.11 for the fifteen countries for which statistics were availab

/The economics of

79. The economies of the countries had been adversely affected to the extent of 0.01 per cent of the gross national product in the case of Australia, up to 0.97 per cent in the case of Pakistan. In the worst years the adverse effect was generally substantially greater, exceeding 2 per cent in some countries. Damage of that order was exceedingly harmful when the *per capita* growth rate seldom exceeded 3 per cent.

80. In the typhoon-affected area, eight countries[1/] had sustained damage to extent of $6,779 million. During the ten-year period 10,657 lives had been lost, 16.7 million people affected, 6.8 million hectares of land inundated and 4.2 million houses and other buildings damaged. Some 62 per cent of the monetary damage was sustained by public works, 15 per cent by private property, 12 per cent by agriculture and 9 per cent by industry. Two per cent of the loss was represented by rescue and relief operations. The average annual damage was about 0.53 per cent of the gross national product for the five countries for which statistics were available. All of these experienced annual damage exceeding one per cent of the gross national product at least once during 1971-70.

81. The Committee noted that the survey undertaken formed the basis for further surveys and studies to be undertaken periodically by the ECAFE secretariat with the object of providing a more complete picture of the flood damage situation, while simultaneously providing a basis for the promotion of interest in flood protection and prevention. In the

/United States

1/ Hong Kong, Japan, Khmer Republic, Republic of Korea, Laos, Philippines, Thailand, Republic of Viet-Nam.

United States flood damage was increasing rapidly in spite of measures taken to mitigate damage, and damage exceeding $3,000 million had recently been sustained during a single storm. It was likely that damage would increase in the typhoon-affected area at a similar rate as development proceeded. In view of the long gestation period associated with protective and other measures it was imperative that such measures be instituted at the earliest possible opportunity.

/VII. CO-ORDINATION

VII. CO-ORDINATION WITH WMO TROPICAL CYCLONE PROJECT AND OTHER REGIONAL PROJECTS

(Agenda item 9)

WMO Tropical Cyclone Project

32. The progress made in the WMO Tropical Cyclone Project was described to the Committee. It was noted, in particular, that since the fourth session of the Typhoon Committee the basic plan for the project drawn up by the WMO Executive Committee Panel of Experts on Tropical Cyclones had been developed into a more comprehensive plan. In May 1972 the Executive Committee had adopted the plan as an initial set of guidelines for the WMO Tropical Cyclone Project. The plan had been distributed to all WMO Members in July 1972 urging them to indicate what assistance they could offer in its execution. At the time of the fifth session of the Typhoon Committee the information received in response to this request showed that the implementation of some aspects of the plan could be undertaken in the near future. Further information was expected. The Committee urged its member countries to participate in the project to the maximum of their ability. As many of the objectives of the project were inevitably closely related to the Committee's own endeavours, the success of the project would be of great benefit to countries in the typhoon area.

33. During the course of the fifth session, a resolution on "International action for the mitigation of the harmful effects of storms" was adopted by the twenty-seventh session of the United Nations General Assembly. It requested WMO to pursue actively the implementation of its tropical cyclone project, continuing and intensifying its other related action programmes, especially the efforts being undertaken towards obtaining basic meteorological data and discovering ways and means of mitigating the harmful effects of tropical storms and of removing or minimizing their destructive potential. The Typhoon Committee noted that the resolution calls upon Member States of the United Nations to undertake or intensify research, as well as operational projects towards that end, and requests other Member States to contribute to and assist in these projects. It noted too that the resolution calls for integrated action through increased co-operation and co-ordination between WMO, UNDP, UNDRO and the UN programme for the environment. The resolution was warmly welcomed by the Committee.

Collaboration with the UN Disaster Relief Office

34. The Committee was informed of the steps taken by WMO to establish contact with the United Nations Disaster Relief Office (UNDRO), which had been set

In this connexion the session learned that the United Nations Conference on the Human Environment had directed a number of recommendations related to programmes such as that being conducted by the Typhoon Committee to the Office of the UN Disaster Relief Co-ordinator. The Committee therefore considered that there should be close and regular contact between WMO, ECAFE and UNDRO in the pursuit of the objectives common to the three organizations. The Committee considered that such co-ordination would help to speed up the implementation of the WMO Tropical Cyclone Project.

Regional tropical cyclone programmes

85. The Typhoon Committee noted the activities being pursued by WMO in other tropical cyclone areas of the world. It heard with interest that both the WMO RA I Tropical Cyclone Committee for the South-West Indian Ocean and the joint WMO/ECAFE Panel on Tropical Cyclones had been formally constitute Sessions of both bodies had been planned for the early months of 1973. In reviewing the decision made at its fourth session, the Committee felt that the WMO/ECAFE Panel was only just begining its work and that it was accordingl too soon to consider merging these new activities with those of the Typhoon Committee. For that reason the Committee requested the representative of Thailand to continue to serve as rapporteur to the Typhoon Committee on the activities carried out by the joint WMO/ECAFE.Panel.

86. With regard to the activities carried out under the WMO Tropical Cyclo Project, as well as under other regional programmes, the Committee was of the opinion that the TCS should serve as the co-ordinating unit, with such assistance of the WMO Secretariat as might be necessary.

87. It was agreed that the TCS should endeavour to secure and circulate research progress and reports of technical meetings dealing with areas of interest to the Committee. A suggestion was made to the effect that possibili be explored for sending a representative of the Typhoon Committee to the annua AMS Hurricane Conference.

/VIII. AMENDMENT

VIII. AMENDMENT TO THE STATUTE OF THE TYPHOON COMMITTEE
(Agenda item 10)

88. The Committee examined several proposed amendments to its Statute. However, it was recognized that there had not been sufficient time to examine them in detail. The Committee therefore instructed ECAFE and WMO to submit the proposed amendments to the participating Governments for comment and in the event of there being no comment by the Governments, for eventual adoption in accordance with Article 11 of its Statute.

IX. DATE AND PLACE OF THE SIXTH SESSION
(Agenda item 11)

89. The Committee accepted with acclamation an offer made by the representative of Hong Kong to explore the possibility of holding the sixth session of the Committee, due to be held in 1973, at Hong Kong. It was left to the ECAFE secretariat, in the event of a formal offer being received from the Government of Hong Kong, to arrange the date of the meeting.

X. CLOSURE OF THE SESSION
(Agenda item 12)

90. At the closure of the session on 21 November 1972 the Committee considered and adopted, with minor amendments, the report of the session prepared by the Drafting Committee. The Committee unanimously adopted

/a vote of thanks

a vote of thanks to the Chairman and Vice-Chairman and to the Chairman of the Drafting Committee for their services during the meeting, to the ECAFE, WMO and TCS secretariats for the arrangements for the meeting, and to the Government and people of Thailand for their warm hospitality.

ANNEX I

LIST OF PARTICIPANTS

MEMBERS OF THE TYPHOON COMMITTEE

HONG KONG

Representative: Mr. G.J. Bell, Director, Royal Observatory

Alternate: Mr. P.C. Chin, Senior Scientific Officer, Royal Observatory

JAPAN

Representative: Mr. Tatsuo Kawagoe, Director-General, Public Works Research Institute, Ministry of Construction, Tokyo

Alternates: Mr. Ken Suda, Telecommunications Councillor, Japan Meteorological Agency, Tokyo

Mr. Yasuo Tokuoka, First Secretary, Embassy of Japan, Bangkok

Mr. Takayuki Kimura, Second Secretary and Alternate Permanent Representative to ECAFE, Embassy of Japan, Bangkok

KHMER REPUBLIC

Representative: Mr. Hak Eng, Counsellor and Permanent Representative to ECAFE, Embassy of Khmer Republic, Bangkok

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KOREA, REPUBLIC OF

Representative: Mr. In Ki Yang, Director-General, Central Meteorological Office, Ministry of Science and Technology, Seoul

Alternate: Mr. Chul Jin Kim, Second Secretary and Alternate Permanent Representative to ECAFE, Embassy of the Republic of Korea, Bangkok

LAOS

Representative: M. Khamtanh Kanhalikham, Directeur du Service Nationale de la Météorologie et de l'Hydrométéorologie, Vientiane

Alternate: M. Issara K. Sasorith, Directeur du Service de l'Hydraulique et de la Navigation, Vientiane

PHILIPPINES

Representative: Mr. Roman L. Kintanar, Director, Weather Bureau, Quezon Cit

Adviser: Mr. A.H. Gordon, Project Manager, UNDP/WMO Project Manager on Meteorological Training and Research, Manila

THAILAND

Representative: Mr. Charoen Charoen-rajapark, Director-General, Meteorolog Department, Ministry of Communications, Bangkok

Alternates: Capt. Prasert Soontarotok, R.T.N., Deputy Director-General, Meteorological Department, Ministry of Communications

Mr. Wiroj Sangvaree, Chief, Hydrometeorology Division, Meteorological Department, Ministry of Communications

Mr. Damrong Jaraswathana, Director, Hydrology Division, Royal Irrigation Department, Ministry of Agriculture

Mr. Thongterm Yuktanuntana, First Grade Engineer, Hydrolog Division, Royal Irrigation Department, Ministry of Agricul

Mr. Suvat Saguanwongse, Hydrologist, Investigation and Planning Division, National Energy Authority, Office of the Prime Minister

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THAILAND (continued)

lternates: continued)

Mr. Chamlong Paladesh, Chief, Civil Defense Division, Department of Local Administration, Ministry of Interior

Second Class Lt. Montree Surarangsan, Second Grade Technical Services Officer, Training Division, Technical Service Division Department of Local Administration, Ministry of Interior

Mr. Prawit Harnnarong, Chief, Disaster Relief Division, Department of Public Welfare, Ministry of Interior

Mr. Tubkaew Bhiboolnakrin, First Grade Technical Officer, International and Public Relations Division, Social Studies and Planning Division, Department of Public Welfare, Ministry of Interior

OTHER ECAFE MEMBER COUNTRIES

AUSTRALIA

epresentative: Mr. A.J. Shields, Regional Director, Bureau of Meteorology, Queensland

FRANCE

epresentative: M. R. du Chaxel, Counseiller Technique du Représentant Permanent OMM, Paris

UNION OF SOVIET SOCIALIST REPUBLICS

epresentative: Mr. E.V. Khrustalev, Counsellor and Permanent Representative of the USSR to ECAFE, Embassy of the USSR, Bangkok

lternate: Mr. V.N. Voronin, Attaché and Assistant Permanent Representative of the USSR to ECAFE, Embassy of the USSR, Bangkok

UNITED STATES OF AMERICA

epresentative: Mr. Donald F. Moore, Assistant Administrator for Environmental Modification, National Oceanic and Atmospheric Administration, Department of Commerce, Washington D.C.

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UNITED STATES OF AMERICA (continued)

Alternates: Mr. Charles R. Holliday, US Joint Typhoon Warning Center, Guam

Mr. Berry W. Rowe, Meteorological Adviser to US Mission, Udorn, Thailand

Mr. Nels E. Johnson, Deputy Director, International Affairs, National Oceanic and Atmospheric Administration, Department of Commerce, Washington D.C.

Mr. William J. Tonesk, First Secretary and Deputy Permanent Representative to ECAFE, American Embassy, Bangkok

OTHER STATE

FEDERAL REPUBLIC OF GERMANY[1]

Representative: Dr. Hinrich Voss, Director, German Meteorological Service, Offenbach

Alternate: Dr. Ingo von Ruckteschell, Counsellor (Economics) and Permanent Observer to ECAFE, Embassy of the Federal Republic of Germany, Bangkok

OTHER UNITED NATIONS BODIES

United Nations Development Programme (UNDP)	Mr. Jukka Holopainen, Deputy Regional Representative of the United Nations Development Programme in the Far East, Bangko
United Nations Disaster Relief Office (UNDRO)	Mr. Jean-Paul Lévy, Disaster Relief Officer

SPECIALIZED AGENCIES

International Civil Aviation Organization (ICAO)	Mr. F.A.L. Oliveira, Technical Officer (Meteorology), Far East and Pacific Office, Bangkok
International Telecommunication Union (ITU)	Mr. K.V. Pai, Senior Regional Telecommunicat Expert, ECAFE/ITU Unit

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1/ The Federal Republic of Germany, participating in a consultative capacit under ECOSOC resolution 617 (XXII) of 20 July 1956.

NON-GOVERNMENT ORGANIZATION

Category I

League of Red Cross Societies (LRCS)	Dr. Kingsley Seevaratnam, Regional Officer for Asia, League of Red Cross Societies, 1211, Geneva 19

SECRETARIAT

ECAFE

J Nyun	Executive Secretary
Mr. Alan D. Benham	Chief, Natural Resources Division
Mr. A.S. Manalac	Officer-in-Charge, Water Resources Section
Mr. M. Kawamura	Economic Affairs Officer, Water Resources Section
Mr. C. Suriyakumaran	Chief, Policy and Co-ordination Office, and Special Assistant to the Executive Secretary
Mr. Joseph F. El Haj	Chief, Division of Administration
Mr. H.P.T. Willis	Chief, Conference and General Services Section, Division of Administration
Mrs. Janette L. McNeill	Chief, Information Service
Mr. Arthur H. Cooke	Information Officer
Mr. Satis Indrakamhaeng	Information Officer

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SECRETARIAT (continued)

Mr. G. Schmidt	Chief, Language Services
Mr. C. Massaux	Interpreter
Mrs. F. Sala	Interpreter
Mr. F. Siegenthaler	Interpreter

WMO

Mr. A.H. Glaser	Director, World Weather Watch Department
Mr. P. Rogers	Special Projects Officer, Operations and Facilities Division

TYPHOON COMMITTEE SECRETARIAT

Mr. S.N. Sen	Chief, Typhoon Committee Secretariat, c/o UNDP, Manila
Mr. C.H. Tang	Telecommunication and Electronic Expert
Mr. A. Hamamori	Hydrologist and Flood Forecasting and Warning Expert

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COMMITTEE FOR CO-ORDINATION OF INVESTIGATIONS OF THE LOWER MEKONG BASIN

Mr. S. Sangsnit	Chief, Hydrometeorologist

ANNEX II

AGENDA

1. Opening of the session
2. Election of the chairman and vice-chairman
3. Adoption of the agenda
4. The Committee's activities during 1972:
   (a) Meteorological component
   (b) Hydrological component
   (c) Complementary protective measures
   (d) Training and research
5. Programme for 1973 and beyond
6. Request to UNDP for assistance in support of the Typhoon Committee
7. Disaster planning and community preparedness
8. Damage caused by typhoons, cyclones and accompanying storm surges
9. Co-ordination with WMO tropical cyclone project and other regional projects
10. Amendment to the Statute of the Typhoon Committee
11. Date and place of the sixth session
12. Closure of the session.

ANNEX III

LIST OF DOCUMENTS

	Title	Document No.
1.	Provisional agenda	WRD/TC.5/1
2.	Annotated provisional agenda	WRD/TC.5/2
3.	Note on the session	WRD/TC.5/3
4.	Provisional list of documents	WRD/TC.5/4
5.	Provisional list of participants	WRD/TC.5/5
6.	Activities of the Typhoon Committee during 1972	WRD/TC.5/6
7.	Programme for 1973 and beyond	WRD/TC.5/7
8.	Draft request to UNDP for institutional support to the Typhoon Committee	WRD/TC.5/8
9.	Disaster planning and community preparedness	WRD/TC.5/9
10.	Damage caused by typhoons, cyclones and accompanying storm surges	WRD/TC.5/10
11.	Co-ordination with WMO Tropical Cyclone project and other regional projects	WRD/TC.5/11
12.	Tentative programme	WRD/TC.5/12
13.	Note on community preparedness and disaster prevention activities in the Typhoon Committee countries	WRD/TC.5/13
14.	Some typhoon soundings and their comparison with soundings in hurricanes	WRD/TC.5/14
15.	International action for the mitigation of harmful effects of storms	WRD/TC.5/15
16.	Proposed amendments to the statute of the Typhoon Committee	WRD/TC.5/16
17.	Typhoon research in the Philippines	WRD/TC.5/17
18.	Examples of methods and machinery for alerting the public and providing protections in zones subject to typhoon	WRD/TC.5/18
19.	1972 Basin-wide flood forecasting for the Lower Mekong Basin	WRD/TC.5/19

FOR PARTICIPANTS ONLY

WRD/TC.5/1/Rev.1
15 November 1972

ORIGINAL : ENGLISH

UNITED NATIONS ECONOMIC COMMISSION FOR ASIA AND THE FAR EAST
AND
WORLD METEOROLOGICAL ORGANIZATION

Typhoon Committee
Fifth session
15-21 November 1972
Bangkok

PROVISIONAL AGENDA

1. Opening of the session
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FOR PARTICIPANTS ONLY

WRD/TC.5/2
7 August 1972

ORIGINAL : ENGLISH

NITED NATIONS ECONOMIC COMMISSION FOR ASIA AND THE FAR EAST
ND
ORLD METEOROLOGICAL ORGANIZATION

yphoon Committee
ifth session
5-21 November 1972
angkok

ANNOTATED PROVISIONAL AGENDA

. Opening of the session

The fifth session of the Typhoon Committee will be held from 15 to 1 November 1972 at Sala Santitham, headquarters of the Economic Commission or Asia and the Far East, Bangkok.

. Election of the chairman and the vice-chairman

Rule 6 of the rules of procedure of the Typhoon Committee states: The Committee shall, at its first meeting of the year, elect from its epresentatives a chairman and a vice-chairman, who shall hold office until heir successors are elected. They shall be eligible for re-election".

. Adoption of the agenda

The provisional agenda was prepared after consultation between ECAFE nd WMO, due consideration being given to the advice of the Committee ecretariat and the views of the participating Governments. Representatives f participating Governments may, if they wish, propose additions to or changes n the agenda.

. The Committee's activities during 1972

A tentative action programme on typhoon damage control was endorsed y the Typhoon Committee at its first session in December 1968. The activities

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of the Committee and its secretariat during 1969, 1970 and 1971 were review at previous annual sessions, and a similar review for 1972 will be made und this item on the basis of a report prepared by the secretariat (WRD/TC.5/6).

In reviewing the four components of the action programme separately, the Committee will be in a position to assess the progress made since its fourth session. Representatives may wish to comment on the activities in 1972, offer suggestions on accelerating the work and draw attention to special items which call for priority action. They may also report on the establishment in their countries during 1972 of any facilities not covered in the report.

5. Programme for 1973 and beyond

While the tentative action programme approved at the first session continues to provide the general guidelines for future activities, the Comm may wish to concentrate on specific items of work during 1973. A tentative list of such items is presented in document WRD/TC.5/7.

6. Request to UNDP for assistance in support of the Typhoon Committee

At its fourth session the Committee considered the outline of a tentative request to UNDP for assistance in the form of institutional supp to the Typhoon Committee. The Committee decided to go ahead with the prop and drew up a revised list of elements that should be included in Phase I the project. It directed the secretariat to prepare a draft request on the basis of the revised list, in consultation with the ECAFE and WMO secr tariats, and to circulate to member countries for their concurrence pri to submission to UNDP. These instructions have been carried out by the Committee secretariat.

In the meantime, and partly as a result of the Committee's decisio to request UNDP assistance, UNDP decided to have the on-going typhoon project reviewed by a joint UNDP/WMO/ECAFE review mission. The purpose of the mission was to evaluate the Typhoon Programme project in the ECAFE regi

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nd to make recommendations on the continuation and possible expansion of he project. The mission team, composed of one representative each from NDP, WMO and ECAFE, visited several member countries during June 1972 and ubmitted its report to UNDP headquarters.

When the Typhoon Committee meets in November, it will be possible o report on the reactions of the member countries to the draft request and n the outcome of the review mission. The Committee may wish to consider he matter in the light of the latest developments and make further recom- endations.

7. Disaster planning and community preparedness

The main development since the last session of the Typhoon Committee nder the component of its programme devoted to complementary protective easures has been the organization of a survey of present disaster planning nd community preparedness arrangements in the member countries. The survey as carried out by a consultant during the last four months of 1971. The consultant visited each of the member countries and prepared a eport, including recommendations for further action. The consultant's report (WRD/TC.5/9) has been circulated by the Committee secretariat and will be before the Committee.

Consultations have taken place between ECAFE, WMO and the League of Red Cross Societies on the best way of following up the consultant's urvey. Because of the need revealed by the survey to improve liaison etween the national agencies involved, a joint LRCS/WMO/ECAFE mission has een proposed with the object of laying the foundations for an accelerated rogramme of community preparedness. At the time of preparing this document, arrangements for organizing the proposed mission in early 1973 were being iscussed between LRCS, WMO and ECAFE. It is intended that the Typhoon ommittee should consider the proposals in detail at its fifth session.

8. Damage caused by typhoons, cyclones and accompanying storm surges

At its ninth session in October 1970 the ECAFE Regional Conference n Water Resources Development advised the secretariat to undertake a comprehensive study and quantification of damage caused by typhoons, cyclones

/and accompanying

and accompanying storm surges and the effect of such damage on the economy of the area affected". In pursuance to this recommendation, the ECAFE secretariat sent out questionnaires to the countries affected by typhoons and cyclones and collected damage statistics. A detailed analysis has been made of the magnitude of damage and its effect on the economies of the countries affected. The results of the study are contained in a note (WRD/TC.5/10) prepared by the ECAFE secretariat.

9. Co-ordination with WMO tropical cyclone project and other regional projects

The main purpose of this item is to inform the Typhoon Committee of recent developments in the WMO tropical cyclone project and other simil regional programmes being carried out by WMO. The joint WMO/ECAFE Panel on Tropical Cyclones, covering the Bay of Bengal and the Arabian Sea, and the RA I Tropical Cyclone Committee for the South-West Indian Ocean have come into operation since the last session, with responsibilities in their areas very similar to those of the Typhoon Committee in South-East Asia.

The document (WRD/TC.5/11) prepared for the fifth session of the Typhoon Committee contains detailed information on the above activitie and proposals for action by the Committee to ensure effective co-ordinatio of these related projects. In this connexion, the Committee may wish to review the decisions recorded in paragraphs 92 and 93 of the report of the fourth session.

10. Date and place of the sixth session

Rule 1 of the rules of procedure of the Committee states: "The Co shall hold at least one session annually. The venues and dates of its ses shall be decided by the Committee".

FOR PARTICIPANTS ONLY

WRD/TC.5/3
7 August 1972

ORIGINAL : ENGLISH

UNITED NATIONS ECONOMIC COMMISSION FOR ASIA AND THE FAR EAST
AND
WORLD METEOROLOGICAL ORGANIZATION

Typhoon Committee
Fifth Session
15-21 November 1972
Bangkok, Thailand

NOTE ON THE SESSION

Background

1. At its twentieth session held in March 1964, the Economic Commission for Asia and the Far East (ECAFE) recommended that the secretariat, in co-operation with the World Meteorological Organization (WMO), look into practical means of initiating a joint programme for investigating typhoons in the ECAFE region. A subsequent study by the ECAFE secretariat showed that the average annual damage caused by typhoons was of the order of US$500 million and that this was a factor retarding the economic development of the region. The ECAFE and WMO secretariats organized a Meeting of Experts on Typhoons at Manila in December 1965 and, as a result of the recommendations of that meeting, a preparatory mission on typhoons was organized jointly by ECAFE and WMO, with financial assistance from UNDP.

2. After visiting several countries affected by typhoons, the mission prepared a report containing a number of recommendations drawn up with a view to minimizing typhoon damage. The report was examined by a second Meeting of Experts on Typhoons, which met at Bangkok from 5 to 10 October 1967. Besides endorsing the recommendations contained in it, the meeting recommended the establishment of a typhoon committee to co-ordinate their implementation.

3. Subsequently, ECAFE and WMO drafted jointly the Statute and Rules of Procedure for a projected typhoon committee and convened an ad hoc meeting of government representatives at Bangkok from 29 February to 2 March 1968. This meeting unanimously adopted the proposed Statutes. The establishment of an inter-governmental Typhoon Committee was endorsed by the Economic Commission for Asia and the Far East at its twenty-fourth session in 1968 and by the Executive Committee of the World Meteorological Organization at its twentieth session in 1968. Shortly thereafter the ECAFE/WMO Joint Unit on Typhoons was established in the ECAFE secretariat with financial assistance from UNDP.

4. After seven countries had signified their intention of joining the Committee, the inaugural session was convened at Bangkok from 17 to 20 Dec 1968. At this session, the Committee formulated a work programme aiming a improvement of forecasting and warning services in the typhoon area. At i second session, convened at Manila in December 1969, the Committee reviewe implementation of work programme during the first year of operation and de at the invitation of the Government of the Philippines, to transfer the EC Joint Unit from Bangkok to Manila.

5. At its third session, convened in Bangkok in November 1970, the Co reviewed the activities of the Typhoon Committee during 1970 and recommend action programme for 1971 and beyond. The Committee also adopted a resolu on international action for the mitigation of typhoon damage which was su embodied in a General Assembly resolution.

6. In March 1971, the ECAFE/WMO Joint Unit on Typhoons was reconstitu as the Typhoon Committee secretariat.

7. At its fourth session, convened at Tokyo in October 1970, the Com directed the Typhoon Committee secretariat to prepare a draft request to for assistance in support of the Committee for the concurrence of partic countries before formally presenting the request to the Governing Council of the UNDP.

8. At the twenty-eighth session of the ECAFE Commission for Asia and East, in response to an invitation extended by the Executive Secretary of and the Secretary-General of WMO on behalf of the Typhoon Committee, the Government of the Khmer Republic indicated its willingness to join the T Committee.

Venue and date

9. The fifth session of the Committee will take place at Bangkok fr 21 November 1972. The inaugural meeting will begin at 10.00 a.m. on Wed 15 November, at Sala Santitham, headquarters of the Economic Commission and the Far East in Bangkok. Subsequent meetings will be held at the sa

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gistration and credentials

. A registration counter set up in front of Committee Room No. 4 on the rst floor of Sala Santitham will open at 9.00 a.m. on Wednesday, 15 November. rticipants are requested to register prior to the inaugural meeting. They are quested to present their official credentials, duly signed by the appropriate thority of their home country, to the Conference Officer when registering.

ogramme

After electing a chairman and vice-chairman, the Committee will review progress of the work undertaken by member countries with the assistance of the hoon Committee secretariat and discuss the action to be taken in respect of ure activities, in accordance with the Provisional Agenda and Annotated visional Agenda.

dy Tour

A one-day tour of meteorological and hydrological facilities in Thailand l be held on Saturday, 18 November 1972 in conjunction with the meeting.

ticipation

Invitations have been extended to the following Governments which are bers of the Typhoon Committee: the People's Republic of China[1/], Hong Kong, an, the Khmer Republic, the Republic of Korea, Laos, the Philippines and land. Australia, France, the Federal Republic of Germany, the Netherlands, Union of Soviet Socialist Republics, the United Kingdom and the United States merica, have been invited to send observers. The International Civil Aviation nization (ICAO), the International Telecommunication Union (ITU) and the League ed Cross Societies have also been invited to send observers.

ate

The climate of Bangkok during November is usually humid and warm, with sional showers. The mean daily temperature is 26.9°C (80.4°F), the average y maximum of 31°C (87.8°F), and average daily minimum 23°C (73°F). The mean nly rainfall is 40 mm (1.9 inches).

1/ In consequence of the General Assembly's recent resolution on the representation of China in the United Nations, the People's Republic of China is entitled to be represented on the Economic Commission for Asia and the Far East and on all its subsidiary and special project bodies, including the Typhoon Committee.

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Passports and visas

15. Participants are required to posses a valid passport and visa for ent to Thailand. Visas are obtainable at any Thai diplomatic or consular missio abroad. Where there is no such mission, participants are advised to make a stop-over en route to obtain the requisite entry visa.

Health requirements

16. Participants must have a valid certificate of vaccination against sm and those coming from or passing through areas infected with cholera are re to be inoculated against cholera. Participants are advised to consult local agencies at least two weeks in advance of departure to obtain the latest inf regarding health requirements.

Foreign exchange

17. Participants may bring travellers cheques or drafts in US dollars or sterling into Thailand and exchange them at the rate of 20.40 bahts to the and about 52.00 bahts to the pound. Rates fluctuate slightly from time to

18. Exchange facilities are available at hotels and at the Sala Santith Branch of the Siam Commercial Bank which is open from 0900 to 1200 and from to 1500 hours from Monday to Friday, with the exception of official holiday

Hotel accommodation

19. Accommodation will be reserved on request at one or other of the undermentioned hotels, all of which are in close proximity to Sala Santitha for that reason recommended. Special tariffs available to participants are follows:

Royal Hotel

Single room	Baht 120
Double room	Baht 180

Viengtai Hotel

Single room	Baht 100
Double room	Baht 140

Majestic Hotel

Single room	Baht 100
Double room	Baht 160

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Thai Hotel

Single room	Baht 120
Double room	Baht 180

R.S. Hotel

Single room	Baht 120
Double room	Baht 180

The rates quoted are for air-conditioned rooms. Charges for meals are ditional and may amount to 100 bahts a day or more. The room rents quoted are clusive of service charge except in the case of the R.S. Hotel, for which a per cent service charge is payable. Meals are subject to a 10 per cent service arge at all hotels: Room rents are subject to alteration without notice.

Participants wishing the secretariat to reserve rooms for them at any of e above hotels are requested to fill in the attached form (annex 1) and send it soon as possible to the Natural Resources Division, ECAFE, Sala Santitham, ngkok.

ception on arrival

. Provided sufficient notice is given, participants will be met on arrival at ngkok Airport by a member of the secretariat who will assist them in complying th customs and immigration formalities and in arranging for transport to their otels.

ocal transport

. As far as possible, transport will be provided to bring participants from e above hotels to Sala Santitham and to take them back at the end of each meeting s well as to and from all official functions. As there is sometimes a heavy demand or transport in the evening, participants are requested not to rely entirely on fficial transport on returning to their hotels. The usual taxi fare from Sala antitham to any of the hotels mentioned is 5 to 7 baht.

orking language

4. The working language of the meeting will be English and French.

ocuments

5. As the number of copies available for distribution at the meeting is limited, articipants are requested to bring a complete set of the working documents sent to em through official channels. Other documents will be distributed as issued during e course of the meeting.

Annex 1

UNITED NATIONS ECONOMIC COMMISSION FOR ASIA AND THE FAR EAST

AND

WORLD METEOROLOGICAL ORGANIZATION
FIFTH SESSION OF THE TYPHOON COMMITTEE

15-21 November 1972
Bangkok

1. Schedule of arrival

Name _____
(surname first)

accompanied by Mr., Mrs., Miss _____

will arrive Bangkok Airport at _____ hours, on _____ 1972
(date)

on board _____
(flight number)

_____ _____
(date) (signature)

.....

2. Hotel accommodation

Name _____
(surname first)

accompanied by Mr., Mrs., Miss _____

wishes to reserve a single/double room at _____ Hotel

from _____ to _____
(date) (date)

_____ _____
(date) (signature)

FOR PARTICIPANTS ONLY

WRD/TC.5/4/Rev.1
26 October 1972

ORIGINAL : ENGLISH

NITED NATIONS ECONOMIC COMMISSION FOR ASIA AND THE FAR EAST
ND
ORLD METEOROLOGICAL ORGANIZATION

yphoon Committee
ifth session
5-21 November 1972
angkok, Thailand

PROVISIONAL LIST OF DOCUMENTS

Title	Document No.
1. Provisional agenda	WRD/TC.5/1
2. Annotated provisional agenda	WRD/TC.5/2
3. Note on the session	WRD/TC.5/3
4. Provisional list of documents	WRD/TC.5/4 (Rev.1)
5. Provisional list of participants	WRD/TC.5/5
6. Activities of the Typhoon Committee during 1972	WRD/TC.5/6
7. Programme for 1973 and beyond	WRD/TC.5/7
8. Draft request to UNDP for institutional support to the Typhoon Committee	WRD/TC.5/8
9. Disaster planning and community preparedness	WRD/TC.5/9
0. Damage caused by typhoons, cyclones and accompanying storm surges	WRD/TC.5/10
1. Co-ordination with WMO tropical cyclone project and other regional projects	WRD/TC.5/11
2. Tentative programme	WRD/TC.5/12
3. Note on community preparedness and disaster prevention activities in the Typhoon Committee countries	WRD/TC.5/13

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WRD/TC.5/5
FOR PARTICIPANTS ONLY

16 November 1972

ORIGINAL : ENGLISH

ECONOMIC COMMISSION FOR ASIA AND THE FAR EAST
AND
WORLD METEOROLOGICAL ORGANIZATION

Typhoon Committee
Fifth session
15-21 November 1972
Bangkok, Thailand

LIST OF PARTICIPANTS

MEMBERS OF THE TYPHOON COMMITTEE

HONG KONG

Representative: Mr. G.J. Bell, Director, Royal Observatory

Alternate: Mr. P.C. Chin, Senior Scientific Officer, Royal Observatory

JAPAN

Representative: Mr. Tatsuo Kawagoe, Director-General, Public Works Research Institute, Ministry of Construction, Tokyo

Alternates: Mr. Ken Suda, Telecommunications Councillor, Japan Meteorological Agency, Tokyo

Mr. Yasuo Tokuoka, First Secretary, Embassy of Japan, Bangkok

Mr. Takayuki Kimura, Second Secretary and Alternate Permanent Representative to ECAFE, Embassy of Japan, Bangkok

KHMER REPUBLIC

Representative: Mr. Hak Eng, Counsellor and Permanent Representative to ECAFE, Embassy of Khmer Republic, Bangkok

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KOREA, REPUBLIC OF

Representative: Mr. In Ki Yang, Director-General, Central Meteorolog
Office, Ministry of Science and Technology, Seoul

Alternate: Mr. Chul Jin Kim, Second Secretary and Alternate Per
Representative to ECAFE, Embassy of the Republic of
Bangkok

LAOS

Representative: M. Khamtanh Kanhalikham, Directeur du Service Nation
de la Météorologie et de l'Hydrométéorologie, Vienti

Alternate: M. Issara K. Sasorith, Directeur du Service de l'Hyd
et de la Navigation, Vientiane

PHILIPPINES

Representative: Mr. Roman L. Kintanar, Director, Weather Bureau, Que

Adviser: Mr. A.H. Gordon, Project Manager, UNDP/WMO Project M
Meteorological Training and Research, Manila

THAILAND

Representative: Mr. Charoen Charoen-rajapark, Director-General, Mete
Department, Ministry of Communications, Bangkok

Alternates: Cap. Prasert Soontarotok, R.T.N., Deputy Director-Ge
Meteorological Department, Ministry of Communicatio

Mr. Wiroj Sangvaree, Chief, Hydrometeorology Divisi
Meteorological Department, Ministry of Communicatio

Mr. Damrong Jaraswathana, Director, Hydrology Divisi
Royal Irrigation Department, Ministry of Agricultur

Mr. Thongterm Yuktanuntana, First Grade Engineer, Hy
Division, Royal Irrigation Department, Ministry of A

Mr. Suvat Saguanwongse, Hydrologist, Investigation a
Planning Division, National Energy Authority, Offic
Prime Minister

Mr. Chamlong Paladesh, Chief, Civil Defense Divisio
Department of Local Administration, Ministry of Int

..

THAILAND (continued)

ernates: Second Class Lt. Montree Surarangsan, Second Grade Technical
ntinued) Services Officer, Training Division, Technical Service Division
Department of Local Administration, Ministry of Interior

Mr. Prawit Harnnarong, Chief, Disaster Relief Division,
Department of Public Welfare, Ministry of Interior

Mr. Tubkaew Bhiboolnakrin, First Grade Technical Officer,
International and Public Relations Division, Social Studies
and Planning Division, Department of Public Welfare,
Ministry of Interior

OTHER ECAFE MEMBER COUNTRIES

AUSTRALIA

resentative: Mr. A.J. Shields, Regional Director, Bureau of Meteorology,
Queensland

FRANCE

resentative: M. R. du Chaxel, Conseiller Technique du Représentant
Permanent OMM, Paris

UNION OF SOVIET SOCIALIST REPUBLICS

resentative: Mr. E.V. Khrustalev, Counsellor and Permanent Representative
of the USSR to ECAFE, Embassy of the USSR, Bangkok

ernate: Mr. V.N. Voronin, Attaché and Assistant Permanent Represen-
tative of the USSR to ECAFE, Embassy of the USSR, Bangkok

UNITED STATES OF AMERICA

resentative: Mr. Donald F. Moore, Assistant Administrator for
Environmental Modification, National Oceanic and Atmospheric
Administration, Department of Commerce, Washington D.C.

ernates: Mr. Charles R. Holliday, US Joint Typhoon Warning Center,
Guam

/...

UNITED STATES OF AMERICA (continued)

Alternates: (continued)

Mr. Berry W. Rowe, Meteorological Adviser to US Missi Udorn, Thailand

Mr. Nels E. Johnson, Deputy Director, International A National Oceanic and Atmospheric Administration, Depa of Commerce, Washington D.C.

Mr. William J. Tonesk, First Secrerary and Deputy Per Representative to ECAFE, American Embassy, Bangkok

OTHER STATE

FEDERAL REPUBLIC OF GERMANY[1]

Representative: Dr. Hinrich Voss, Director, German Meteorological Ser Offenbach

Alternate: Dr. Ingo von Ruckteschell, Counsellor (Economics) and Permanent Observer to ECAFE, Embassy of the Federal R of Germany, Bangkok

OTHER UNITED NATIONS BODIES

United Nations Development Programme (UNDP)	Mr. Jukka Holopainen, Deputy Regional Representative of the United Nations Development Programme in the Far East Bangkok
United Nations Disaster Relief Office (UNDRO)	Mr. Jean-Paul Lévy, Disaster Relief

SPECIALIZED AGENCIES

International Civil Aviation Organization (ICAO)	Mr. F.A.L. Oliveira, Technical Offic (Meteorology), Far East and Pacific Bangkok
International Telecommunication Union (ITU)	Mr. K.V. Pai, Senior Regional Teleco Expert, ECAFE/ITU Unit

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1/ The Federal Republic of Germany, participating in a consultative under ECOSOC resolution 617 (XXII) of 20 July 1956.

NON-GOVERNMENTAL ORGANIZATION

Category I

eague of Red Cross ocieties (LRCS)	Dr. Kingsley Seevaratnam, Regional Officer for Asia, League of Red Cross Societies, 1211, Geneva 19

SECRETARIAT

CAFE

Nyun	Executive Secretary
----------	
r. Alan D. Benham	Chief, Natural Resources Division
r. A.S. Manalac	Officer-in-Charge, Water Resources Section
r. M. Kawamura	Economic Affairs Officer, Water Resources Section
----------	
r. C. Suriyakumaran	Chief, Policy and Co-ordination Office, and Special Assistant to the Executive Secretary
----------	
r. Joseph F. El Haj	Chief, Division of Administration
r. H.P.T. Willis	Chief, Conference and General Services Section, Division of Administration
----------	
rs. Janette L. McNeill	Chief, Information Service
r. Arthur H. Cooke	Information Officer
r. Satis Indrakamhaeng	Information Officer

/...

SECRETARIAT (continued)

Mr. G. Schmidt	Chief, Language Services
Mr. C. Massaux	Interpreter
Mrs. F. Sala	Interpreter
Mr. F. Siegenthaler	Interpreter

WMO

Mr. A.H. Glaser	Director, World Weather Watch Depa
Mr. P. Rogers	Special Projects Officer, Operatio Facilities Division

TYPHOON COMMITTEE SECRETARIAT

Mr. S.N. Sen	Chief, Typhoon Committee Secretari c/o UNDP, Manila
Mr. C.H. Tang	Telecommunication and Electronic E
Mr. A. Hamamori	Hydrologist and Flood Forecasting Warning Expert

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COMMITTEE FOR CO-ORDINATION OF INVESTIGATIONS OF THE LOWER MEKONG

Mr. S. Sangsnit	Chief, Hydrometeorologist

FOR PARTICIPANTS ONLY

WRD/TC5/6
13 October 1972

ORIGINAL : ENGLISH

UNITED NATIONS ECONOMIC COMMISSION FOR ASIA AND THE FAR EAST

AND

WORLD METEOROLOGICAL ORGANIZATION

Typhoon Committee
Fifth session
15-21 November 1972
Bangkok

ACTIVITIES OF THE TYPHOON COMMITTEE IN 1972

(Item 4 of the provisional agenda)

Note by the Typhoon Committee secretariat

Contents

I. FOURTH SESSION OF THE TYPHOON COMMITTEE

1. The fourth session of the Typhoon Committee was held at Tokyo from 4 to 11 October 1971. The meeting was attended by representatives of all seven member countries. Representatives of Australia, the Khmer Republic, the Federal Republic of Germany, the Union of Soviet Socialist Republics, the United States of America attended as observers. A representative of the United Nations Development Programme (UNDP) and observers for the International Civil Aviation Organization (ICAO), the International Telecommunication Union (ITU), the League of Red Cross Societies (LRCS) and the Committee for Co-ordination of Investigations of the Lower Mekong Basin were also present.

2. The representatives reviewed the activities of the Typhoon Committee and its secretariat during 1971 and took stock of the current state of implementation of the meteorological, telecommunication, hydrological and complementary facilities required for an efficient system for the mitigation of typhoon damage. The list of priorities drawn up at the third session for the implementation of observational and telecommunication facilities was reviewed by the Committee in the light of the progress made and a new priority list was drawn up to guide future implementation.

3. The Committee discussed the sources of assistance for new facilities. It recorded appreciation to the USSR for operating research vessels in the Pacific during the typhoon season and expressed its hope that this support would continue. The Government of Japan's offer of technical assistance and flood forecasting equipment to the Philippines was welcomed. The Committee also recorded its appreciation of the valuable assistance provided by the Government of Japan in organizing training courses on flood forecasting during 1971 and for their offer of similar training courses in 1972.

4. Referring to the survey conducted by a community preparedness/disaster relief expert during the last four months of 1971, the Committee expressed its appreciation of the assistance provided by the League of Red Cross Societies in arranging for that expert's services. It also expressed the hope that an expert in this field would be available on a part-time basis in future years to assist the Committee in carrying out this part of its programme.

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5. The Committee agreed on the outline of a tentative request to UNDP for institutional support to the Typhoon Committee. The Committee requested the TCS to prepare a final draft request to UNDP on the basis of the outline and, after consultation with ECAFE and WMO secretariats, to circulate the request to the member countries for their concurrence prior to submission to UNDP.

6. Another important topic discussed by the Committee was that of the proposed transfer of Project Stormfury to the Pacific in 1972. The proposal was welcomed in principle by the Committee, subject to agreement on appropriate criteria and restrictive conditions for seeding experiments. The Committee was informed that the United States authorities would take up the questions through bilateral consultations.

7. The session was followed by a three-day study tour which included visits to Lake Biwa and Yodo river flood forecasting and flood control facilities. The visit to the storm surge barriers and enbankments protecting Osaka was specially impressive.

II. ACTIVITIES DURING 1972

8. The twenty-eighth session of ECAFE, held at Bangkok in March 1972 considered the report of the Typhoon Committee. The Committee expressed appreciation of the progress made by the Typhoon Committee during 1971 and endorsed the work programme for 1972 and beyond. It also endorsed the Committee's proposal to approach UNDP for increased assistance to ensure rapid progress in accomplishing its objectives. Recalling the proposal of the United States to transfer its "Stormfury" research project to the Pacific the Commission was informed that owing to a number of unresolved difficulties it would not be possible to proceed with the proposed transfer in 1972, as originally anticipated.

9. It was announced at the session that the Government of the Khmer Republic had announced its decision to join the Typhoon Committee. ECAFE, WMO, and TCS, on behalf of the Typhoon Committee, welcomed the Khmer Republic as a member of the Committee. With reference to the Preparatory Mission's

/recommendations

commendations in 1967, which covered the Khmer Republic as well, the TCS quested the national agencies concerned to send information on the latest velopments in meteorological and hydrological facilities.

In accordance with the decision of the fourth session of the Committee, draft request to UNDP for assistance was prepared by the TCS. After detailed scussions with the WMO and ECAFE secretariats, a revised text was finalized d copies were distributed to the member countries. The revised draft request ll be discussed under agenda item 8 and a separate document (WRD/TC5/8) prodes relevant background and the latest information on the subject.

. The UNDP organized a joint UNDP/WMO/ECAFE review mission to evaluate e on-going typhoon project with the aim of making recommendations concerning e project's continuance and possible expansion. The review mission was ganized partly as a result of the Typhoon Committee's decision to request stitutional support from UNDP. The joint review mission comprising of . Morton G. Wurtele (UNDP), Mr. R.H. Foote (WMO) and Mr. M. Kawamura (ECAFE) sited Bangkok, Tokyo, Seoul and Manila from 2 to 23 June 1972. The mission scussed with the appropriate Government authorities the benefits so far rived from the project and future plans for the Typhoon Committee's activities. e mission also had discussions with TCS and prepared its report at Manila.

. The experts of the TCS made the following visits to member countries d to the ECAFE and WMO secretariats:

(a) Dr. Sen	:	Bangkok, Vientiane and Hong Kong, 13-28 March; Geneva, 9-21 April; Bangkok and Hong Kong, 7-13 May; Seoul, Tokyo, Bangkok and Phnom Penh, 26 September - 13 October 1972.
(b) Mr. Tang	:	Basco and Gaguio (Philippines), 25-29 March and 7-9 April; Bangkok and Vientiane, 11-23 September 1972.
(c) Mr. Hamamori	:	Seoul, 17-21 October 1971; Bangkok and Vientiane, 22-30 March; Bangkok, 6-14 September 1972.
(d) Mr. Hickey	:	Seoul, Taipei and Hong Kong, 19-30 October 1971; Bangkok and Vientiane, 29 November - 7 December 1971.

/13.

13. Details of the progress made or action taken since the fourth ses under each component of the action programme are reported in the followi sections. Points on which the Committee may wish to consider further act listed under each of these sections.

A. METEOROLOGICAL COMPONENT

1. Status of meteorological observing and telecommunication syst

14. It is customary at each session of the Typhoon Committee to exami the degree to which the meteorological and telecommunication facilities essential to an efficient typhoon warning service have been implemented i the member countries. The review is based essentially on facilities form part of the World Weather Watch (WWW) plan.

15. The information presented here is intended to assist the Committe reviewing this part of its programme. It consists mainly of lists of th facilities which are not yet in operation, together with brief remarks on outlook for their implementation over the next few years. The informati excluding deficiencies in surface observations, is presented in a conden form in annexes I-III.

16. Annex IV summarizes the state of implementation and further plan those facilities included in the revised priority list established at th fourth session. The Committee may wish to give further attention to mea of speeding up action where appropriate. Notification of any correction additions or changes at the session will be appreciated.

2. Other meteorological activities

17. Further developments since the fourth session regarding radio-so radiowind (RS/RW) and radar stations in the Philippines are as follows:

(a) RS/RW station at Cebu and RS station at Zamboanga continued record 00Z observations. RW equipment could not be installed at Zamboan due to lack of land space required for installation of an antenna system new RW station was established at Legaspi in February 1972 and it comme recording 00Z observations. The spare parts needed for repair of the De

/type

ype RW equipment at Manila, which was damaged by typhoon in November 1970, ere received by Weather Bureau and observations are expected to be resumed y the end of 1972. RS/RW observations at Laoag were suspended in November 971 owing to a defective power generator. A building for RW station at uerto Princesa was planned and expected to be completed before the end of 972.

(b) The 10 cm radars at Guian and Virac were out of commission for ant of spare parts. The Weather Bureau initiated necessary action for pro- urement of the required spare parts. Five new 10 cm radars, procured hrough a loan from the United States Import-Export Bank, were received at anila in October 1971. These radars are to be installed at Basco, Baguio, ebu, Daet and San Mateo (near Manila). The installation of the radars at ebu and Daet was completed and their regular operation was expected to ommence soon. The building for the radar at Basco was under construction nd its installation was expected to be completed by the end of 1972.

8. The telecommunication and electronics expert of the TCS rendered ssistance to the Philippine Weather Bureau in carrying out site surveys or installation of the new radars. He visited Basco and Baguio with Weather ureau officials for this purpose. He also assisted the Weather Bureau in epairing the 5.6 cm radar at Manila, some parts of which became defective n July 1972.

9. The Japan Meteorological Agency is planning to take over the upper- ir observation responsibility now borne by the United States forces at adena and to begin upper-air observations at Naha instead of Kadena from January 1973.

0. APT equipment was expected to be installed at Vientiane by the end f 1972 through a bilateral project under which France supplied the equipment. n connexion with efforts made by Laos to secure a weather radar, the TCS uggested to the Director of the Meteorological Service that consideration hould be given to submitting a request to WMO for aid under VAP.

1. Hong Kong reported that reconnaissance flights were made into Typhoon usan in July this year to locate the centre of the typhoon and that plans ere being prepared to carry out such reconnaissance observations in future henever possible.

22. The TCS made a review of the telecommunication facilities in the Philippines by organizing joint discussions with the representatives of the Weather Bureau and other agencies concerned. The results of a study conducted by the TCS on the collection and dissemination of national data were presented, summarizing existing deficiencies with suggestions for remedial measures.

23. A big fire at the Manila International Airport building on 22 January 1972 destroyed Weather Bureau's telecommunication equipment in that building. TCS sent a report to WMO with a recommendation for VAP assistance for early restoration of the essential communication facilities disrupted by the fire. On receipt of Secretary-General's reply and assurance of full support, TCS assisted the Philippine Weather Bureau to prepare a VAP request for telecommunication equipment worth US$509,000 in two phases. The Chief of the TCS discussed the VAP request with the WMO secretariat in April 1972.

24. The telecommunication and electronics expert of TCS visited the United States air base at Clark Field with Weather Bureau officials and discussed arrangements for the establishment of a direct communication link between the Weather Bureau and Clark air base. The direct circuit was established in June 1972.

25. The Meteorological Department at Bangkok submitted a revised VAP request to WMO for strengthening the RTH at Bangkok, taking into account the proposals made by the TCS last year. Following consultations by the chief of TCS at Bangkok and Geneva, various details concerning this request have been the subject of correspondence. In the meantime WMO placed orders for part of the equipment offered under the VAP Cash Fund for $50,000. Equipment worth $20,000 was also received through VAP assistance from Australia and was being installed.

26. Laos has been experiencing difficulty in the maintenance of telecommunication equipment used for national data collection for want of necessary spare parts. The Meteorological Service recently prepared a list of spare parts urgently needed and approached the TCS for assistance in procuring them. The matter will be looked into during the visit of the telecommunication and electronics expert of TCS to Vientiane in September

/27.

7. The following regional point-to-point circuits have been implemented since the fourth session of the Committee:

(a) The Bangkok-Rangoon circuit was established in September 1971;

(b) The Bangkok-New Delhi circuit was established in November 1971.

8. During typhoon situations affecting the Philippines, the Chief of the TCS discussed the current weather charts and inadequacy of observational data with the Weather Bureau forecasters on several occasions. These discussions led to consideration of several remedial measures. Following typhoon "Konsing", which hit Manila on 25 June 1972, it was suggested that arrangements should be made to publish isobaric maps in daily newspapers, at least on days of depressions and typhoons threatening the Philippines. The practice was adopted by some of the newspapers immediately.

9. The existing facilities for dissemination of typhoon warnings in the Philippines and the need for improving them were considered in a joint meeting of the TCS experts and Weather Bureau officials. Necessary steps were taken for the collection of full particulars of the existing facilities and the nature of the deficiencies. It was considered that this would be a useful pilot study and that a similar study could be undertaken in certain other Member countries as well.

3. Actions on decisions of the fourth session

RS/RW station at Vientiane (paragraph 20[1])

10. An unexpected delay occurred in the establishment of this station. However, ground equipment, generators and chemicals were received in the Meteorological Office at Vientiane in March 1972. Arrangements were also completed for the visit of the Vaisala Engineer for installation of the equipment at Vientiane. The station was expected to be established later in the year.

/Installation

[1] This and subsequent references to paragraphs relate to the report of the Committee on its fourth session (E/CN.11/1005).

Installation of an ocean weather ship in the southwest Pacific (paragraphs 23, 24, 25)

31. Soon after the fourth session, the USSR authorities informed the Secretariat and the TCS that they were considering the work programme of research vessels during the 1972 typhoon season. Arrangements for recepti of the observations and for port and other facilities in Japan and in the Philippines were completed by February 1972. At the time of preparing thi document, the decision of the USSR and information on programme of their ships in 1972 were being awaited.

32. Original microfilm strips containing the upper-air observations t by the USSR ocean weather ship "Priliv" in 1970 were distributed to the m countries of the Typhoon Committee.

33. In response to an inquiry made by the Secretary-General of WMO wh German research vessels will take observations during the 1972 typhoon se the Federal Republic of Germany transmitted the programme of their resear vessels "Jason" and "Pollux" in the typhoon area. The information was c lated to the members of the Typhoon Committee.

Bangkok-Vientiane point-to-point link (paragraph 29)

34. The equipment provided by the USSR reached Vientiane in May 1971. telecommunication expert from the USSR visited Vientiane in December 197 determine further steps required to make the link operational. The reco tions made by the Soviet Union expert and questions relating to procurem an antenna system have since been under consideration. After ascertaini latest position at Vientiane in March 1972, the chief of TCS discussed th matter with the WMO secretariat in April 1972. Possible solutions are u consideration. Meanwhile, a visit of the TCS telecommunication and elec expert to Vientiane in September 1972 was planned.

Exchange of radar fixes of typhoons and code for exchanges (paragraphs 32 and 33)

35. Statistics pertaining to radar fix messages exchanged during 197 were collected in a special format and analyzed by the TCS. Two members furnished complete statistics, which showed that only 40 per cent of the

/transmitted

ransmitted messages were actually received by the addressee. The results f this analysis were notified to the members in a circular letter. Members ere requested to ensure regular exchanges of radar fix messages during the urrent typhoon season. They were also requested to maintain statistics of xchanges in suitable form so as to facilitate identification of deficiencies nd taking remedial measures.

36. The new WMO code for the exchange of radar observations became ffective on 1 January 1972. As agreed by the Committee, the member ountries were requested to use Part A of the new code for exchanges of adar fix messages.

Priorities for the implementation of observing and telecommunication facilities (paragraphs 34, 35 and 36)

37. The Typhoon Committee secretariat maintained close contact with member ountries, both by correspondence and by visits, with a view to expediting the mplementation of the facilities recommended. Wherever bilateral or VAP ssistance was offered or fresh assistance needed, representatives of the rospective donor country or the WMO secretariat were consulted, and the eceiving country advised on further action.

Denser network of special observations from land stations (paragraph 39)

38. The TCS issued a circular to member countries inviting comments on he need for a denser network of special observations from land stations, s envisaged by the WMO Executive Panel of Experts on Tropical Cyclones. eplies received from Hong Kong, Japan and the Republic of Korea indicate hat they do not consider it necessary to establish additional stations in heir respective countries.

Observations from mobile ships (paragraphs 40 and 88)

39. Regarding the inadequacy of ship's reports in the typhoon areas, the ecretary-General of WMO issued a circular to the member countries suggesting easures that they might take at coastal radio stations and at national eteorological centres to improve the present situation. The circular was lso addressed to other WMO Members which have recruited ships, some of which ay operate in the areas of concern of the Typhoon Committee.

/Role

Role of the Typhoon Committee (paragraph 42)

40. The fourth session agreed "to look beyond WWW requirements in order identify other deficiencies in the basic systems needed for typhoon predicti and warning". The TCS, in consultation with the WMO Secretariat, listed se areas of possible deficiencies, which are not covered by GOS and GTS of WWW sent a circular letter to member countries inviting their views and suggesti The list included the following items (numbers in parentheses are related p graphs of the fourth session's report):

(1) Denser network of special observations (39))
(2) Network of radar stations (36)) already under consideration of the Typhoo Committee
(3) Ocean weather station and research vessels (23-25))

(4) Automatic weather stations, specially of the marine type (88)

(5) Aircraft reconnaissance flights

(6) Geostationary satellite (80)

(7) Observations needed for storm surge forecasting (80)

(8) Communication facilities for dissemination of typhoon warnings within the country

(9) Special observations in connection with research programmes, such as typhoon modification experiments (87).

41. Replies have so far been received from Hong Kong, the Philippines Thailand. Points arising from their comments which the Committee may wish note or give further consideration are summarized below:

(1) Need for review of items 7 and 8 was supported;

(2) One member suggested that assistance might be sought from developed countries for installation of automatic weather stations in the Pacific;

(3) The plan of the Japanese Government to put a geostationary satellite in orbit in 1976/77 is most welcome;

(4) A suggestion was made that special wind observations recorde high ground (paragraph 66 of the second session report) migh disseminated under arrangements similar to those for the exch of radar fixes of typhoons.

/4.

4. Further action proposed

It is suggested that the Typhoon Committee may wish:

(a) to welcome the Khmer Republic formally as a new member of Typhoon Committee;

(b) to examine the factual material contained in the annexes, especially the progress made in implementing the facilities to which priority was assigned at the fourth session;

(c) to revise the list of priorities, as necessary, taking into account the requirements, if any, of the Khmer Republic;

(d) to recommend further measures to speed up the implementation of the meteorological and telecommunication facilities forming part of the Committee's programme;

(e) to recommend continuance of the exchange of radar fix messages in accordance with the agreed procedure, and to consider, in the light of the 1971 statistics, measures that could be taken to ensure regular and prompt exchanges of such messages;

(f) to consider the views expressed by some of the members on the question of a denser network of special observations from land stations and whether further action need be taken in this matter;

(g) to express its views on the latest position regarding inadequacy of ship's reports in the typhoon areas, in the light of the action taken by the Secretary-General of WMO, and to suggest further measures, if considered appropriate;

(h) to consider the results of the preliminary enquiry on deficiencies outside WWW requirements in the basic systems needed for typhoon prediction and warning, and to recommend remedial measures, where appropriate.

HYDROLOGICAL COMPONENT

1. General activities

Further progress has been made in developing comprehensive plans for establishing pilot flood forecasting and warning systems in the key river ins selected for this purpose in the Republic of Korea, Laos, the Philippines Thailand. Fresh developments during 1972 are summarized below:

ublic of Korea

The improvement of flood forecasting in the Republic of Korea hss been nned by the Government according to a four-year programme expected to begin 1972. The programme covers four major river basins, in which 77 per cent of

/the

the average annual flood damage of the country occurred in the past. Since
Han river basin is the most important area of the country, early implementa
of pilot flood forecasting in this basin is being urged by the Government.

45. On the basis of a review made last year of the requirements for imp
mentation of a pilot flood forecasting and warning system for the Han river
basin, it was considered that expert assistance for analysis of hydrologica
data and training in hydrology and telecommunication were needed urgenly.
efforts of TCS to explore the possibility of assistance from the Government
Japan were reported at the fourth session of the Committee. Shortly after
fourth session, the hydrologist of TCS visited Seoul and had further discus
with representatives of the Bureau of Water Resources Development regarding
requirements of assistance for a flood forecasting system in the Han river

46. The Bureau of Water Resources Development, Seoul, submitted an offi
request for assistance to the Government of Japan early in 1972. In compli
with this request of the Government, the Government of Japan sent a team o
experts to Seoul in June 1972 for a period of three weeks. The team condu
a survey of the Han river basin and collected relevant data for subsequent
analysis in Japan with the help of computers. It is expected that the sur
team will submit an interim report to the Government of the Republic of Ko
in December 1972, which will be followed by the final report in September

47. In connexion with the proposed draft request to UNDP for assistanc
TCS made a rough estimate of the equipment that would be required for the
establishment of pilot flood forecasting in the Han river basin. With a v
to keeping the cost of equipment within $100,000, as proposed at the fourt
session, TCS estimated that five telemetering water level gauges, four tel
metering rain gauges and two relay stations to link the telemetering gauge
with the forecast centre constituted the minimum requirement. It was assu
that the existing SSB network, specially in the South Han river basin, wou
be fully utilized.

48. A suggestion was made by the TCS for trial application of the 10 c
radar at Seoul for the estimation of precipitation, which could eventually
be useful in flood forecasting for the Han river basin. A map showing the
radar coverage for this purpose and a list of reference publications were
sent to the Meteorological Service. A visit to Seoul by the telecommunica

/and

electronics expert to give practical training in rainfall estimation by the
r is planned. The possibility of getting one or two Korean officers trained
apan is also being explored.

The Committee at its fourth session recognized that it had not been
ible to make adequate progress in the development of a pilot flood fore-
ing system in the Se Bang Hieng river basin, because of the insecure
ation and the lack of meteorological and hydrological data. More than two
ds of the basin area remained inaccessible during 1972. However, the selec-
of Se Bang Hieng as the pilot basin for establishment of a flood forecasting
em was confirmed by the Government of Laos, in view of the high priority the
lopment of this basin has in the country programme.

A tentative network of meteorological and hydrological stations for the
ose of flood forecasting in the Se Bang Hieng river basin was prepared by
with the help of topographic maps and other available information. The
osed network was approved by Laos. The cost of equipment involved was
mated in connexion with the proposed draft request to UNDP.

The Committee at its fourth session considered the desirability of using
her radar for the estimation of precipitation and application to flood fore-
ing. TCS studied this question and it was considered that a 10 cm radar if
d at or near Savannakhet could provide coverage for major part of the Se
Hieng river basin. During discussions at Vientiane, government officials
ched high priority to such a radar and suggested Kengkok (east of Savannakhet)
suitable site for the radar. The TCS later suggested to the Director of the
orological Service in Laos that he should consider submitting a request for
assistance to WMO for this radar.

A note on the flood problem of the Se Bang Hieng river basin is being
ared by the TCS on the basis of the available information. It is expected
the note will be useful in connexion with the development and implementa-
of the pilot flood forecasting and warning system. Much of the informa-
to be included in this note is being extracted from various studies made
he Mekong Committee.

/Philippines

Philippines

52. The recent flood which devastated the Central Luzon area in July 197 was the most destructive within living memory. It took a toll of over 500 human lives and caused unprecedented damage to property, public works and crops, involving an estimated loss of 2,000 million pesos. The worst affected areas were the provinces of Bulacan, Pampanga, Tarlac and Pangasina where rampaging flood waters breached dikes and washed away thousands of houses. Enormous resources, both national and from external sources, will be needed to complete the rehabilitation programme, which may extend over a period of four to five years.

53. In connexion with the implementation of pilot flood forecasting in the Pampanga river basin, the Flood Forecasting Unit in the Weather Bureau carried out case studies of past floods with the assistance of the hydrologist and flood forecasting expert of the TCS. Estimation of flood hydrograph in the target area was completed for the floods in 1962 and 1970 and compared with observed records. In view of certain observed discrepanc some modifications in the initial and boundary conditions were considered and further trials are in progress.

54. As suggested by the TCS, the Government of the Philippines submitte a formal request to the Government of Japan for assistance in the selectio of sites for telemetering equipment to be installed in the Pampanga basin. In compliance with this request, the Government of Japan sent a team of three experts to the Philippines in February 1972. The team stayed for one month and carried out detailed topographic survey and transmission tests in collaboration with government officials and the experts of the TCS. The TCS also assisted in preparatory arrangements for the survey and in ensurin co-ordination with the agencies concerned. The team submitted an interim report in March 1972. The final report, including detailed design and specifications of equipment, is in preparation in Japan. Test equipment worth US$6,800 used for communication tests by the Japanese team was donate to the Government of the Philippines.

55. It was understood that appropriation of US$260,000 from the 1972 budget was approved by the Diet of Japan in April 1972 for providing

/equipment

uipment and training for the implementation of Pampanga flood forecasting stem. The Government of the Philippines, for its part, approved an location of 500,000 pesos as counterpart expenditure for housing and other cilities. It is expected that the equipment from Japan will reach the ilippines early in 1973 and that the flood forecasting system will be plemented before the next flood season.

As regards the training of personnel for the operation of the mpanga flood forecasting system, arrangements were completed for training two hydrologists in Japan during September-December 1972. Furthermore, aining of three telecommunication engineers was also expected to commence the near future.

. Having experienced an unprecedentedly severe flood in the Pampanga ver in July 1972, the Flood Forecasting Centre at Manila initiated, in llaboration with the TCS, a study of the hydrological aspects of the flood. was expected that analysis of the available meteorological and hydro-gical data might throw now light on the proposed method of flood forecasting the Pampanga river basin.

ailand

. As reported at the fourth session, trial flood forecasting in Mae ong river basin could not be carried out satisfactorily during the 1971 ood season because of irregularity in the reception of daily rainfall data om the selected stations. Shortly after the session, the TCS suggested at case studies of some past floods should be undertaken in order to cilitate trial flood forecasting during the 1972 flood season. The tting up of SSB communication at selected stations was also suggested as means of improving the collection of rainfall data.

. The Meteorological Department and the Royal Irrigation Department mpleted calculations for the floods of 1967 and 1970 with respect to the scharge at K10 station in Kwae Noi and K6 station in Kwae Yai. Although ere were some discrepancies in each tributary, the proposed method was und to be reasonably accurate for the purpose of flood forecasting for the sin as a whole. Incidentally, the officials engaged in the case studies ined some practical experience in handling and computing the data needed r the proposed flood forecasting system.

/60.

60. As suggested by the TCS, the Meteorological Department and the Royal Irrigation Department agreed to set up temporary SSB communication between Bangkok and the selected stations (except Umphang) in the basin. It was therefore expected that sufficient facilities would be available for trial flood forecasting in 1972. At the time of preparing this document, arrangements were being made for the hydrologist and flood forecasting expert of the TCS to visit Bangkok so that he could render further assistance in the activities relating to trial flood forecasting.

2. Action on decisions of the fourth session

61. The action taken on the decisions contained in paragraphs 49, 50 and 51 (assistance for establishment of pilot flood forecasting in Laos, Philippines and Thailand) and paragraphs 72 and 73 (flood forecasting equipment proposed to be included in the draft request to UNDP) has been described under the respective country headings in the preceding section.

3. Further action proposed

62. It is suggested that the Typhoon Committee may wish:

(a) to record its appreciation for the valuable assistance provided by the Government of Japan in:

(i) sending a team of experts to the Republic of Korea in connexion with the development of flood forecasting in the Han river basin;

(ii) sending a second team of experts to the Philippines for the selection of sites in the Pampanga river basin and giving further assistance by the appropriation of US$260,000 for equipment and training in the implementation of the pilot flood forecasting system;

(b) to consider the steps so far taken towards the implementation of pilot flood forecasting in each of the countries and to offer suggestions where appropriate, with a view to expediting action.

C. COMPLEMENTARY PROTECTIVE MEASURES

1. General activities

Review of disaster prevention organization

63. It will be recalled that a summary of the existing disaster prevention organization against typhoons and floods in member countries was

/prepared

epared by the TCS, and copies distributed at the fourth session. At that ssion the Committee requested members to provide supplementary information the TCS so that a revised summary could be prepared in due course. All e additional material received from member countries has been incorporated a new version of the summary which was distributed in September 1972.

ovision of an expert in community preparedness

. With the assistance of the League of Red Cross Societies (LRCS), an pert in community preparedness and disaster planning (Mr. James Hickey) s appointed to serve in the TCS for the last four months of 1971. its fourth session, the Committee agreed on the following broad functions r the expert:

(a) to carry out surveys of community preparedness arrangements in selected member countries of the Typhoon Committee;

(b) to advise national authorities on the improvements desirable under the arrangements;

(c) to assist in the drawing up of plans to mitigate natural disasters where no such plans exist;

(d) to assist in the implementation of plans to mitigate natural disasters by organizing exercises to test the efficiency of preparations;

(e) to establish a programme of work as part of TCS activities to ensure that adequate attention is devoted to complementary protective measures in the next few years.

. As foreseen by the Committee, the expert's activities during the ur-month assignment were principally devoted to a survey of the present atus of disaster preparedness planning. He visited all the member untries and drew up a report on his findings, including recommendations each of the countries. His report was distributed to all countries rly in 1972 (WRD/TC5/9).

. Although the disaster planning arrangements have reached an advanced vel in many of the countries, the survey revealed an urgent need in most untries to improve liaison between the various national agencies with sponsibilities under the present typhoon warning system. The expert was

/of the

of the opinion that priority should be given to remedying this situation as a first step in the Committee's programme of work under this component. Consultations were therefore held with LRCS to obtain advice on the best way of undertaking this essential first task.

67. These consultations led to the LRCS proposing that a joint LRCS/WMO ECAFE team should visit the member countries concerned to discuss the problem with the appropriate national authorities. The main purpose of the mission would be to seek ways of making liaison between all the national agencies involved more effective and to prepare a programme of those aspect of the community preparedness arrangements to which priority attention should be given over the next few years. It has been suggested that the mission should take place in early 1973. The fifth session will provide a opportunity to discuss in detail the arrangements for and main objectives of the mission.

Regional seminar on disaster preparedness and relief

68. A regional seminar on disaster preparedness and relief was held at Manila from 7 to 16 May 1972. The seminar was organized by the Philippine National Red Cross within the framework of the development programme of the League of Red Cross Societies. The national Red Cross Societies of South Asian countries, national agencies in the Philippines and several inter- national organizations were represented at the seminar. The seminar provi an excellent opportunity for detailed discussions on subjects ranging fro pre-disaster planning to relief and rehabilitation.

69. The WMO experts of the TCS represented WMO in this seminar and furnished information on relevant activities of the Typhoon Committee.

2. Action on decisions of the fourth session

70. The action taken on the decisions contained in paragraph 55 (summ of disaster prevention organization) and in paragraphs 57 and 58 (expert in community preparedness) has been recorded in the preceding section. further comment is required under this heading.

/3.

3. Further action proposed

It is suggested that the Typhoon Committee will wish:

(1) to review the action taken by its member's in response to the recommendations formulated by the consultant following his 1971 survey. It is expected that each member will report separately to the Committee on national progress;

(2) to discuss the detailed arrangements for the proposed LRCS/ WMO/ECAFE mission, urging its member countries to co-operate closely in planning visits to the national agencies concerned and in facilitating the work of the team.

TRAINING AND RESEARCH

1. Training of personnel

1. In pursuance of the offer made by its representative at the fourth ession, the Government of Japan decided to organize during 1972 three raining courses in flood forecasting and warning for the benefit of the yphoon Committee's member countries. As in the previous years, the raining courses will be part of Japan's technical co-operation schemes for veloping countries. Course A on hydrology will last six months commencing d-September 1972, course B on Radar meteorology and Course C on hydro- teorological telecommunication will be for four months commencing in d-November 1972. Courses A and B will be conducted in English and Course C Japanese. Invitations for the nomination of trainees have been sent to e Governments of the Republic of Korea, Laos, the Philippines and Thailand. e Directors of Meteorological and Hydro-logical Services in these countries ve also been informed.

1. As the nominee from Laos could not join the course on hydrology in 71 owing to delay in processing of the nomination, the Ministry of nstruction, Japan, agreed to accept two candidates from Laos for the 72 course on hydrology. Laos was informed accordingly. Furthermore, nce the sub-course in meteorology in 1971 was conducted in Japanese, and os, Philippines and Thailand could not therefore nominate any trainee r that course, it was decided to conduct the 1972 course B on Radar teorology in English.

/74.

74. In view of the offer of assistance made by France at the third session to meet the entire training requirements of Laos in meteorology and hydrology for a period of five years, TCS suggested that the Director of the Meteorological and Hydrological services in Laos should take full advantage of this generous offer by submitting formal proposals and nominations for training to the French Government.

75. With reference to the information given by the observer from Australia at the fourth session regarding the excellent training facilit available in his country, details of the training facilities and awards available in Australia were collected by the TCS from the Australian Bur of Meteorology. The information was circulated to the member countries the Typhoon Committee.

76. The telecommunication and electronics expert of the TCS provided on-the-job training in maintenance of radar at Manila. The proposed on-the-job training in operation and maintenance of telecommunication equip ment at Vientiane had to be postponed and is now scheduled for September

2. Co-ordination of research activities

77. The eleventh report on research work in tropical meteorology was distributed by WMO in April 1972. A sufficient number of copies was sen to the Permanent Representatives concerned for distribution to their national institutes.

78. The Director of the Royal Observatory, Hong Kong, reported that computerization of operational meteorological data for tropical cyclone forecasting is in progress. A computer system has been selected and det of the programme will be provided at the fifth session.

79. Hong Kong also provided the TCS with a summary of research activ currently in progress in Hong Kong. Copies of this summary were distrib to the Directors of Meteorological Services in the other member countrie A few extracts from this summary are reproduced below:

"(a) the thermal structure of tropical cyclone in the western Pacific has been examined using more than 100 upper-air soundings and a comparison is made between these soundings and those made in hurricanes.

/(b)

(b) Tropical cyclone tracks for the period 1884 to 1970 have been up-dated and analysed. Part of the results are being published as 'Royal Observatory Technical Memoir No. 11, Volume I' which should be ready for distribution at the fifth session.

(c) detailed statistical analyses of tropical cyclones for the period 1884 to 1970 are being undertaken and the results will be included in 'Royal Observatory Technical Memoir No. 11, Volume II'."

The Government of the Republic of Korea submitted in April 1972 a vised request to UNDP for assistance in implementing the project eteorological Research and Training Institute". The subjects of research der this project include typhoon forecasting and hydrometeorology, with rticular emphasis on flood forecasting and warning.

A regional seminar on "wind effects on buildings and structures" s held at Manila from 22 to 26 November 1971. The seminar, which was onsored by UNESCO in co-operation with WMO, was organized as a follow-up a technical mission of UNESCO to the Philippines for investigation of e November 1970 typhoon in Manila. UNESCO-sponsored participants from l seven member countries of the Typhoon Committee attended the seminar, at ich the chief of the TCS represented WMO. The following papers presented the seminar were of special interest:

(i) Analysis of extreme wind speed over the Philippines;

(ii) UNESCO report on typhoons of October and November 1970;

(iii) Wind effects on high-rise buildings;

(iv) Design methods for wind forces on buildings and structures;

(v) Material and construction techniques for wind forces on buildings and structures.

The proposed transfer of the "Stormfury" research project to the cific was discussed at the fourth session. At the twenty-eighth session ECAFE in March 1972 the United States delegation reported that it would t be possible to proceed with the proposed transfer in 1972. In a related velopment, a national project on typhoon moderation was recently intro-ced in the Philippine Congress. The proposal involves the participation the Philippine Weather Bureau, the Philippine Air Force and other national

/agencies.

agencies. It is expected that the representative of the Philippines at the fifth session will inform the Committee of the latest developments in this matter.

3. Actions on decisions of the fourth session

Offers of assistance by Japan, France and Australia (paragraphs 61, 62 and 63)

83. Follow-up action has been recorded in the preceding section.

Seminar on tropical cyclone forecasting techniques and warning systems in Asia and the South-West Pacific (paragraph 64)

84. Definite arrangements have now been made to hold the seminar on tropical cyclone forecasting techniques and warning services in Asia and the South-West Pacific at the Univercity of Queensland, Brisbane (Australia) from 14 to 26 May 1973. Detailed preparations for the seminar are now in hand.

Possibility of joint collaboration in typhoon research (paragraph

85. In pursuance of the suggestions offered by the Meteorological Research Institute of the Japan Meteorological Agency, the TCS issued a circular to the member countries inviting their views and suggestions for further consideration at the fifth session.

4. Further action proposed

86. It is suggested that Typhoon Committee may wish:

(a) to record its appreciation of the valuable assistance provided by the Government of Japan in organizing three training courses during 1972 for the benefit of the member countries;

(b) to urge all member countries to participate fully in the training seminar on tropical cyclone forecasting techniques and warning services to be held in May 1973;

(c) to note the latest developments regarding the proposed transfer of "Stormfury" project to the Pacific and the related national project of the Philippines, and to consider in what manner and to what extent the Committee wishes to be associated with these developments;

(d) to comment on the possibility of joint collaboration and co-ordinated effort in studying selected typhoon problems.

/Annex I

Annex I

WWW GLOBAL OBSERVING SYSTEM - UPPER-AIR STATIONS

(a) Level of implementation (1 July 1972)

Country	Number of stations from which observations are requested	Number of observations made					
		Radiowind (W)				Radiosonde (R)	
		00	06	12	18	00	12
g Kong	1	1	1	1	1	1	1
an	17	17	15	17	15	17	17
r Republic	1	1	0	1	0	0	0
ea, Republic of	3	3	1	3	1	3	3
s	1	0	0	0	0	0	0
ippines	6(W) 4(R)	2	1	1	1	3	1
iland	4	4	1	4	1	4	4
al	33(W) 31(R)	28	19	27	19	28	26

/(b)

(b) Deficiencies and further plans

Country/station	Radiowind (W) 00	06	12	18	Radiosonde (R) 00	12	Plans/remarks
Japan							
47971 Chichijima		0		0			
991 Minamitorihima		0		0			
Khmer Republic							
48991 Phnom-Penh/ Pochentong		0		0	v	v	VAP Project OB/1/1/1 circ 1971, no offer to date.
Korea, Republic of							
47138 Pohang		0		0			Budgetary and staff prob
187 Mosulpo AB		0		0			
Laos							
48940 Vientiane b/	v 1972	0	v 1972	0	v 1972	v 1972	
Philippines							
98223 Laoag b/	0	0	0	0	0	0	
618 Puerto Princesa	0	0	0	0			
645 Cebu		0	0	0		0	
755 Davao	0	0	0	0			This station carries out air observations by Pilo balloon soundings
836 Zamboanga b/	0	0	0	0		0	
Thailand							
48327 Chiangmai		0		0			
455 Bangkok		0		0			
568 Songkhla		0		0			

Notes: v = VAP request; year is shown if implementation approved
A year alone indicates implementation from national resources
b/ = Typhoon Committee priority station

Annex II

GLOBAL OBSERVING SYSTEM - OTHER FACILITIES NOT YET IMPLEMENTED

(a) Storm-warning radar stations

a, Republic of	Kwangju	No plans
	Cheju	Implementation is planned for 1976 from national resources
ippines	Guiuan	Implementation is planned for 1972
	Daet	Implementation is planned for 1972
	Cebu	Implementation is planned for 1972
	Baguio	Implementation is planned for 1973
	Basco	Implementation is planned for 1973
	San Mateo (20 Km. NE of Manila)	Implementation is planned for 1974
	Cuyo	Implementation is planned for 1975
land	Bangkok	Bilateral project

(b) Automatic picture transmission (APT) stations

r Republic	Phnom-Penh	VAP Project OB/3/1/1 circulated in 1971, No offer to date
a, Republic of	Pusan	Implementation planned for 1973 from national resources

Annex III

WWW GLOBAL TELECOMMUNICATION SYSTEM (GTS)

(a) National collection facilities

It is understood that some shortcomings subsist in the national collection facilities of Laos and the Philippines. See Section A, 2 of the present paper.

(b) Regional telecommunication links not yet implemented

Country	Link	Remarks
Japan	Tokyo - Khabarovsk	National project 1974 (1,200 b
Laos	Vientiane - Bangkok	VAP project - implementation i
Thailand	Bangkok - Dacca	National project 1972
	Bangkok - Kuala Lumpur	National project 1972
	Bangkok - Phnom-Penh	National project 1972
	Bangkok - Saigon	National project 1972
	Bangkok - Vientiane	National project 1972

Annex IV

PRIORITIES ASSIGNED BY THE FOURTH SESSION OF THE TYPHOON COMMITTEE

Summary of state of implementation and further plans

ing facilities

pper-air stations

o plans: 98836 Zamboanga (Philippines) (RW, 12Z RS) - no known plans

lready planned: 48940 Vientiane (Laos) - Installation expected in 1972 under VAP

98223 Laoag (Philippines) - 12 GMT radiosonde/radiowind. Partial implementation expected in 1972 from national resources.

eather radar

o plans: Kwangju (Rep. of Korea) (or other selected site)
Vientiane (Laos)

lready planned: Basco (Philippines) - National project in 1973

Bangkok (Thailand) - Bilateral project

APT stations

lready planned: Vientiane (Laos) - Implementation expected in 1972 under bilateral project

Ocean weather stations

lo plans (after 1971): Sship at 16°N, 135°E - USSR is continuing to provide support from its research vessels in 1972

mmunication facilities

National collection facilities

Already planned: Laos - National project

Philippines - National/bilateral project

Regional telecommunication

Establishment of the following point-to-point links:

Already planned: Bangkok - Saigon - National project 1972

Bangkok - Vientiane - National/VAP project 1972

Other telecommunication facilities

Partial implementation planned:

Thailand - strengthening of RTH, Bangkok - Will be partially implemented with help of VAP project and national resources.

FOR PARTICIPANTS ONLY

WRD/TC5/7
6 October 1972

ORIGINAL : ENGLISH

NITED NATIONS ECONOMIC COMMISSION FOR ASIA AND THE FAR EAST

nd

ORLD METEOROLOGICAL ORGANIZATION

YPHOON COMMITTEE

ifth session
5-21 November 1972
angkok

PROGRAMME FOR 1973 AND BEYOND

(Item 5 of the provisional agenda)

Note by the Typhoon Committee secretariat

. The tentative action programme approved by the Typhoon Committee at ts first session continues to provide the general guidelines for its future ctivities. The functions of the Committee as given under Article 6 of its tatutes, and the functions and duties of the Typhoon Committee secretariat s approved by the second session are also relevant in this connexion.

. Under provisional agenda item 8, the Committee is invited to consider draft request to UNDP for assistance covering a period of three years as he first phase of the programme. The proposed work plan for three years is iven in chapter III of the draft request. The project activities, their tarting dates and proposed duration, as given in that chapter, correspond ith what can be foreseen at the present time.

. Assuming that the requested UNDP assistance may not be forthcoming efore January 1974, it may be useful to draw up a list of specific items of ork on which the Committee might wish to concentrate during 1973. Taking

/into

into account the progress made so far and the items on which work has al
begun, the following items are suggested for special attention during 197

(a) to take further steps to accelerate the provision of meteorological and telecommunication facilities included in the priority list as revised during the session;

(b) to assist Laos and the Philippine Weather Bureau in improving their national data collection systems;

(c) to study the deficiencies in the existing system of dissemination of typhoon warnings in the Philippines and to suggest remedial measures;

(d) to continue experimental flood forecasting in the Mae Klong river basin (Thailand) and to consider further improvement of the plan;

(e) to assist the Philippines in the implementation of a flood forecasting system in the Pampanga river basin with assistance from Japan;

(f) to assist the Republic of Korea and Laos in the planning and preparations for flood forecasting in the selected river basins;

(g) with the assistance of a consultant on community preparedness, to review and advise on disaster planning and community preparedness;

(h) to take up appropriate follow-up action to expedite procurement of assistance from external sources, where appropriate;

(i) to study the requirements of the Khmer Republic in more detail and initiate action as appropriate within the framework of the Committee's programme;

(j) to finalize the draft request to UNDP for assistance, incorporating such changes as agreed to at the session, and to take further steps for its submission to UNDP.

Action proposed

4. It is suggested that the Committee may wish:

(a) to consider the anticipated work programme for 1973 and beyond and to urge member countries to take all possible measures, with the assistance of the Typhoon Committee secretariat, to accelerate implementation of the Committee programmes;

(b) to approve in principle or suggest amendments to the prop items of work on which to concentrate during 1973.

. . . . .

FOR PARTICIPANTS ONLY

WRD/TC5/8
2 October 1972

ORIGINAL : ENGLISH

ITED NATIONS ECONOMIC COMMISSION FOR ASIA AND THE FAR EAST

d

RLD METEOROLOGICAL ORGANIZATION

PHOON COMMITTEE
fth session
-21 November 1972
ngkok

REQUEST TO UNDP FOR ASSISTANCE IN SUPPORT OF THE TYPHOON COMMITTEE

(Item 6 of the provisional agenda)

Note by the Typhoon Committee secretariat

e draft request to UNDP

In accordance with the recommendation of the fourth session of the phoon Committee, a draft request to UNDP for assistance, as Phase I of e project, was prepared by the Typhoon Committee secretariat in consultation th the ECAFE and WMO secretariats. The UNDP and counterpart contributions cluded in the draft request are based on the list drawn up by the fourth ssion. The text of the draft request has been revised after detailed nsultations between the WMO secretariat and the Chief of the Typhoon mmittee secretariat during the latter's visit to Geneva in April 1972.

The revised draft request was distributed in June 1972 to the rectors of Meteorological Services and the Directors of Hydrological rvices in the member countries of the Typhoon Committee for their ncurrence. It was explained to the Directors that formal submission of e final request to UNDP will have to be done through the respective UNDP presentative in accordance with UNDP's inter-country programming procedure,

/and that

and that the purpose of circulating the draft request was to ascertain whether it met with their approval and also to obtain an indication that would be supported by the government authorities concerned when formally presented for their concurrence and signature.

3. Additional copies of the revised draft request will be available the fifth session for distribution to participants.

Comments by member countries

4. Replies have so far been received from the Directors of the Meteorological Services in Hong Kong, Laos, the Philippines and the Republ of Korea, and also from the Director of the Hydrological Service in the Republic of Korea. Their comments are summarized below:

Hong Kong	:	Supports the draft request and is prepared be a signatory.
Laos	:	Has no objection to the draft request.
Philippines	:	Assures full support of the Government for the draft request.
Republic of Korea	:	Gave an interim reply seeking clarificatio A detailed letter was sent explaining thos parts of UNDP assistance and counterpart expenses which relate to the Republic of K

UNDP/WMO/ECAFE review mission and its recommendations

5. UNDP organized a joint UNDP/WMO/ECAFE mission to review the on-g typhoon project with the aim of making recommendations concerning the pr continuation and possible expansion. The review mission was organized partly as a result of the Typhoon Committee's decision to request instit support from UNDP. The mission visited Bangkok, Tokyo, Seoul, and Manil during June 1972. At the time of preparing this document, the report of the review mission was still under study by UNDP and its conclusions had been available for general distribution.

Action proposed

6. The Typhoon Committee is invited to examine the revised draft re to UNDP in the light of the comments already received, additional commen given at the session.

/7.

Since no provision has been made in the draft request (Phase I) for e Khmer Republic, which recently joined the Typhoon Committee, the mmittee may wish to consider how and when related adjustments in the oject are to be made.

If the Committee decides to submit the draft request after incor- rating such amendments as are accepted at this session, it may wish to quest WMO and ECAFE as executing agencies to arrange formal submission the final request to UNDP as soon as possible.

. . . . .

FOR PARTICIPANTS ONLY

WRD/TC.5/9
16 August 1972

ORIGINAL : ENGLISH

NITED NATIONS ECONOMIC COMMISSION FOR ASIA AND THE FAR EAST
ND
ORLD METEOROLOGICAL ORGANIZATION

yphoon Committee

ifth session
5-21 November 1972
angkok, Thailand

DISASTER PLANNING AND COMMUNITY PREPAREDNESS

(Item 7 of the provisional agenda)

Note by the ECAFE secretariat

The attached report was prepared for the Typhoon Committee secretariat y a consultant. The views expressed in the reports are not necessarily those f the United Nations or of the secretariats of ECAFE and WMO.

FOR PARTICIPANTS ONLY

WRD/TC5/10
12 October 1972

ORIGINAL : ENGLISH

TED NATIONS ECONOMIC COMMISSION FOR ASIA AND THE FAR EAST

LD METEOROLOGICAL ORGANIZATION

hoon Committee
th session
21 November 1972
gkok

DAMAGE CAUSED BY TYPHOONS, CYCLONES AND ACCOMPANYING STORM SURGES

(Item 8 of the provisional agenda)

Report by the ECAFE secretariat

CONTENTS

A. INTRODUCTION

1. Most countries of the ECAFE region outside of the arid and semi-a zones experience heavy rainfall during the south-west monsoon, which gene lasts from May to November. Typhoons and cyclones[1/] occurring during the months bring additional rainfall, often causing considerable damage.

2. The countries most frequently visited by typhoons are China, Hong Kong, Japan, Korea and the Philippines. The Khmer Republic, Laos, Thail and Viet-Nam are less frequently visited. Tropical cyclones originating in the Bay of Bengal or the Arabian Sea traverse Burma, India, Banglades and, to a lesser extent, Malaysia, Sri Lanka (Ceylon) and Thailand. Aust and New Zealand are occasionally visited by tropical cyclones.

3. The destruction wrought by typhoons and cyclones is caused by hig winds, torrential rainfall, accompanying storm surges and consequential flooding from streams and sea. The loss of life and damage to property often considerable. Information on flood damage has been published regu by the secretariat in the Water Resources Journal since 1952. In 1964, secretariat undertook a preliminary study of typhoons and their impacts the economy and water supply of the countries affected. It was found that damage to the extent of about US$500 million annually was inf in the western Pacific area. In order to substantiate the secretariat's programme for the mitigation of flood damage, the Regional Conference on Water Resources Development, at its ninth session held in 1970, directed the secretariat to undertake a more comprehensive study and quantificat of damage caused by typhoons, cyclones and their accompanying storm surg A questionnaire was accordingly despatched to all countries of the regi in January 1971. The first part of the questionnaire sought informatio on the extent of physical damage, year by year, from 1961 to 1970; the part sought information on the extent of damage in monetary terms.

4. Of the 22 countries to which the questionnaire was despatched, were received from Australia, Hong Kong, India, Indonesia, Japan, Malay New Zealand, the Philippines, the Republic of Korea, the Republic of Vi Singapore, Sri Lanka (Ceylon) and Thailand. The information available thus incomplete and in all probability the regional figures presented in

1/ "Typhoon" and "cyclone" are terms used for the same phenomenon, being used in the western Pacific area, "cyclone" in the Bay of Ben and the Arabian Sea.

report underestimate the position. Some of the difficulty experienced aking a comprehensive survey may be gathered from the fact that in Nepal Sri Lanka (Ceylon) there is no central authority for assessing flood ge; in Indonesia, there has so far been no over-all survey of flood damage; in Hong Kong, neither individuals nor companies are obliged to disclose es caused by typhoons to government authorities.

Data for New Zealand supplied in response to the questionnaire included erty damage, damage to river control works and information on the extent looding; data for India and Thailand included all damage, irrespective he type of storm or flood causing damage. Damage to property and industry unavailable for Malaysia and the Republic of Viet-Nam in monetary terms, e information on Singapore was limited to the unprecedented local flooding occurred on 10 December 1969. The analysis which follows is based on necessarily somewhat limited information, supplemented by information acted from the relevant issues of the Water Resources Journal, the eedings of the Regional Conference on Water Resources Development and r publications.

FREQUENCY OF OCCURRENCE OF CYCLONES AND TYPHOONS

Table 1 shows the frequency of occurrence of tropical cyclones, hoons and super typhoons in the western Pacific during 1961-1970 and the quency of cyclonic storms and depressions in the Bay of Bengal and the bian Sea during the same period. Altogether there were 295 tropical lones with maximum surface winds exceeding 33 knots in the western Pacific, luding 195 typhoons whose maximum wind speed exceeded 64 knots. Of the ter, 60 were classified as super typhoons with maximum wind speeds in ess of 130 knots. In the Bay of Bengal there were 147 cyclonic storms depressions.

The occurrence of these storms was fairly regular throughout the iod. In the western Pacific, there were from 19 to 40 tropical cyclones ually, including from 12 to 26 typhoons and from 2 to 11 super typhoons. 2 and 1964 were the worst years for typhoons; 1965 was the worst year super typhoons. In the Bay of Bengal and the Arabian Sea, cyclonic storms depressions were less frequent than tropical cyclones in the western ific, there being from 12 to 18 annually.

/Table 1

Table 1. Frequency of occurrence of typhoons and cyclones, 1961-1970

Area	Type of storm	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
Western Pacific	Tropical cyclones	31	30	25	40	34	30	35	27	19	24
	Typhoons	20	24	19	26	21	20	20	20	13	12
	Super typhoons	8	6	8	6	11	3	4	5	2	7
Bay of Bengal and Arabian Sea	Cyclonic storms and depressions	16	12	13	16	14	18	15	13	15	15

Sources: Annual Typhoon Report 1970, Fleet Weather Central/Joint Typhoon Warn Center, Guam, Mariana Islands; Water Resources Journal, March 1962-1

Note: Tropical cyclone = maximum surface winds exceeding 33 knots.

Typhoon = maximum surface winds exceeding 64 knots.

Super typhoon = maximum surface winds exceeding 130 knots.

Table 2. Seasonal frequency of tropical cyclones and typhoons in the western Pacific, 1961-1970

Area	Type of storm	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Western Pacific	Tropical cyclones	5	5	5	8	14	15	46	63	52	44	27	11
	Typhoons	1	1	2	7	12	11	30	40	35	32	19	5
	Super typhoons	0	0	1	1	1	4	5	10	18	10	7	3

The seasonal frequency of tropical cyclones, including typhoons and r typhoons, is indicated in table 2. The tendency is for these storms ncrease steadily in frequency from a minimum in the period January to ch, when in each month storms occur only every other year on the average, maximum in August when there are on the average six tropical cyclones, luding four typhoons and one super typhoon. Super typhoons occur most quently in September, when there is an average of two a month.

DAMAGE CAUSED BY CYCLONES AND TYPHOONS

The monetary damage sustained by 21 countries of the region is set year by year over the period 1961-1970 in table 3, along with the total tary and physical damage sustained during the period, the latter being ted under four headings. The total damage amounted to $9,885 million, of ch $6,779 million was sustained in typhoon-affected areas and $3,106 million yclone-affected and other areas. This last figure must be accepted with rve. While it includes damage caused by storms other than cyclones in ia, thus tending to inflate the estimate, it does not include the catastropic age caused in East Pakistan in 1970. Nevertheless, the figures as they nd are indicative of the scale of damage and may be seen in their true spective when it is noted that the cummulative financing of the World Bank ing the period 1961-1970 amounted to $9,416 million.[2/] In other words, damage sustained in Asia and the Far East offset by a substantial margin finance made available by the Bank throughout the world in the interest economic expansion and development.

By far the greatest monetary damage ($5,867 million) was sustained Japan, in spite of the advanced degree of protection provided by that ntry. Second in order of magnitude was India, with $2,073 million, including age by storms other than cyclones. Third was Pakistan (mostly in East istan), with $837 million, excluding damage caused in 1967 and 1970. The ublic of Korea ($333 million), the Philippines ($266 million) and Thailand 00 million) followed. Damage in other countries was appreciably lower.

Altogether some 74,000 lives were lost (53,000 in Pakistan), 224 million ple were affected, 96 million hectares were inundated and/or damaged and million houses and other buildings were damaged. The greatest physical ses were sustained in India, Japan and Pakistan.

/Table 3

2/ World Bank and International Development Association, Annual Report, 1970.

Table 3. Damage sustained by countries of the region, 1961-1970

	Monetary damage (in million US dollars)											Physical damage 1961-1970				
	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1961-1970	Lives lost (No.)	People affected (No.)	Area inundated and/or damage (ha)	Houses and buildings damaged (No.)	Information available
ffected area																
	-	-	-	-	-	4.05	-	0.11	0.02	0.29	4.47	322	90,855	500	4,911	1961-1970
	1,268.9	418.9	391.4	522.1	747.5	660.5	628.8	280.1	491.3	457.0	5,866.5	3,024	6,993,541	1,993,902	2,715,018	1961-1970
	-	-	-	-	-	23.67	-	-	-	-	23.67	-	-	440.702	-	1966
	15.40	8.60	31.53	16.90	49.33	24.37	1.67	19.21	99.59	66.18	332.78	2,537	1,376,500	1,279,361	327,760	1961-1970
	0.18	-	-	-	-	13.84	-	2.59	-	0.61	17.22	-	-	191,800	-	1961-1966, 1968-1970
	4.15	12.68	6.05	17.08	0.61	10.95	0.22	5.51	0.69	208.55	266.49	3,200	6,863,913	233,092	720,288	1961-1970
	1.0	19.6	1.0	44.5	1.0	32.9	8.5	7.8	32.7	50.8	199.8	1,185	867,816	1,990,614	180,895	1961-1970
of	22.74	-	-	9.34	4.56	25.52	0.002	0.43	0.11	5.42	68.12	389	532,648	673,635	250,841	1961-1970
	1,312.37	459.78	429.98	609.92	803.00	795.80	639.192	315.75	624.41	788.85	6,779.05	10,657	16,725,273	6,782,606	4,199,713	
ffected and other areas																
	-	-	-	-	-	-	-	-	-	-	-	180	-	-	-	1963
	0.16	0.18	0.28	3.80	0.35	0.19	13.52	0.14	0.21	4.80	23.63	18	11,560	2,110	2,074	1961-1970
	-	-	-	-	0.01	-	-	-	-	-	0.01	-	-	222	-	1965
	0.80	0.40	0.09	0.28	-	0.53	0.26	0.17	0.96	0.68	4.17	10	-	2,122,152	-	1961-1970 excluding 1965
	89.32	200.39	83.79	146.15	17.68	95.01	199.29	321.58	486.67	433.14	2,073.02	9,438	177,400,000	59,600,000	6,200,000	1961-1970
	-	0.19	0.23	-	-	8.97	-	4.03	-	-	13.42	334	506,241	1,305,832	126,481	1962-1970 excluding 1964, 1965
	-	-	0.005	0.03	4.91	0.003	11.41	0.02	0.69	5.67	22.74	151	218,893	355,539	680	1961-1970
	-	-	-	-	-	62.50	-	-	-	-	62.50	-	-	-	-	1966
	-	-	-	-	-	-	-	-	-	-	-	342	-	-	3,800	1970
	2.48	2.74	5.03	1.26	3.14	2.54	1.11	5.15	0.52	2.21	26.18	51	-	53,100	-	1961-1970
	63.02	115.79	51.17	80.65	116.98	145.31	-	242.61	21.14	-	836.67	52,857	28,677,745	25,287,150	3,900,000	1961-1969
	-	-	-	-	-	-	0.04	-	1.49	-	1.53	5	-	2,754	-	1967, 1968, 1969
rlon)	-	-	-	39.60	-	0.54	-	-	2.01	-	42.15	-	263,969	10,530	17,573	1964, 1966, 1969
	155.78	319.69	140.595	271.77	143.07	315.593	225.63	573.70	513.69	446.50	3,106.02	63,386	207,078,408	88,739,389	10,250,608	
	1,468.15	779.47	570.575	881.69	946.07	1,111,393	864.822	889.45	1,138.10	1,235.35	9,885.07	74,043	223,803,681	95,521,995	14,450,321	

Table 4. Maximum annual damage (in million US dollars)

1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
Japan (1,268.9)	Guam[a] (over 100)		Sri Lanka (Ceylon) (39.60)		Hong Kong (4.05)	Australia (13.52)	New Zealand (5.15)	Burma (0.96)	Philippines (208.55)
					Indonesia (8.97)	Malaysia (11.41)	Pakistan (242.61)	India (486.69)	Thailand (50.8)
					Khmer Rep (26.67)			Rep.of Korea (99.59)	
					Laos (13.84)			Singapore (1.49)	
					Mongolia (62.5)				
					Rep.of Viet-Nam (25.52)				
100	181	90	180	100	226	144	306	325	391

a/ Water Resources Journal, March 1963

b/ Total flood damage for 1961 (excluding Japan) listed in table 3 ($199.25 million) = 100

12. As might be expected, the monetary damage varied somewhat in each from one year to the next. Table 4 shows the year in which the greatest occurred in 18 of the 21 countries listed in table 3, and the correspondi amount of damage. A provisional figure for the damage sustained by Guam 1962 is included in table 4. For six of the countries listed, damage was greatest in 1966, while, for four countries, it was greatest in 1969.

13. The regional totals listed in table 3 are influenced considerably the damage sustained in Japan. If figures for Japan are excluded and the total for the remaining countries is adopted as an index of damage, damag increased somewhat irregularly, as indicated by table 4, to nearly four times the 1961 total in 1970. The apparent increase is probably attribut in part to changes in price levels and foreign exchange rates; and to imp accuracy and coverage in the collection of flood damage statistics. The apparent increase is probably due, too, to population growth and economic

14. In figure 1, the average annual damage over the period of record plotted against the mean population. This shows that, in general, damage is a function of population; the countries with the largest populations experience the greatest damage. To some extent this diagram is also infl by climatic and topographic conditions, countries with the highest rainfa and flattest terrain being most prone to flood damage. In India, 59.6 mi ha were inundated during the period under consideration, in Pakistan 25.3 million ha, in Burma 2.1 million ha, in Thailand 2 million ha and in Indo 1.3 million ha. The magnitude of damage is evidently related to socio-ec conditions as well as to physiographic conditions, including the size, duration and frequency of storms. Whereas some 70 to 90 per cent of the physical damage of the region occurred in India and Pakistan, this damage accounted for less than 30 per cent of the monetary damage. Japan alone accounted for nearly 60 per cent of the monetary damage (table 5).

/Fig.

Table 5. Geographic distribution of damage, 1961-1970

	Total for the region	Countries in order of damage sustained (percentage of total damage)				
		1	2	3	4	5
ost	74,043[a/]	Pakistan (71.4)	India (12.7)	Philippines (4.3)	Japan (4.1)	Korea,Rep.of (3.4)
affected on)	223.80[b/]	India (79.3)	Pakistan (12.8)	Japan (3.1)	Philippines (3.1)	Korea,Rep.of (0.6)
undated on ha)	95.52[c/]	India (62.4)	Pakistan (26.5)	Burma (2.2)	Japan (2.1)	Thailand (2.1)
damaged on)	14.45[d/]	India (42.9)	Pakistan (27.0)	Japan (18.8)	Philippines (5.0)	Korea,Rep.of (2.3)
damage lion)	9,885[e/]	Japan (58.3)	India (21.0)	Pakistan (8.5)	Korea (3.4)	Philippines (2.7)

a/ 16 countries listed in table 3

b/ 12 countries listed in table 3

c/ 18 countries listed in table 3

d/ 13 countries listed in table 3

e/ 19 countries listed in table 3

15. The average annual damage sustained by 15 countries of the re is summarized in table 6. On the average 7,396 lives were lost annually, 22.5 million people were affected in some way, 9.6 million ha were inunda and/or damaged, and 1.4 million houses and other buildings were damaged. Taking the region as a whole, a population equivalent to double that of Australia was affected annually by floods, and an area equivalent to abou 90 per cent of the total land under cultivation in Thailand was inundated or otherwise damaged. All this resulted in monetary damage to the exten of about US$ 1,002 million. Excluding Indonesia and Pakistan, for which sectoral figures were not available, the average annual damage amounted to $895 million, of which 24.4 per cent was accounted for in damage to agricultural products, 14.6 per cent in damage to property, 6.8 per cent in damage to industry, 50.3 per cent in damage to public works, 1.1 per cent in damage to public utilities, and 2.8 per cent in rescue and relief operations. In short, one-half of the total damage was incurred in damag to public works and one-quarter in damage to agricultural products.

16. In some cases there is a fairly close relationship on an an basis between physical damage as assessed by the number of people affecte monetary damage. This is indicated by figure 2. The correlation is par strong for India, Japan and the Republic of Korea, and pronounced, thoug not so strong, for the Philippines. This suggests the possibility of fi in gaps in the record where such a correlation exists and also of cross- checking assessments when there is uncertainty as to the accuracy of monetary or physical damage estimates.

/Table 6

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by the number of people affected
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of Korea, and pronounced, though
suggests the possibility of fil
ation exists and also of cross-
ainty as to the accuracy of

/Table 6

Table 6. Average annual damage sustained by countries of the region, 1961-1970

Period	Average annual physical damage: Lives lost (No.)	People affected (1,000)	Area inundated and/or damaged (1,000)	Houses and buildings affected (1,000)	Average annual monetary damage (in million US dollars): Agricultural products	Property	Industry	Public works	Public utilities	Rescue and relief	Total	Annual per capita damage (US dollars): Minimum	Maximum	Average	Annual per capita damage (per cent GNP): Minimum	Maximum	Average
affected area																	
1961-1970	32	9.1	-	0.5	-	-	-	0.84[a]	-	0.05	0.89	0.01	1.09	0.23	-	-	-
1961-1970	302	699.3	197.3	271.5	39.67	94.37[b]	60.67	383.37	7.52	1.06	586.66	2.77	13.49	5.95	0.17	1.53	0.42
1961-1970	254	137.6	127.9	32.8	12.46	2.63[b]	-	17.35[c]	0.64	0.20	33.28	0.06	3.20	1.16	0.03	1.51	0.76
1961-1970	320	686.4	23.3	7.2	11.55	-	-	14.37[c]	0.67	0.06	26.65	0.01	5.42	0.80	0.003	2.04	0.43
1961-1970	148	108.8	248.8	22.6	12.40	5.15	-	2.43	-	-	19.98	0.03	1.49	0.64	0.02	1.24[d]	0.44[d]
1961-1970	39	53.3	67.4	25.1	5.28	-	-	0.52	0.54	0.46	6.80	0.01	1.59	0.51	0.00[d]	2.02[d]	0.31[d]
	1,095	1,694.5	664.7	359.7	81.36	102.15	60.67	418.88	9.37	1.83	674.26	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-	-	3.25[e]	-	-	0.53[f]
affected and other areas																	
1961-1970	2	1.2	0.2	0.2	0.75	0.43	0.32	0.43	0.42	0.02	2.37	0.01	1.57	0.21	0.00[d]	0.05[d]	0.01[d]
1961-1970	1	-	212.2	-	0.07	-	-	0.39	-	-	0.46[g]	0.004[g]	0.04[g]	0.02[g]	0.005[h]	0.03[h]	0.01[h]
1961-1970	944	17,740	5,960	620	133.15	24.62	-	26.85[a]	-	22.70	207.30	0.04	0.91	0.42	0.04[i]	0.61[i]	0.33[i]
1962-1970	48[l]	72.3[l]	186.5[l]	18.1[l]	-	-	-	-	-	-	3.36[j]	0.002[j]	0.08[j]	0.03[j]	0.003[k]	0.10[k]	0.03[k]
1961-1970	15	24.3	35.6	0.1	0.86	0.20	-	1.76	0.01	0.01	2.84	0.001	1.34	0.34	0.00[m]	0.42[m]	0.09[m]
1961-1970	5	-	5.3	-	-	1.89	-	0.73	-	-	2.62	0.19[n]	1.99[n]	0.99[n]	0.01[n]	0.11[n]	0.04[n]
1961-1969	5,286	2,867.7	2,528.7	390	-	-	-	-	-	-	104.58[n]	0.19[n]	2.22[n]	1.02[n]	0.14[n]	1.71[n]	0.97[n]
1957-1969	-	-	-	-	0.11	0.21[b]	-	0.08	0.08	0.03	0.51	0.00	0.74	0.26	-	-	-
Ceylon) 1964-1969	-	26.4	1.0	1.7	1.67	1.85	-	1.07	0.28	0.35	4.22[o]	0.05[o]	3.63[o]	0.37[o]	0.03[o]	0.43[o]	0.27[o]
l	6,301	20,731.9	8,929.5	1,030.1	136.61	28.20	0.32	31.29	0.79	23.11	328.26	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-	-	0.45[e]	-	-	0.06[f]
	7,396	22,426.4	9,594.2	1,389.8	217.97	130.35	60.99	450.17	10.16	24.94	1,002.52 (894.58)[p]	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-	-	1.11[e]	-	-	0.17[f]

uding public utilities
uding industry loss
uding property and industry loss
-1969

e/ Weighted according to population 1961-1970
f/ Weighted according to GNP in 1966
g/ Excluding 1965
h/ 1963, 1966, 1967, 1968
i/ 1961-1967
j/ 1962, 1963, 1966, 1968
k/ 1963, 1966, 1968
l/ Excluding 1964, 1965
m/ 1963-1969, West Malaysia only
n/ Excluding 1967
o/ 1964, 1966, 1969
p/ Excluding Indonesia and Pakistan.

The annual per capita damage varied according to country from zero up 13.49 for Japan, averaging $1.11 for the 15 countries listed over the od 1961-1970; excluding Japan, it was $0.52. Expenditure on flood control, he other hand, was probably substantially less. Expenditure in India ng 1951-1966 was equivalent to $0.05 per capita per annum; over shorter ods within this interval, the Republic of Korea spent $0.23, Pakistan 7 and Japan $2.50.[3/]

EFFECT OF DAMAGE ON THE ECONOMY OF COUNTRIES AFFECTED

In table 7 and figure 3, thirteen of the countries listed in table 6 classfied into two categories: (a) those in which the average annual ge was less than 0.1 per cent of the gross national product; and (b) those hich the average annual damage was greater than 0.1 per cent of the gross onal product. Australia, Burma, Indonesia, Malaysia and New Zealand fall the first category; India, Japan, Pakistan, the Philippines, the Republic orea, the Republic of Viet-Nam, Sri Lanka (Ceylon) and Thailand into the nd one. While these categories are generally indicative of the scale of ge experienced over a lengthy period, it is the damage sustained during ngle year that may have a crippling effect on a country's economy. With exception of India, the countries in the second category experienced annual ge exceeding 1 per cent of the gross national product at least once during -1970 and are liable to experience greater damage in the years ahead. ge of this order is exceedingly harmful when the per capita growth rate eldom more than 3 per cent. For the region as a whole, damage amounted .17 per cent of the gross national product; for the five countries affected yphoons, it was 0.53 per cent; for the seven countries affected by cyclones, as 0.17 per cent; and for Australia and New Zealand, it was 0.03 per cent.

The figures cited for India, Japan and the Republic of Korea are based omprehensive national surveys covering the period of interest. The monetary res for Australia, New Zealand, the Philippines and Thailand likewise red the period 1961-1970. Comparable figures were not available for

/Fig. 2

[3/] "The scope of water resources development needed to meet the anticipated food requirements of the developing countries of the region 1970-1990" (E/CN.11/WRD/Conf.9/L.3), September 1970.

Table 7. Classification of countries according to damage sustained

(Percentage of gross national product)

gory	Country	Average	Minimum	Maximum	Years
annual less than cent	Australia	0.01	0.00	0.05	1961-1969
	Burma	0.01	0.005	0.03	1963, 1966-1968
	Indonesia	0.03	0.003	0.01	1963, 1966, 1968
	Malaysia	0.09	0.00	0.42	1963-1969
	New Zealand	0.04	0.01	0.11	1961-1970
annual more than cent	India	0.33	0.04	0.61	1961-1967
	Japan	0.42	0.17	1.53	1961-1970
	Pakistan	0.97	0.14	1.71	1961-1966, 1968-1969
	Philippines	0.43	0.003	2.03	1961-1970
	Korea, Rep. of	0.76	0.03	1.51	1961-1970
	Viet-Nam, Rep. of	0.31	0.01	2.02	1961-1969
	Sri Lanka (Ceylon)	0.27	0.00	2.43	1964, 1966, 1969
	Thailand	0.44	0.02	1.24	1961-1970

Hong Kong, Indonesia, Malaysia, Singapore, Sri Lanka (Ceylon) or the Repu
of Viet-Nam. The monetary damage figures quoted for Burma, Mongolia and
Pakistan were extracted from the Water Resources Journal and other source
information. For Brunei, the Khmer Republic, Laos and Mongolia, there we
little information. Physical damage statistics were available for only a
countries as the majority had not instituted regular flood damage surveys

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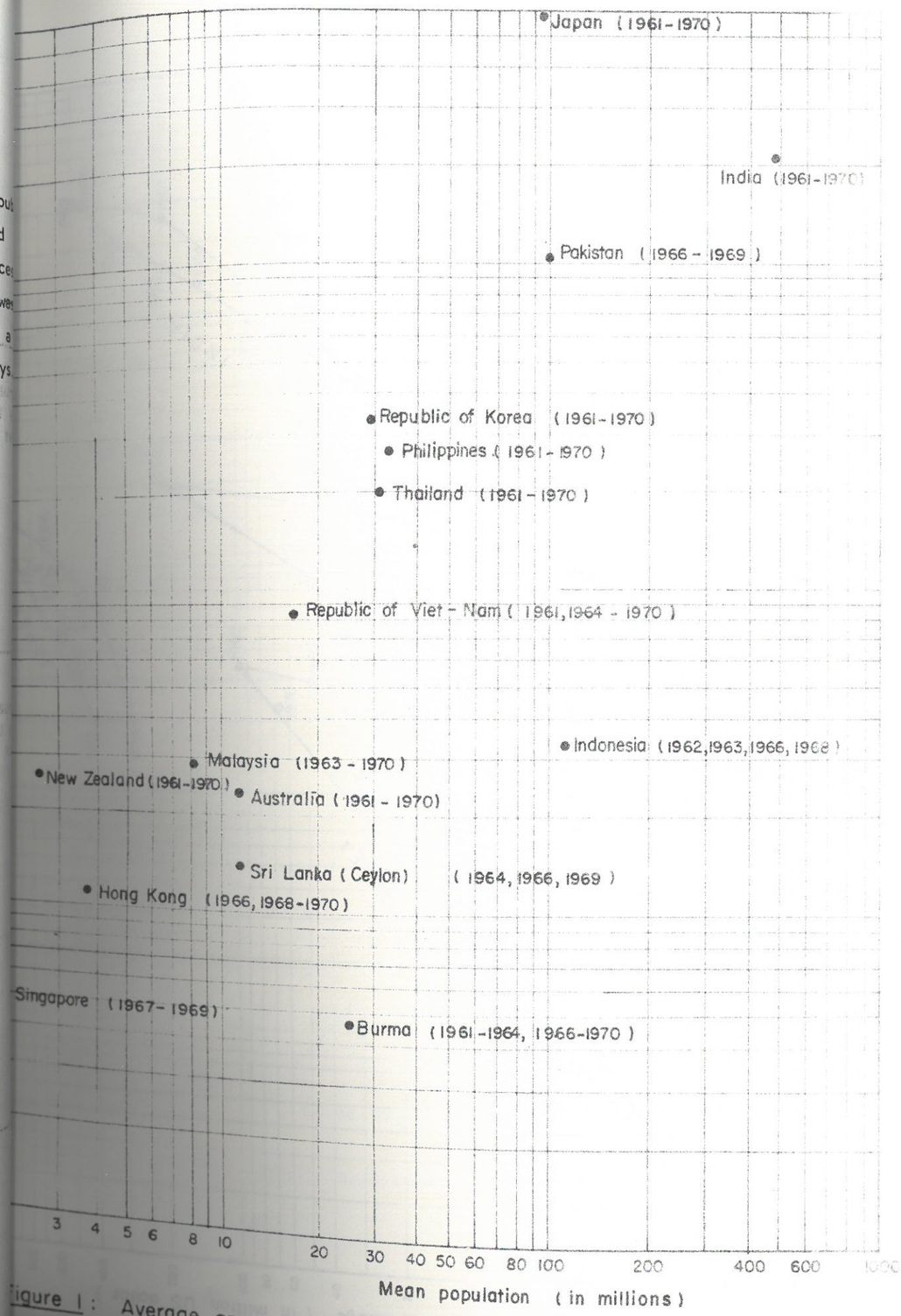

Figure 1: Average annual damage in terms of mean population

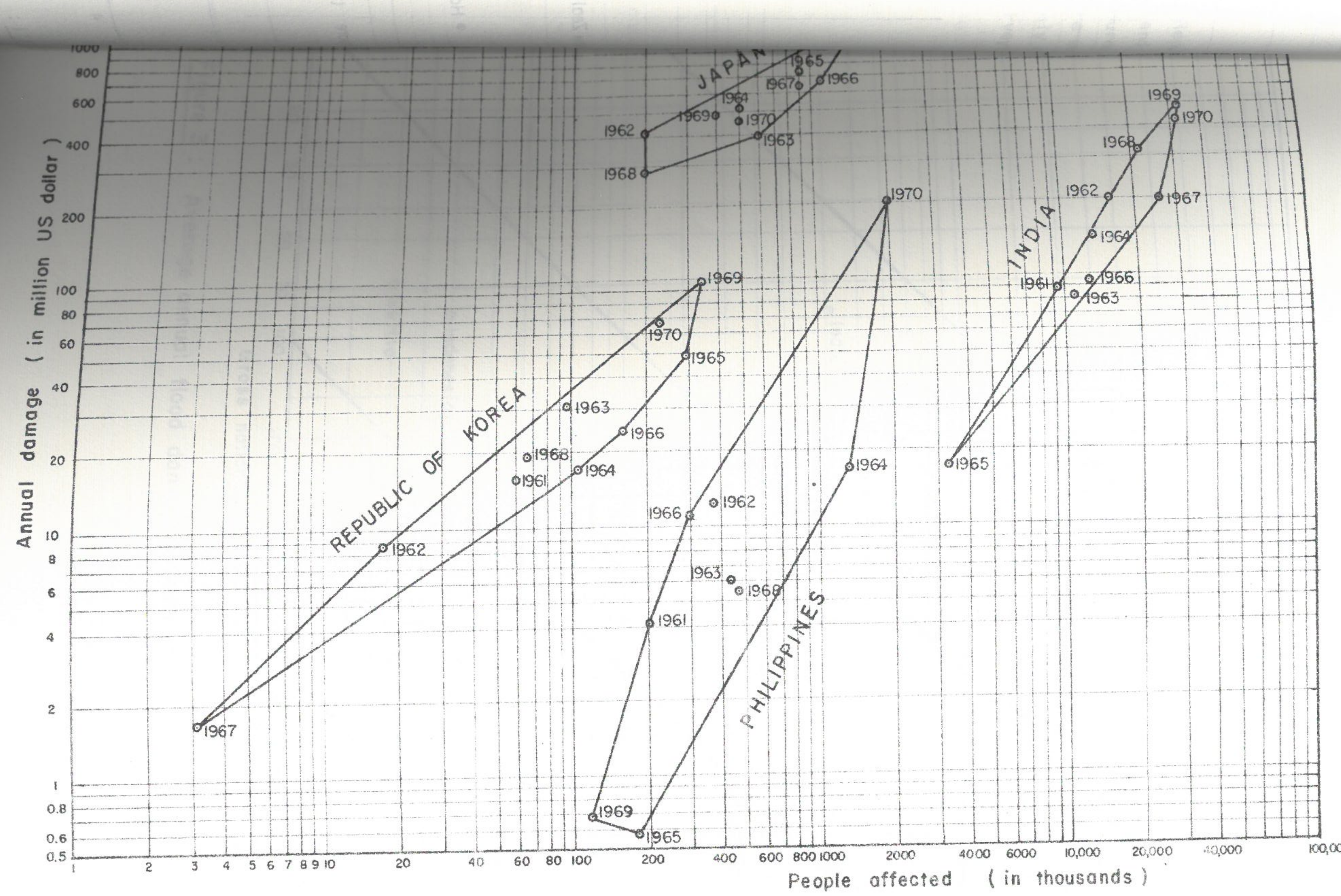

Figure 2 : Annual damage in terms of people affected.

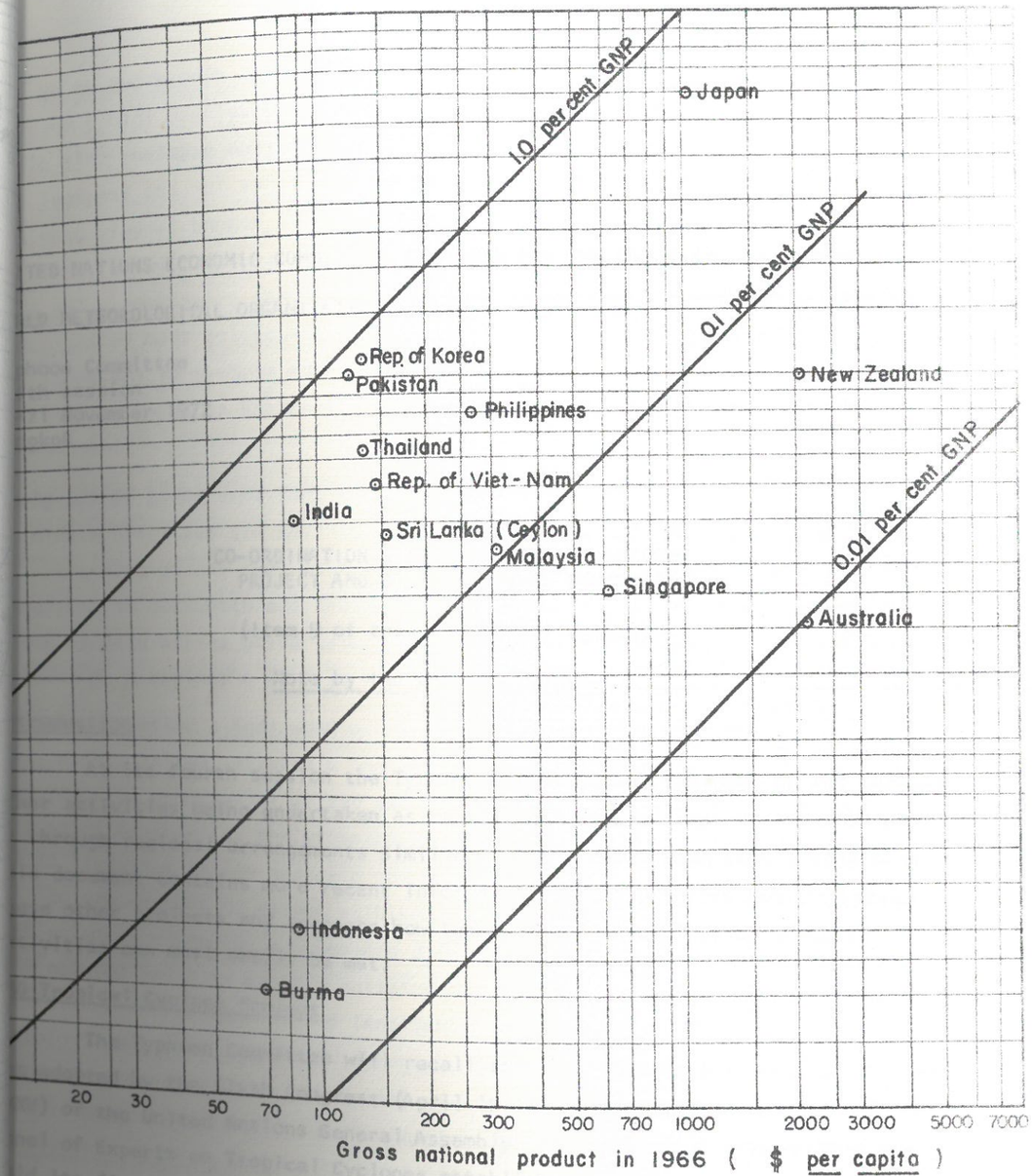

Figure 3 : Average annual flood damage in terms of gross national product.

FOR PARTICIPANTS ONLY

WRD/TC.5/11
17 August 1972

ORIGINAL : ENGLISH

ITED NATIONS ECONOMIC COMMISSION FOR ASIA AND THE FAR EAST
D
RLD METEOROLOGICAL ORGANIZATION

phoon Committee
fth session
-21 November 1972
ngkok

CO-ORDINATION WITH WMO TROPICAL CYCLONE PROJECT AND OTHER REGIONAL PROJECTS

(Item 9 of the provisional agenda)

Note by the WMO secretariat

ntroduction

. At its fourth session the Typhoon Committee was informed of the various ther activities being undertaken as part of the WMO Tropical Cyclone Project r through regional arrangements similar to the Typhoon Committee's programme. his document contains more recent information on the progress achieved under hese other projects and suggests how the need for co-ordination of these ctivities can most easily be met.

MO Tropical Cyclone Project

. The Typhoon Committee will recall that the WMO Tropical Cyclone Project as adopted by the Sixth Congress (April 1971) in response to resolution 2733D XXV) of the United Nations General Assembly. It will also remember that the anel of Experts on Tropical Cyclones established by the WMO Executive Committee eld its first session in Tokyo in September 1971, immediately before the fourth ession of the Typhoon Committee.

/3.

3. In the period since its first session the basic plan drawn up by the panel for the WMO Tropical Cyclone Project has been developed into a more comprehensive plan. In May 1972 the Executive Committee examined this plan and decided to adopt it as an initial set of guidelines for the Tropical Cyclone Project. The actual implementation of the plan will depend largely upon the willingness of WMO Members to undertake the studies included in it, and upon their to provide the facilities forming part of the regional programmes. The plan has accordingly been distributed to all WMO Members urging them to indicate what assistance they can offer in its support. The members of the panel of experts will continue to keep the plan under review and to stimulate its implementation.

4. The Executive Committee also recognized that some parts of the plan could only be carried out with the help of expertise not available within WMO. At the same time it expressed its conviction that the co-ordination of implementation of the project should remain under the direction of WMO, international organizations and national agencies being called upon to assist as might be required. Co-ordination meetings will be organized when necessary.

5. The Typhoon Committee may also wish to know that a United Nations Disaster Relief Co-ordinator was appointed and a Disaster Relief Office set up being on 1 March 1972. This office was set up in response to resolution 2816 (XXVI) of the United Nations General Assembly and is intended to be the focal point in the United Nations system for disaster relief matters. One of its functions is that of assisting in providing advice to Governments on pre-disaster planning in association with appropriate voluntary agencies and drawing upon UN resources. Close collaboration will be effected between the Disaster Relief Office and other international bodies active in this field including WMO. Preliminary discussions on the WMO Tropical Cyclone Project have already taken place between the new Office (which is located in Geneva) and WMO, and close contact will be maintained on all matters of joint interest.

6. More recently the United Nations Conference on the Human Environment (Stockholm, June 1972) has also made recommendations of interest to the Typhoon Committee and related to the programmes WMO is carrying out. These recommendations were in fact directed to the Disaster Relief Co-ordinator /the

further emphasize the importance of collaboration between WMO and his ce. Whilst the Stockholm recommendations deal with all types of natural sters, particular importance is attached to measures to detect and provide ings of tropical cyclones. The need to take full advantage of existing tems and plans such as the World Weather Watch and the WMO Tropical lone Project is pointed out. Without going into too many details in this ument, it may be said that the stockholm Congerence has further underlined importance of, and the need for activities such as those forming part of Tropical Cyclone Project.

ional tropical cyclone programmes

Since the fourth session of the Typhoon Committee there have been main developments in the regional tropical cyclone programmes. In ember 1971 a meeting of experts in Mauritius recommended the establishment an RA I Tropical Cyclone Committee for the South West Indian Ocean. The essary procedural steps were put in hand in early 1972 and by the middle the year six of the seven WMO Members invited to participate had signified ir desire to do so. This Committee will have been formally constituted fore the Typhoon Committee session; its objectives are broadly those of the phoon Committee.

It is expected that the first session of the RA I Committee will be ganized in May 1973. That session will be preceded by expert surveys of e facilities now existing in the countries concerned, and also of the present vel of community preparedness and disaster prevention arrangements. On the sis of these surveys the Committee will then decide upon the programme it shes to undertake.

The other development under this heading has been the formal setting of the joint WMO/ECAFE Panel on Tropical Cyclones as the regional body r the Bay of Bengal and the Arabian Sea. The present members of the panel e India, Pakistan, Sri Lanka and Thailand. Consultations with these countries re in course at the time of drafting this document to see how they would sh to initiate their programme of work.

/10.

10. In this context the Typhoon Committee will no doubt wish to re
the decision taken in paragraph 92 of the report of its fourth session
will be recalled that the Committee decided not to accept a proposal t
its activities be merged with those of the WMO/ECAFE Panel on Tropical
It appointed the representative of Thailand to serve as a rapporteur t
co-operation between the two bodies and, at the same time, agreed to r
the matter at its fifth session. The panel is only just beginning its
and there has been no real change in the considerations which led the
to reject the proposed merger last year. It is therefore presumed tha
will wish to maintain its independent status and continue to make othe
arrangements for co-ordination with other regional bodies.

Action proposed

11. The Typhoon Committee is invited to examine the information gi
this document and to decide whether the exiting arrangements for co-or
with the WMO Tropical Cyclone Project and other regional projects are
statisfactory. It is suggested that it may specifically wish:

(a) to note with satisfaction the progress made in initiating the WMO Tropical Cyclone Project;

(b) to urge its member countries to give their full support t this project, contributing to its implementation in any wa that they may find possible;

(c) to request the Secretary-General of WMO to continue and t strengthen the collaboration between WMO and the United Na Disaster Relief Co-ordinator with a view to speeding up inplementation of the Tropical Cyclone Project;

(d) to invite the representative of Thailand to continue to se as rapporteur to the Typhoon Committee on the activities c out by the joint WMO/ECAFE Pane on Tropical Cyclones;

(e) to empower the Typhoon Committee Secretariat to serve as t link between its own activities and those conducted under WMO Tropical Cyclone Project, seeking the assistance of th WMO Secretariat whenever required.

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FOR PARTICIPANTS ONLY

WRD/TC5/12
26 October 1972

ORIGINAL : ENGLISH

NATIONS ECONOMIC COMMISSION FOR ASIA AND THE FAR EAST

METEOROLOGICAL ORGANIZATION

on Committee
session
November 1972
ok, Thailand

TENTATIVE PROGRAMME

vember - Wednesday

09.00 - 09.45 hours — Registration

10.00 - 10.40 hours — Opening session

(1) Inaugural address
(2) Statement by the Executive Secretary of ECAFE
(3) Statement by the Secretary General of WMO
(4) Vote of thanks

Recess 20 minutes

11.00 - 12.30 hours — Technical session

(5) Election of the chairman and vice-chairman
(6) Adoption of the provisional agenda (WRD/TC5/1)
(7) Agenda item 4: Committee's activities during 1972 (WRD/TC5/6)

14.30 - 17.00 hours

(8) Continuation of discussion on agenda item 4:
(a) Meteorological component
(b) Hydrological component

vember - Thursday

09.30 - 12.30 hours

(1) Continuation of discussion on agenda item 4:
(c) Complementary protective measures
(d) Training and research
(2) Agenda item 5: Programme for 1973 and beyond (WRD/TC5/7)

/14.30

14.30 - 17.00 hours

(3) Agenda item 6: Draft request to U
assistance in support of the Typh
Committee (WRD/TC5/8)

17 November - Friday

09.30 - 12.30 hours

(1) Continuation of discussion on age
(2) Agenda item 7: Disaster planning a
preparedness (WRD/TC5/9 and WRD/T

14.30 - 17.00 hours

(3) Continuation of agenda item 7
(4) Agenda item 8: Consideration of re
damage caused by typhoons, cyclone
accompanying storm surges (WRD/TC

18 November - Saturday

09.30 - 12.30 hours

(1) Agenda item 9: Co-ordination with
tropical cyclone project and other
regional projects (WRD/TC5/11)
(2) Agenda item 10: Date and place of
sixth session

14.30 - 17.00 hours

(3) Meeting of the Drafting Committee

19 November - Sunday

Free

20 November - Monday

Study tour

21 November - Tuesday

09.30 - 12.30 hours

(1) Consideration of the draft report
(2) Closure of the session.

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FOR PARTICIPANTS ONLY

WRD/TC5/13
25 October 1972

ORIGINAL : ENGLISH

ITED NATIONS COMMISSION FOR ASIA AND THE FAR EAST
D
RLD METEOROLOGICAL ORGANIZATION

phoon Committee
fth session
-21 November 1972
ngkok, Thailand

NOTE ON COMMUNITY PREPAREDNESS AND DISASTER PREVENTION ACTIVITIES IN THE TYPHOON COMMITTEE COUNTRIES

(Agenda Item 7)

Note by the WMO secretariat

ntroduction

. In 1971, WMO engaged a high-level consultant (Mr. James R. Hickey), hrough the League of Red Cross Societies, to make a survey of community reparedness and disaster prevention arrangements in the typhoon area. he consultant visited all Typhoon Committee member countries and prepared valuable report with recommendations for further action.

. One of his most significant findings was that, in most countries, here is a serious lack of contact between the meteorological/hydrological gencies and those responsible for community preparedness. There seems be insufficient understanding of the complementary nature of the nctions of the two sides, and of the extent to which the responsibilities the one impinge upon the other. The survey thereby revealed a state affairs not previously recognized and one that has alarming implications r the safety of human life and property in these countries.

/3. It is

3. It is now important to follow up the survey with action desig
rectify a potentially dangerous situation and thus build upon the fou
already laid. It is also important to move ahead whilst the survey i
fresh in the minds of those concerned in the member countries. A pro
course of action is therefore outlined below.

Proposed course of action

4. This problem has been discussed at a series of meetings with
in Geneva, and by correspondence with ECAFE. A number of ideas aimed
bringing the two communities together have been examined. The one m
favoured by IRCS, because it was felt to have the best chance of succ
proposed that a LRCS/WMO/ECAFE team should visit the countries mainly

5. The purpose of the joint mission would be to visit, in the se
countries, the Meteorological/Hydrological Services and the community
preparedness/disaster prevention agencies, in order to explain to the
the ways in which both can, and should, contribute to the total syste
the protection of human life and property. Whilst this statement is
an over-simplification, it is felt that progress towards these genera
objectives can be accelerated by arranging for detailed discussions a
explanations to the two communities, both separately and collectively
No approach of this type has previously been made.

6. An essential feature of the joint mission would be the physic
bringing together of representatives of the two communities. Thus it
suggested that the individual members of the team would first have se
discussions with their counterpart services, in order to explain full
the purpose of the mission and the ways in which they believe this pu
could best be achieved. The next step would be to arrange joint meet
suitable executive levels between the two sides. These meetings woul
provide opportunities to expound in greater detail the theme of an
integrated programme of protection against typhoons and the respecti
roles of each of the national agencies involved. Careful attention s
be given to ensuring that all have a full understanding of the capabi
and the limitations of present methods, not only of prediction and w
but also of preventive measures.

/7. One

One of the most important objects of the mission would be to draw
n agreed programme of the action that should be taken in each country
the next few years to improve community preparedness. If possible,
if time permits, further meetings and discussion groups should be
nized between operational staff from both communities during the course
he mission.

Amongst the steps which might be recommended to foster closer
acts and a more effective level of collaboration, the following
suggested:

Establishment of national disaster prevention plans, where they do not already exist;

Creation of national committees representing all agencies concerned to apply and review, as required, the plan under (a) above;

Regular meetings at the national level for discussion of common problems;

Visits of community preparedness/disaster prevention personnel to Meteorological/Hydrological Services, and vice-versa;

A special annual pre-typhoon season conference;

Joint exercises before the typhoon season to test preparedness;

Setting up of direct communication links between the agencies involved to ensure complete and continuous co-ordination of efforts in pre-disaster and disaster situations;

Appointment of "liaison officers" to provide regular contact between the agencies;

Full participation of all national authorities concerned in the activities of the Typhoon Committee, including its sessions;

Preparation of public information material so that all members of the public are fully conscious of risks and how to minimize them. This material to be prepared jointly by all responsible bodies in each country.

It would be necessary to make advance arrangements with each of the
tries concerned to avoid loss of time upon arrival of the mission. A
fully scheduled programme of meetings and discussions should be planned
submitted to each government well in advance (see also paragraph 12 below).

/Countries

Countries to be visited

10. The following Typhoon Committee member countries should be incl... the mission: Hong Kong, Korea and Thailand. These three countries have ...gramme, both for the results that can be obtained in the typhoon area and selected as a pilot follow-up to the survey made by the consultant in ...o because it provides what is, in effect, a pilot project which can show is hoped that the visits to these countries will show how further actio...re most efforts should be placed in carrying through the community follow up the Hickey report can best be taken in the Typhoon Committee ...paredness part of the WMO Tropical Cyclone Project. Mr. Hickey's in general. A stay of 7-10 days in each country would be necessary. ...ort contains many recommendations that will require attention at both The total time involved would thus be of the order of 3-4 weeks. ... international and national levels. Before anything much can be done at

Timing ... international level, the present gap between the scientific and social

11. The period suggested for the mission is March 1973. This is ba...fers a reasonable prospect of substantial progress towards this first upon LRCS arrangements for a seminar in Bangkok from 6-27 February 197...ective. the consequent availability of a staff member in the area immediately thereafter.

Further immediate action

12. LRCS is of the opinion that a mission of this type is a necessa... prelude to further work in this component of the Typhoon Committee prog... and wishes to go ahead as speedily as possible. The mission also has t... support of the Office of the United Nations Disaster Relief Co-ordinato... A detailed plan for the joint mission should therefore now be drawn up. This plan should include a schedule for the visit to each country with ... persons and authorities to be contacted, suggestions for discussion gro... The plan should be submitted to each country with the proposal for the ... mission. Prior acceptance by each country should be obtained, together ... agreement to make the internal arrangements needed. The preliminary co... with each country will, therefore, need to be at a sufficiently high le... for there to be a reasonably good assurance that full and effective arr... will be made to receive the mission, and that its work can be productiv...

Concluding remarks

13. The importance of the community preparedness aspects of the Typ... Committee programme have been fully recognized only in the last year or ... It is true to say that the success of the programme will ultimately dep... principally on the action taken to improve community preparedness and ... disaster prevention measures. Unless real progress is made in this res... the hopes of achieving any worthwhile reduction in damage must remain s...

/14. No

No opportunity should therefore be missed to further this side of the

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FOR PARTICIPANTS ONLY

WRD/TC.5/14
8 November 1972

ORIGINAL : ENGLISH

D NATIONS ECONOMIC COMMISSION FOR ASIA AND THE FAR EAST

METEOROLOGICAL ORGANIZATION

on Committee
session
November 1972
ok, Thailand

SOME TYPHOON SOUNDINGS AND THEIR COMPARISON WITH SOUNDINGS IN HURRICANES 1/

(Agenda item 14 of the provisional agenda)

1/ This abstract of a paper by Gordon J. Bell and Tsui Kar-sing, Royal Observatory, Hong Kong, is circulated as presented by that organization.

ROYAL OBSERVATORY, HONG KONG
PRE-PRINT SEPTEMBER, 1972

Some Typhoon Soundings and their Comparison with Soundings in Hurricanes

Gordon J. Bell and TSUI Kar-sing
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Abstract

Over 100 radiosonde soundings made within 185 km of the centres of typhoons are averaged in 5-mb classes of sea-level pressure (SLP). The mean typhoons are warmer and more humid in the troposphere and have a higher tropopause and colder stratosphere than equivalent mean hurricanes. Similar differences are found between long-period mean September soundings for the West Indies and those from the western North Pacific Ocean. High correlations between SLP and some parameters are found and regression equations are presented and compared with those for eye soundings.

Anomalies of the heights of isobaric surfaces, temperatures and humidities in the mean hurricane and typhoon soundings are compared. They confirm the existence of the hurricane upper cold core which is shown to be colder in deeper hurricanes. No such cold core is found in the mean typhoon soundings; this is attributed to the higher tropopause and colder stratosphere in the Pacific. Anomalies for all known radiosonde eye soundings in hurricanes and typhoons are presented including those for two eye soundings through the tropopause. In typhoon soundings at relatively large values of SLP, the tropopause is found to lie below that in the normal September atmosphere but to be high again at smaller values of SLP. In mean hurricane soundings the tropopause changes little at large values of SLP and is higher at smaller values of SLP. The tropopause over the inner regions of tropical cyclones is usually higher than normal but its topography appears to be variable in that it is not always highest directly over the eye.

1. Introduction

Sheets (1969) presented radiosonde soundings made during the period 1956-67 within 185 km (100 n. miles) of the centres of hurricanes south of 35N over the Gulf of Mexico, the Caribbean Sea and the North Atlantic Ocean. He found, inter alia, that the values of the various parameters in the soundings were a function of the sea level pressure (SLP) so that he was able to stratify the data by ranges of SLP to obtain mean soundings for each range. One of the authors (Bell) noticed marked differences between individual soundings in typhoons and hurricanes and therefore thought it worthwhile examining, after the manner of Sheets (1969), a large number of typhoon radiosonde soundings to determine whether there were any significant systematic differences. In all, 101 typhoon soundings meeting Sheets' (1969) criteria have been collected and compared with his 92 hurricane soundings. Those parts of Sheets' work which are equally valid for typhoons have not been repeated here as our aim has been to concentrate attention on differences between the soundings.

The terms "typhoon" and "hurricane" will be used loosely to denote tropical cyclones of any intensity in the western North Pacific and Atlantic regions respectively.

2. The Data

Data for ascents made in named tropical storms or typhoons during the period 1953-1971 at the eight stations listed in Table 1 were obtained from the Northern Hemisphere Data Tabulations U.S.W.B., Aerological Data of Japan J.M.A., and Meteorological Results Part II, Royal Observatory Hong Kong. Both Schacht (1946) and Sheets (1969) have shown that there is a diurnal variation in temperatures in hurricanes. The latter found the difference to be a maximum at 300 mb where the afternoon ascent was approximately 2C warmer than the night soundings. To avoid this diurnal effect, attention is here confined to ascents made at 0000 GMT which, in terms of local time, varies from 0800 at Hong Kong to some two hours later at Iwo Jima, the most easterly of the stations used.

Those ascents made with Japanese instruments were reduced to the standard of U.S. sondes after the manner described by Shimada (1962). Vaisala

soundings were reduced to British Kew MK IIB standard using the results of Apps (1971). No thorough comparison of the British or Vaisala instruments with U.S. radiosondes is available but the U.S. 403 MHz sonde is currently flown in Thailand from several stations at 0000 GMT whereas, at 1200 GMT, Vaisala instruments are used. Data from these flights, together with the Hong Kong soundings and the data in Apps (1971) suggest that systematic differences due to instrument type are not significant in the context of this paper. Furthermore, mean monthly soundings in the troposphere for August and September at Hong Kong lie close to the mean value for the eight stations with Clark Field means being the coldest and those from Taipei the warmest. In the stratosphere the Hong Kong mean ascents appear colder than those at neighbouring stations which use U.S. sondes, the difference amounts to 2C at 70 mb. No correction to the soundings has been made for this difference because it is not known how much of it may be due to genuine spatial variations and, additionally, the few Kew-standard soundings in the stratosphere that have been used lie within the spread of readings from other types of sonde in equivalent typhoons. Accordingly, the 82 ascents reduced to the standard of the U.S. sondes have been combined with the 19 ascents to the British Kew MK IIB standard to from one set of 101 soundings.

Table 1

The number of ascents made in each month from May to December were respectively: 5,12,18,30,25,6,3 and 2. None of the ascents were made in the eye wall region of typhoons. Mean values of the parameters at each pressure level are shown in Table 2. Mean soundings corresponding to each of six 5-mb ranges of SLP are given in Tables 3 to 8. To facilitate comparison with the results of Sheets' (1969) his format has been retained except that humidity mixing ratio is given in preference to relative humidity and data are given for the surface rather than 1000 mb. It should be noted that the means for the surface and the tropopause do not strictly form part of a set of observations for constant pressure surfaces.

Tables 2 to 8

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radiosonde
All known/eye soundings in hurricanes and typhoons have been used. The first eye sounding to penetrate the tropopause was made at Hong Kong in typhoon Alice at 0352 GMT on 19 May 1961 (Royal Observatory, 1961) then followed an ascent in the eye of hurricane Arlene (Stear, 1965). These two soundings are for storms of similar SLP (981 and 978 mb) and both sondes were tracked to ascertain that they remained in the eye. A sounding through the tropopause was also made in the eye of typhoon Shirley (SLP 966 mb) from Hong Kong at 1015 GMT on 21 August 1968 (Royal Observatory, 1968). Since the balloon was not tracked by radar it is not possible to be sure that it did not move out of the eye at upper levels. Equivalent potential temperatures in this ascent were higher than those in Alice at all levels except at 100 and 150 mb but the sonde may have left the eye before reaching the tropopause. Three other hurricane eye ascents are used namely, Tampa 1944 (Riehl, 1947), Tampa 1946 (Simpson, 1947) and hurricane Inez 1966 (Sugg, 1967) but none of these soundings reached the tropopause.

3. Mean Conditions for the Western North Pacific Area

Jordan (1958a) presented mean soundings for the hurricane season in the West Indies and found that they agreed with Colon's (1953) mean ascents for the rainy season of the western North Pacific except that the Pacific data had lower surface pressures, higher humidities and a temperature about 4C lower in the vicinity of the tropopause. Shimada (1962) determined mean soundings for various regions of the western North Pacific and discussed their seasonal variation. He found that in the area of the West Carolines and the Marianas the 100 mb mean temperatures were up to 6.0C (4.0C and 3.8C in August and September) cooler than the West Indies soundings but that between 400 and 200 mb the Pacific soundings were some 2-3C warmer. In view of the differences in these findings it was thought advisable to determine means for the area from which the typhoon soundings used in this paper were taken, and to make use of the long-period records now available. Attention was confined to the months of August and September which coincide with peak tropical cyclone activity in both the western Pacific and the West Indies and which contain the

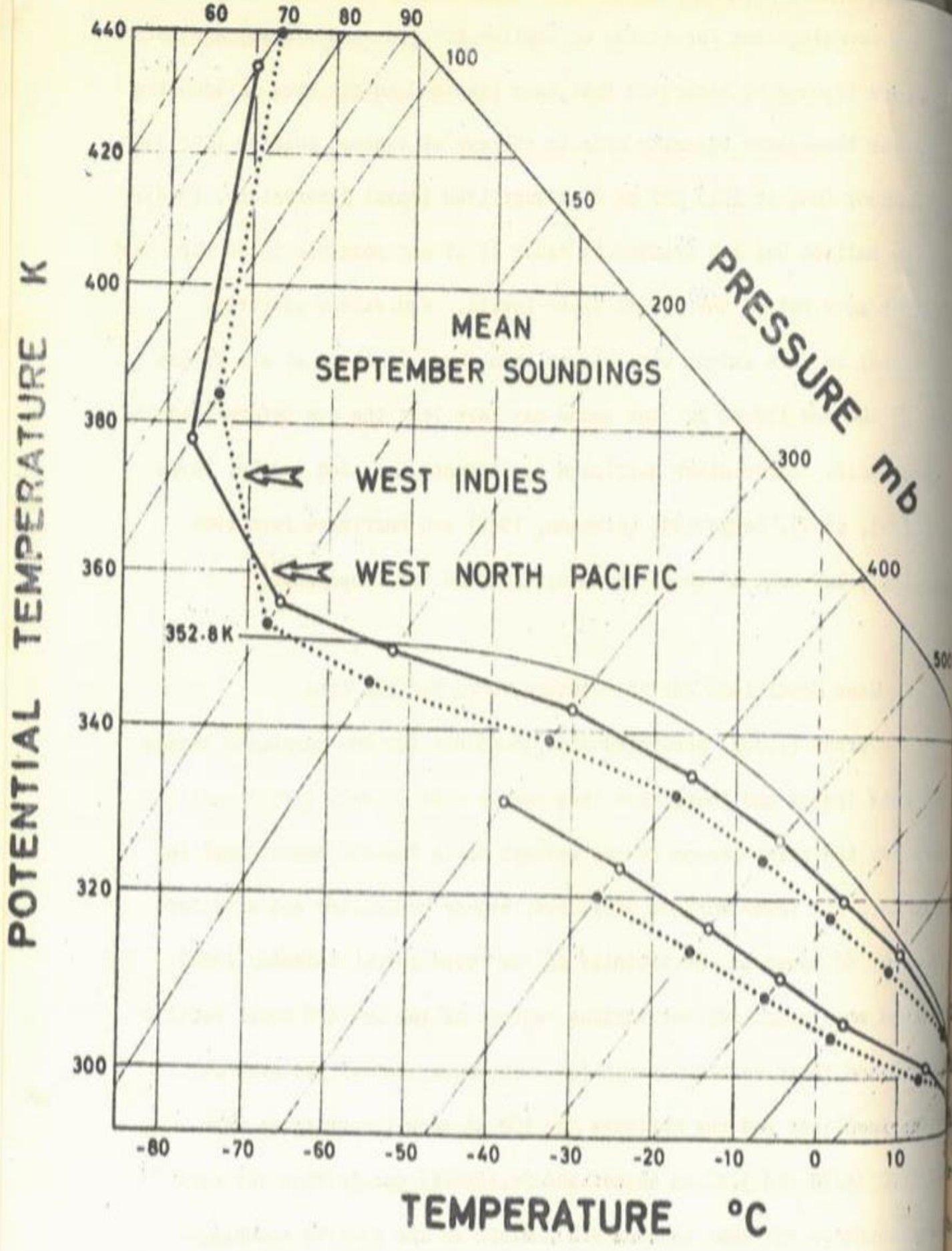

Fig. 1. Mean September tropical sounding for the West Indies region (Jordan, 1958a) and a mean September sounding for the tropical Western North Pacific Ocean from the results in Table 9.

half of typhoon ascents to be examined. There were no significant differences between the means found for August and September. Details of the September soundings are given in Table 9 and Fig. 1 where Jordan's West Indies September means have also been shown. The differences between the two ascents are similar to those found by Shimada (1962), that is, the Pacific soundings were ~~moister~~ more moist and warmer in most of the troposphere (the temperature difference between the ascents increases from zero at 850 mb to 2.9C at 200 mb) and above 100 mb the West Indies ascent is the warmer by approximately 3C.

Table 9

It will also be seen in Tables 9 and 10 that the mean sea level pressure in the Western Pacific during the summer is several millibars lower than that in the West Indies.

Table 10

4. Surface Temperatures

In his hurricane soundings Sheets (1969) included data for the 1000 mb surface but, with most of the typhoon soundings this level was below the surface and extrapolation from surface temperature and humidities could not be satisfactorily made. The mean temperature and humidity recorded at station level have therefore been included in Tables 2 to 8 but they should be used with discretion because they are from different levels and pressures. In diagrams where surface data have been plotted against pressure, the pressure chosen is that of the mean of the whole group (996.0 mb) or subgroup being considered.

Sheets (1969) was uncertain of the cause of the lower than normal surface temperatures in his sample of hurricane soundings. He hypothesised that increased cloudiness and heavy rain in hurricanes over land caused the air temperature to be less than normal and that

it could be 1-2C warmer over the sea. Surprisingly the overall mean surface air temperature for both the typhoon and hurricane soundings is 25.2C though temperatures of the order of 27C would be expected. For example, the mean air and sea temperatures determined from over 3,000 ship observations made in Pacific tropical storms and typhoons during the period 1958 to 1968 were 27.7C (σ = 2.0C) and 27.8C (σ = 1.5C) respectively.

It would be expected that rain and clouds would cause the temperature to be below normal wherever they occurred. In order to get an estimate of the magnitude of this effect, observations made at 0000 GMT on the small island of Waglan (Lat. 22° 11' N, Long. 114° 18' E, height 56 m, 4 km southeast of Hong Kong) were examined for the months of July, August and September in the years 1968-71. The mean air and sea temperatures for this period were 27.6C and 27.3C respectively and the temperature departures in various weather conditions were: one half cover of cloud or less + 0.4C, cloudy -0.2C, typhoon within 740 km -0.7C, typhoon strong winds -1.0C, typhoon gales -1.9C. As this temperature fall alone is not great enough to cause the surface temperature in typhoons to fall by 2.5C from 27.7C over the sea to 25.2C at sounding stations, contributions from other effects must be sought.

Temperatures from sixty ship observations made within 185 km of the centre of typhoons during 1958 to 1968, have been stratified into the 5-mb surface pressure classes of Tables 3 to 8 and are shown in Table 11. They indicate that within 185 km of the centre the mean air temperature is 1.1C lower than the overall typhoon mean of 27.7C.

Table 11

Similar departures were found in the 3,300 ship observations made in typhoons and analysed in Koninklijk Nederlandsch Meteorological Institut paper number 119 (1939); in particular the 0800 LST temperatures with rain during the preceeding few hours are there shown to be 0.6C below the sample mean of 27.6C whereas, the observations without rain were 0.3C

above this mean. The deviation from typhoon mean temperature caused by rain at 0000 LST was -1.6C. All these analyses indicate that the mean surface temperature in the typhoon soundings (25.2C) is about 1.0C lower than would be found in equivalent conditions over the sea.

In looking for further causes of this effect, the mean surface temperature, at the time of typhoon soundings, was determined for each station listed in Table 1. The results in Table 12 show that the higher stations tend to have lower mean temperatures; indeed, the lapse rate between the lowest and highest stations (2.9C/288 m) closely corresponds to the dry adiabatic lapse rate. The mean temperatures at the lowest two stations are close to those over the sea (Table 11). However, surface temperatures at stations well inland e.g. Canton (18 m, 100 km inland) and Clark (196 m, 60 km inland) have lower mean temperatures than stations nearer the coast at comparable altitude, a fact attributed to the insufficient supply of sensible heat over land to counteract adiabatic cooling.

Table 12

In summary, the overall mean surface temperature in typhoons at 0000 GMT as measured by ships is 27.6C. Nearer the centre this temperature is reduced by an amount which varies with the cloudiness and intensity of the rain (and probably sea temperature) and ranges between -0.3 and -1.6C to give a mean surface temperature of 26.6C (Table 11). Similar mean surface temperatures are reported from low-lying coastal stations in typhoons (Table 12). Typhoon temperatures at other stations decrease as their height and distance away from the sea increase. Representative surface air temperatures for typhoons should be taken from Table 11. The mean surface temperature in September for the Pacific stations listed in Table 9 is 25.8C and is less than the mean temperature at sea level near typhoon centres (26.6C); temperatures at low-lying coastal stations in typhoons should therefore show positive anomalies in the mean (Table 12), whilst those at higher stations and stations further inland should have negative anomalies.

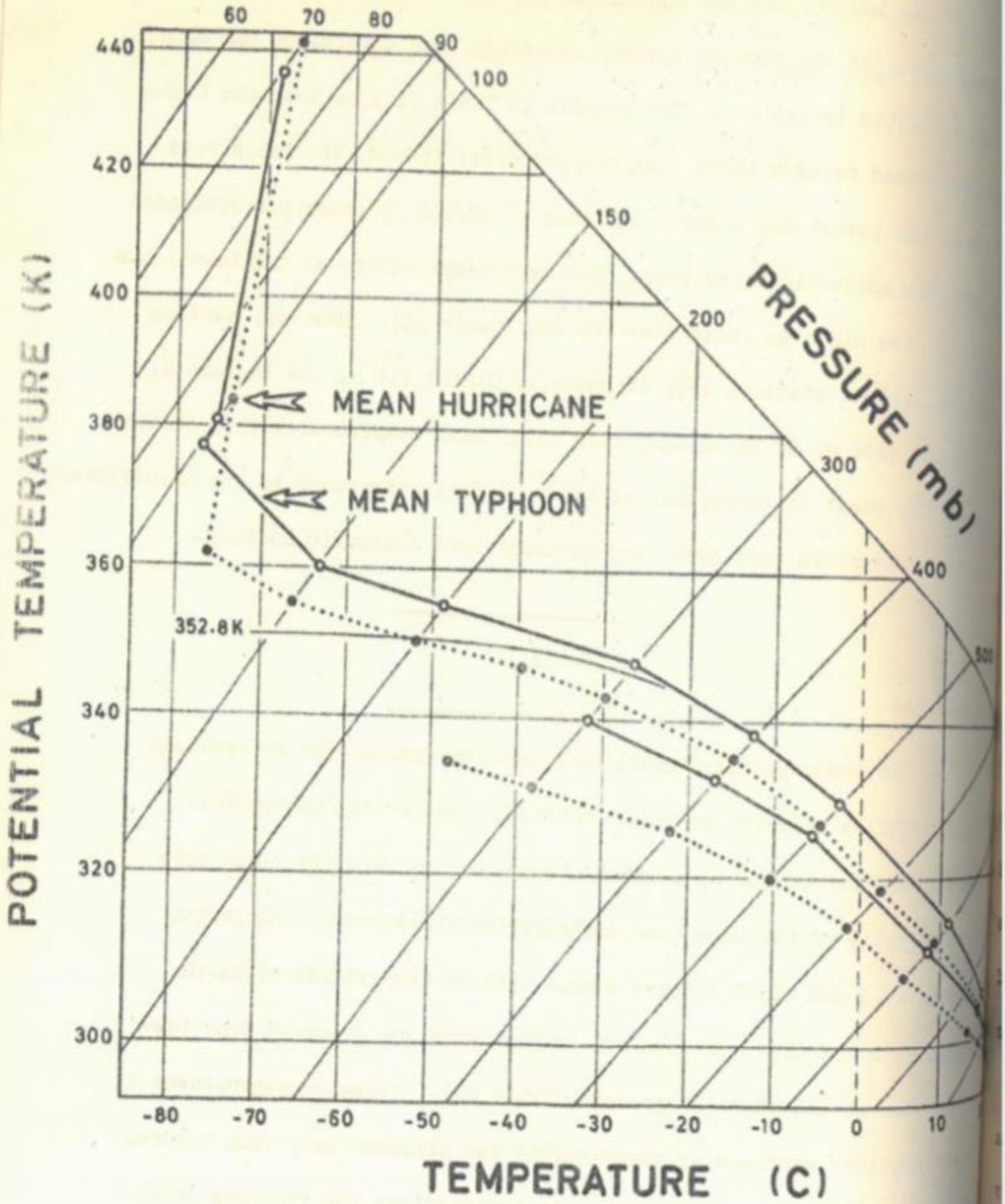

Fig. 2. Mean soundings from 101 typhoons and 92 hurricanes. The temperatures of the tropopauses have been plotted at the corresponding mean pressures.

The mean hurricane and typhoon soundings have been plotted in Fig. 2. It can be seen that, relative to the hurricane, the typhoon sounding is 2-3C warmer at 400 mb and below, 3-4C warmer in the upper troposphere and 2-3C colder in the stratosphere. The mean typhoon tropopause is 17.2 mb higher than in the hurricane but the tropopause mean temperatures are within 1C of each other. The mean typhoon sounding would be expected to be a little warmer because, as in all typhoon/hurricane comparisons, the relative abundance of very deep typhoons tends to cause a given sample of typhoons to be more intense, in the mean, than a sample of hurricanes. For example, in Hubert and Timchalk's (1969) analysis of satellite photographs of typhoons and hurricanes, the typhoons have a greater mean minimum diameter of cloud cover and higher mean wind speeds in the case of the most developed category - and indeed for the less intense categories too. In addition, the lower environmental pressure in the western North Pacific (Table 10) makes it difficult to find typhoon ascents with surface pressures above 1008 mb, therefore, no ascents could be found to compare with the hurricane sample in the 1010-1014 mb range. Similarly, for the low pressure data, Sheets (1969) had no grouping of hurricane soundings corresponding to SLP of 990-994 mb although he had a class with SLP $<$ 995 mb. The mean SLP for all ascents in the typhoon sample is 996.0 mb and for hurricanes 1003.2 mb. These differences alone would be expected to lead to a warmer mean typhoon sounding in the troposphere but it will be shown that other factors are also involved.

In the troposphere the mean soundings lay close to saturated adiabats up to about 300-250 mb above which level they were considerably warmer than would be achieved by the saturated ascent of air having the mean surface parameters given in Table 2.

6. Comparison of Soundings by SLP

As already indicated there are no typhoon soundings in the highest pressure range to compare with the hurricane soundings in this category and there are no hurricane soundings in the 990-994 mb class but only a group with SLP less than 995 mb. The lowest pressure class

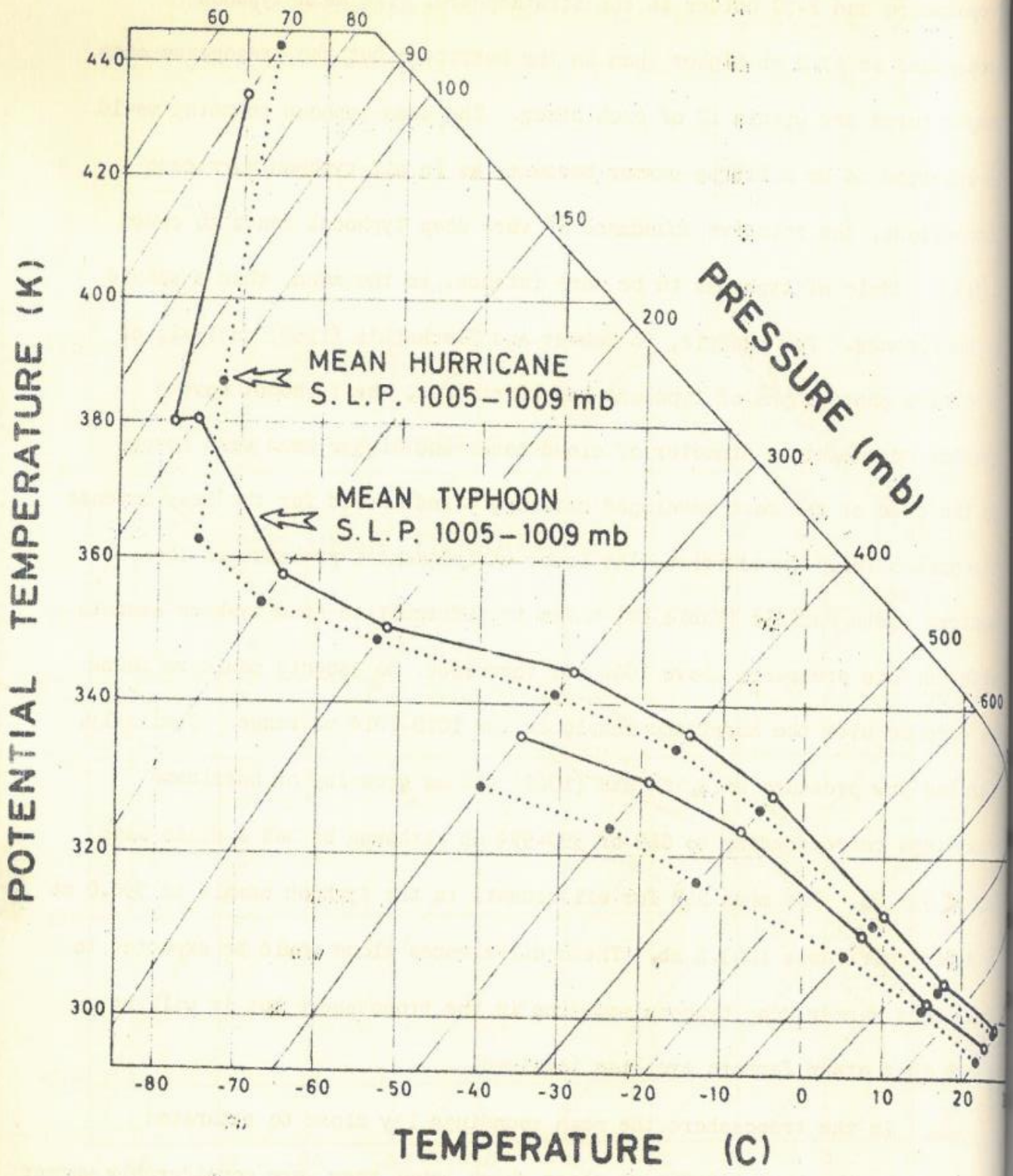

Fig. 3. Mean soundings from hurricanes and typhoons having SLP between 1005-1009 mb. Mean tropopauses included.

for typhoon soundings has SLP less than 985 mb and contains one ascent with SLP of 964.8 mb and six with pressures less than 980 mb. If the lowest class of hurricanes (SLP < 995 mb) is compared with the 990-994 mb typhoon class then there are four comparable groups. Within each of these classes the typhoon soundings are warmer than hurricanes in the tropopsphere and colder in the stratosphere. The temperature excess in typhoons below the 150 mb level ranges from zero to 2.4C. The differences at all levels were least in the 1000-1004 mb class. In no group was a hurricane warmer than the equivalent typhoon at any pressure level below 150 mb. In Fig.3 the soundings in the group 1005-1009 mb have been plotted together with their mean tropopauses. In this group the temperatures of the typhoon soundings at 300 and 150 mb are warmer than in hurricanes by 2.3C and 2.4C respectively. These comparisons show that the differences in temperature between the mean hurricane and mean typhoon soundings (Fig. 2) are not entirely due to sampling variations but also reflect genuine differences.

7. Anomalies of the Height of Isobaric Surfaces, Temperature and Humidity

The variation with altitude and SLP of the height of isobaric surface, temperature and humidity in typhoons and hurricanes is shown in Figs. 4, 5, and 6 in terms of the departures, or anomalies, from the respective normal September tropical atmospheres (Table 9). The heavy lines refer to mean typhoon and hurricane soundings, the thinner lines depict soundings in different pressure classes and the dashed lines represent all available eye soundings. These will be discussed in Section 9.

Care should be taken in interpreting the anomalies. The environment of individual typhoons or hurricanes may depart markedly from the mean tropical sounding and Koteswaram (1967) has shown that there were significant asymmetries in the atmosphere around some hurricanes he studied. However, it is probable that the mean environment beyond the low-level circulation is not far different from the appropriate mean tropical sounding. This can be inferred by the way in which the anomalies tend to zero in Figs. 4, 5 and 6 as the SLP approaches that of the mean tropical atmosphere. Thus it is probable that in layers of negative anomalies of pressure heights,

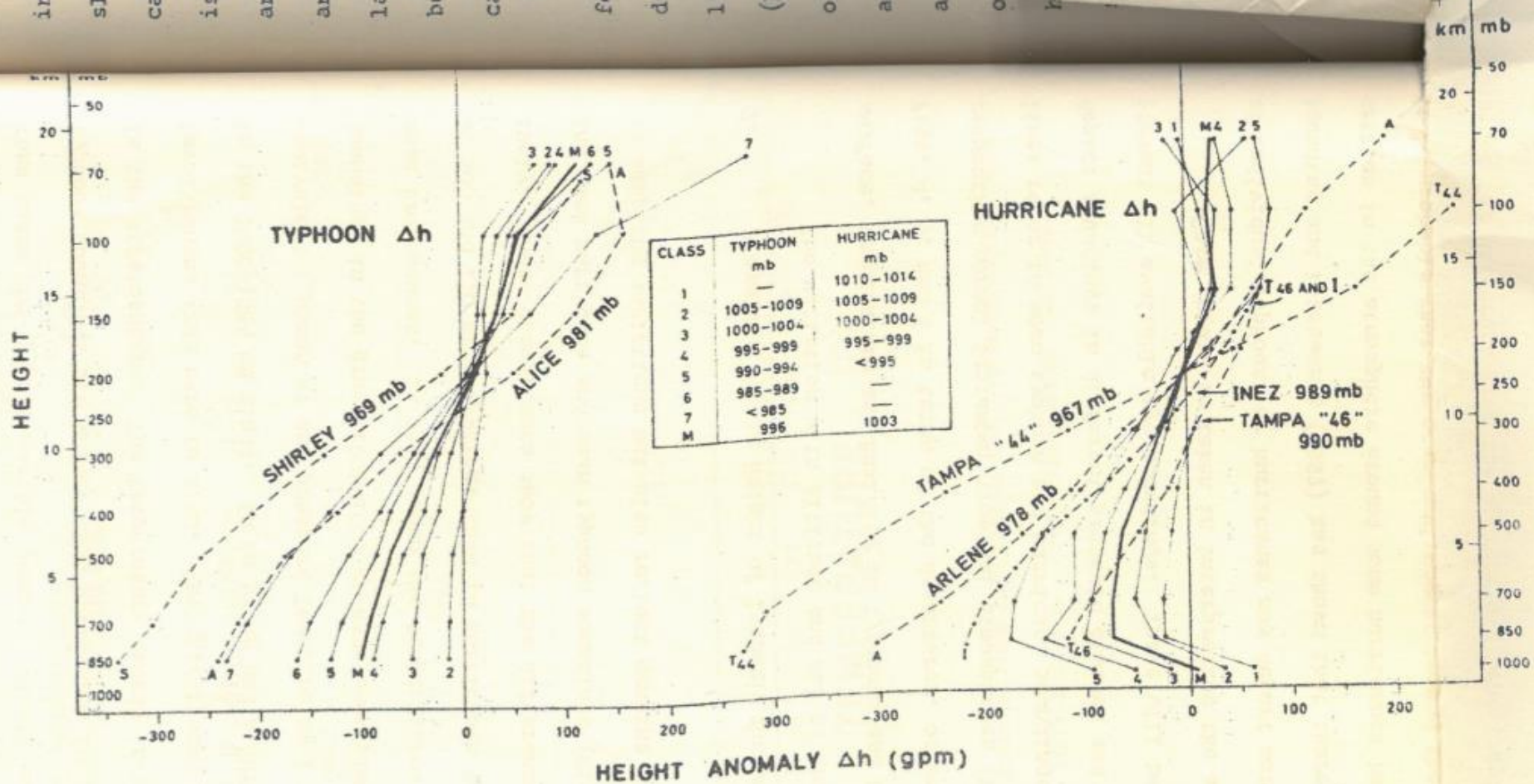

Fig. 4. Anomalies of the height of isobaric surfaces (from their respective normal September atmosphere) in the mean soundings of hurricanes and typhoons by 5-mb classes of SLP. The heavy lines denote the overall mean hurricane and typhoon soundings whilst the dashed lines refer to eye soundings as indicated.

the mean gradients are directed inward toward the centres and that in layers of positive anomalies the mean gradients are directed outward from the centres.

The anomalies of the heights of isobaric surfaces, $\triangle h$, are shown in Fig.4. In the case of typhoons it will be seen that, at 200 mb, $\triangle h$ is slightly positive and essentially independent of SLP. In the hurricane case a similar crossover point appears just below 200 mb at $\triangle h = 0$ but is less well defined than in typhoons. In hurricanes, the layer containing an outward directed pressure gradient appears to be less deep, less intense and at a lower altitude than in typhoons. Furthermore, in hurricanes, the layer of outward directed pressure gradient appears to be greatest at or below 100 mb above which level it decreases with height whereas, in the case of the typhoon soundings, $\triangle h$ is still increasing up to 70 mb.

The temperature anomalies are shown in Fig. 5. The reasons for the negative temperature anomalies near the surface have already been discussed. However, in addition, negative anomalies are also apparent at 150 mb and above in the case of some mean hurricane soundings. Simpson (1947, 1955) was the first to point out that the upper part of the core of hurricanes was colder than the surrounding. This phenomenon is also apparent in Schacht's (1946) mean noon and midnight hurricane temperature anomalies as determined from soundings made within 322 km of the centre of Atlantic tropical cyclones of hurricane intensity. Gentry (1967) found hurricane Isbell to have a cold core in the upper troposphere and lower stratosphere (90-115 mb). Koteswaram (1967) found cold cores in all but one (Arlene) of the hurricanes he examined and he noted that the magnitude of the anomaly, which occurs above 15 km (130 mb) was larger in strong hurricanes than in weak ones. This latter relationship is also confirmed by the results presented here. Koteswaram (1967) discussed the upper cold core in some detail and concluded that it was the result of penetrative convection of cumulo-nimbus towers through the tropopause level with over-shoots of 1-3 km. Gentry (1967) reported cumulo-nimbus tops 2.5 km above the tropopause in hurricane Isbell. Koteswaram (1967) also found that although the magnitude of the anomaly was influenced by the intensity of the hurricane it was also determined by ambient conditions so that large

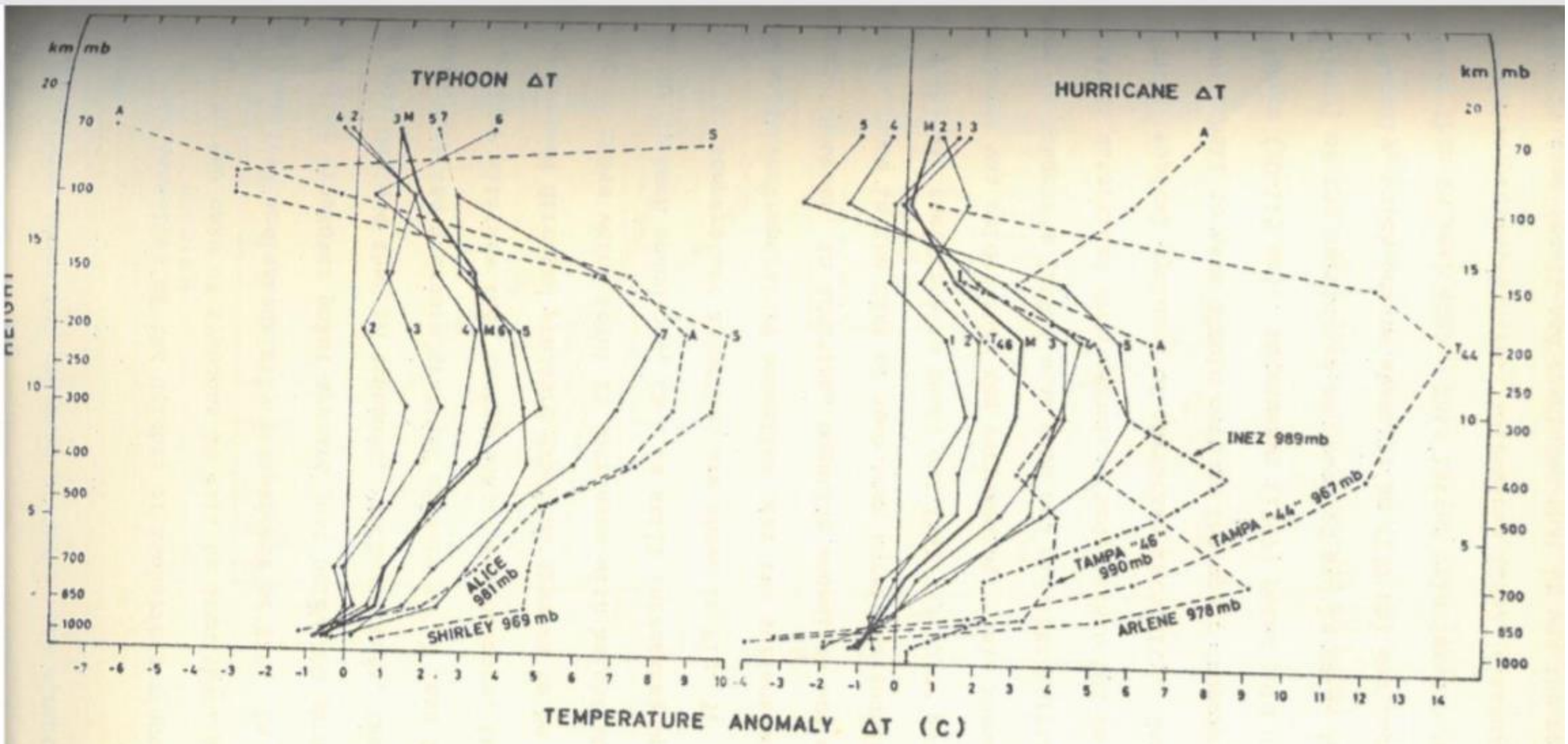

Fig. 5. As Fig. 4 but for anomalies of temperature.

negative anomalies sometimes occurred with weak hurricanes and vice versa. In the hurricanes that he studied the cold anomalies were not to be found after recurvature.

The mean typhoon soundings show no significant negative temperature anomalies at high altitude although two of the weaker classes (1005-1009 mb and 995-999 mb) do go slightly negative in the stratosphere at 70 mb. The lack of a cold core in the typhoon soundings is probably attributable to the higher tropopause and colder stratosphere found in the western North Pacific. The difference of 3C between the two tropical stratospheres is of the same order of magnitude as the negative temperature anomalies in the more intense class of hurricanes considered here. Since U2 aircraft have overflown typhoons and hurricanes and have found cloud tops up to 19.8 km in the former (Fletcher et al, 1961) and 19 km (68 mb) in the latter (Penn, 1965) it is probable that the most intense typhoons would also have negative temperature anomalies in the lower stratosphere.

The greatest positive temperature anomaly in all soundings outside the eye, occurs between 200 and 300 mb.

Anomalies of humidity mixing ratio Fig.6 show that with the sole exception of the eye sounding in hurricane Arlene, a maximum positive anomaly is attained at the 700 mb level. Both the anomalies and absolute values are greater in typhoons than hurricanes.

Riehl (1954) presented a now well-known diagram to show the variation in the vertical of the mean pressure-gradient force per unit mass* in hurricanes. The diagram is based on calculations which appear in Riehl (1948) and which in turn were based on Schachts' (1946) mean hurricane soundings; these soundinds did not extend above 19 km and it was

*/Incorrectly called "pressure difference" in reference. In the upper-troposphere, because of reduced density, there is a difference of one order of magnitude between the pressure difference expressed as a percentage of the surface value and that of mean pressure-gradient force per unit mass, also expressed as a percentage of the surface value.

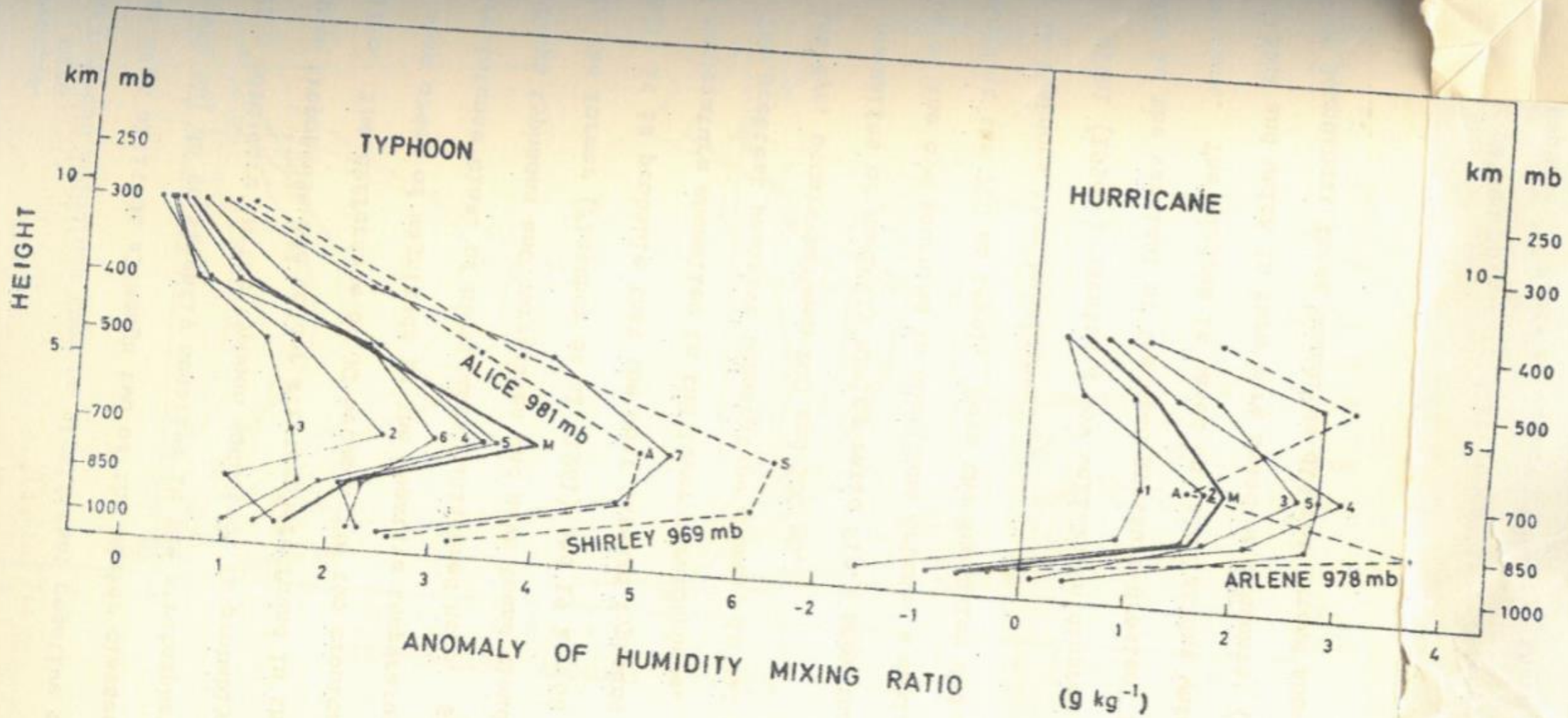

Fig. 6. As for Fig. 4 but for anomalies of humidity mixing ratio.

thought worthwhile to verify and extend the diagram (Fig. 7). Fig. 7(A) shows the vertical variation of the mean pressure-gradient force per unit mass in the mean typhoon and the mean hurricane and includes Riehl's (1954) curve for comparison. In Fig. 7(B) shows the variation in mean pressure-gradient force per unit mass between the environment and the eyes of hurricane Arlene (978 mb, 9 August 1963) and typhoon Alice (981 mb, 19 May 1961). There is no significant difference between Riehl's curves and the other below 200 mb. However, above this level Riehl's (1954) curve shows greater negative values than any of the other four curves. At 700 mb the hurricane retains a greater percentage of the surface pressure-gradient force per unit mass than does the typhoon. This feature is also implied in the hurricane curves of Fig. 4 which, between 850 and 700 mb, are less sloping than their typhoon counterparts. This fact might account for Jordan's (1960) finding that the maximum 700 mb winds determined in reconnaissance flights in hurricanes are generally greater than the surface wind speeds whereas the opposite is the case in typhoons (Bell,1961).

The shape of the normalized curves of Fig. 7 is applicable to the typhoon and hurricane soundings in all pressure groups as can be seen from the form of the $\triangle$ h anomaly curves, Fig. 4.

8. Correlations with SLP

Correlation coefficients, r, between SLP and all other parameters in each of the typhoon soundings were calculated for the total sample. They are presented in Table 2 in the same format as was used by Sheets (1969) for hurricanes. In cases where large correlation coefficients are found, those relating to typhoons are in general greater than the corresponding coefficients for hurricanes although the typhoon samples are usually larger. This higher correlation is probably due to the typhoon sample being made up of ascents at a fixed time and from better developed storms in so far as it contains more storms with low SLP than the hurricane sample. In what follows the statistical significance of the correlation coefficients is not given on every occasion but it can be gauged from the figures in Table 13, which are from Brooks and Carruthers (1953).

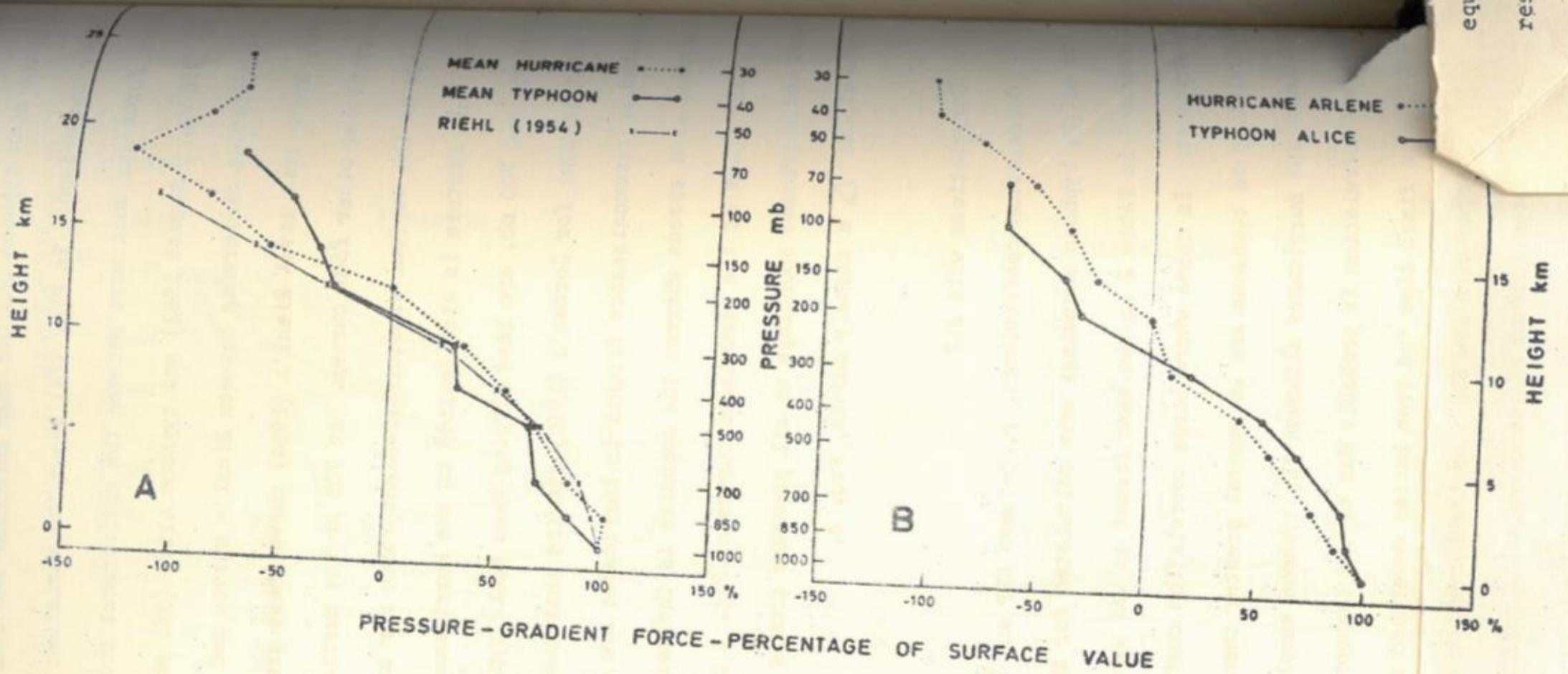

Fig. 7(A). Mean Pressure-gradient force per unit mass between the inside and outside of typhoons and hurricanes expressed as a percentage of the mean surface pressure-gradient force per unit mass.

(B). Similar curves but for individual eye-ascents.

Table 13

The vertical variation of r generally proceeds smoothly from one level to the next as is shown in Figs. 8 and 9. The correlation of SLP and temperature is shown in Fig. 8(A); in typhoons, at the surface, r is -0.080, and at sea, -0.097 (Table 11) though both values are not significant. In the case of hurricanes r is positive at the surface which, following the discussion in Section 4, is attributable to heavier cloud and rain and adiabatic cooling in the deeper hurricanes causing greater depressions of air temperature at inland stations.

The cold dome in hurricanes at 100 mb is seen to be significantly co.related with SLP thus confirming the finding of Koteswaram (1967).

The temperature at 200 mb in typhoons and at 400 mb in hurricanes are most highly correlated with their respective SLP values. However, in the hurricane, there is little change in r between 200 and 400 mb. The tropopause temperature in the hurricane, being in the cold dome, is correlated significantly (5%) with SLP whereas in the typhoon the SLP is independent of tropopause temperature. Increasing negative coefficients r in the lower stratosphere above typhoons lend support to the trend shown in the hurricane curve and indicate a warmer stratosphere between 50 and 15 mb in deeper storms with, less confidently, a maximum close to 30 mb (24 km).

Coefficients of correlation between the height of isobaric surfaces and SLP are shown in Fig. 8(B). Below 500 mb the correlation is not as good in hurricanes as it is in typhoons. Above this level r falls steadily with height to 150 mb and is zero near 200 mb in both hurricanes and typhoons. Above 200 mb r is negative and achieves its largest numerical value at 100 mb in hurricanes and at 70 mb or above in typhoons.

Figs. 9(A) and 9(B) show the variation of r between SLP and the equivalent potential temperature θ_e and the potential temperature θ respectively. Sheets (1969) did not include values of r for levels above 150 mb. It is seen that in typhoons r attains its greatest negative value at 200 mb and is highly significant. In the case of hurricanes the correlation at 200 mb is not so good.

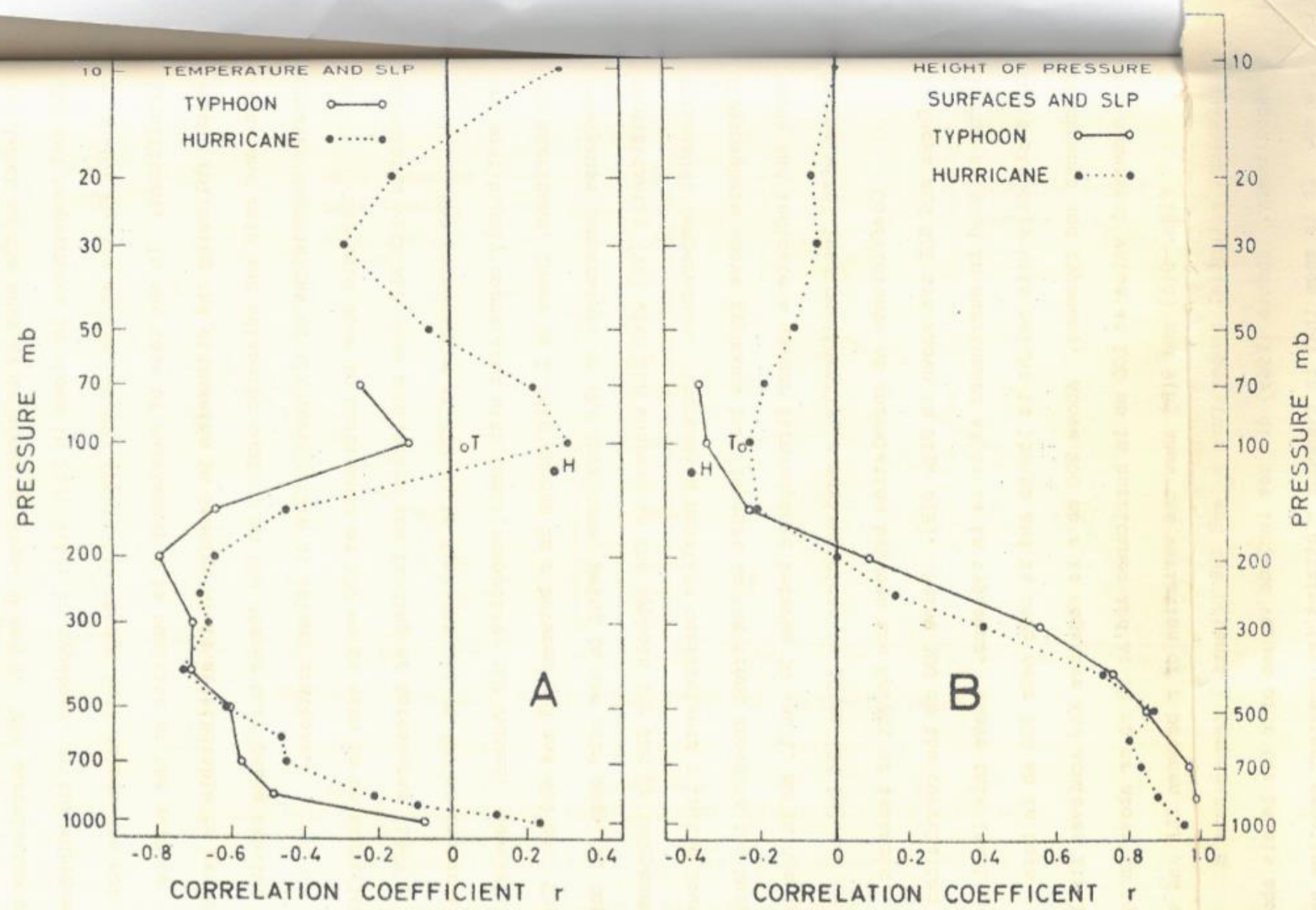

Fig. 8 The variation with altitude of the correlation coefficient:
(A) between temperature and SLP and
(B) between the height of isobaric surfaces and SLP. The points T and H are for the tropopause in typhoons and hurricanes respectively.

Figures showing the variation of r in the case of SLP and humidity mixing ratio have not been presented because Sheets (1969) used relative humidity as his moisture parameter. However, in the case of typhoons the correlation of SLP with humidity mixing ratio achieves its greatest value of -0.579 at 500 mb. In hurricanes, the best relationship with relative humidity, -0.482 is attained at 850 mb.

9. The Tropopause

There is still uncertainty about the shape of the tropopause surface over tropical cyclones. Koteswaram (1967) has proposed two models, one of which differs from that originally proposed by Palmen (1948). The generally accepted view is that the tropopause rises towards a maximum over the eye and that it is higher in deep storms than in weak ones.

The height of the hurricane tropopause is negatively correlated with SLP (Fig. 8(B)) at a level of significance better than 5%. The typhoon tropopause is not significantly correlated and the reason is clear from Fig. 10. With falling SLP the typhoon tropopause falls below that of the mean tropical atmosphere - about 17 km, 95 mb - until SLP values below 995 mb are achieved, thereafter the tropopause rises with decreasing SLP. The minimum, defined by the class with SLP 995-999 mb, is based on only six observations and is probably lower than would be found in a larger sample. The addition of data from outside the period 1953-1971 raised the minimum to just above 16 km. Although the total number of tropopauses considered is only 32, no less than 23 occur at a height which is below the normal for September. Some light on this behaviour is shed by the plots in Fig. 11 which show the mean tropopause in mean hurricanes and mean typhoons in each of three SLP classes. It should again be noted that a mean tropopause is not strictly compatible with other points in a mean sounding in that it is not on a constant pressure surface; it nevertheless adds useful information. Soundings in the 1005-1009 mb SLP class, Fig. 11(A), show the relatively cold stratosphere of the typhoon and the warmer upper troposphere and high tropopause. The 1000-1004 mb class (not shown) has similar features. For the group with SLP of 995-999 mb (Fig.11(B)) the temperature of the upper troposphere around 150 mb in the hurricane is higher along with the tropopause but, in the

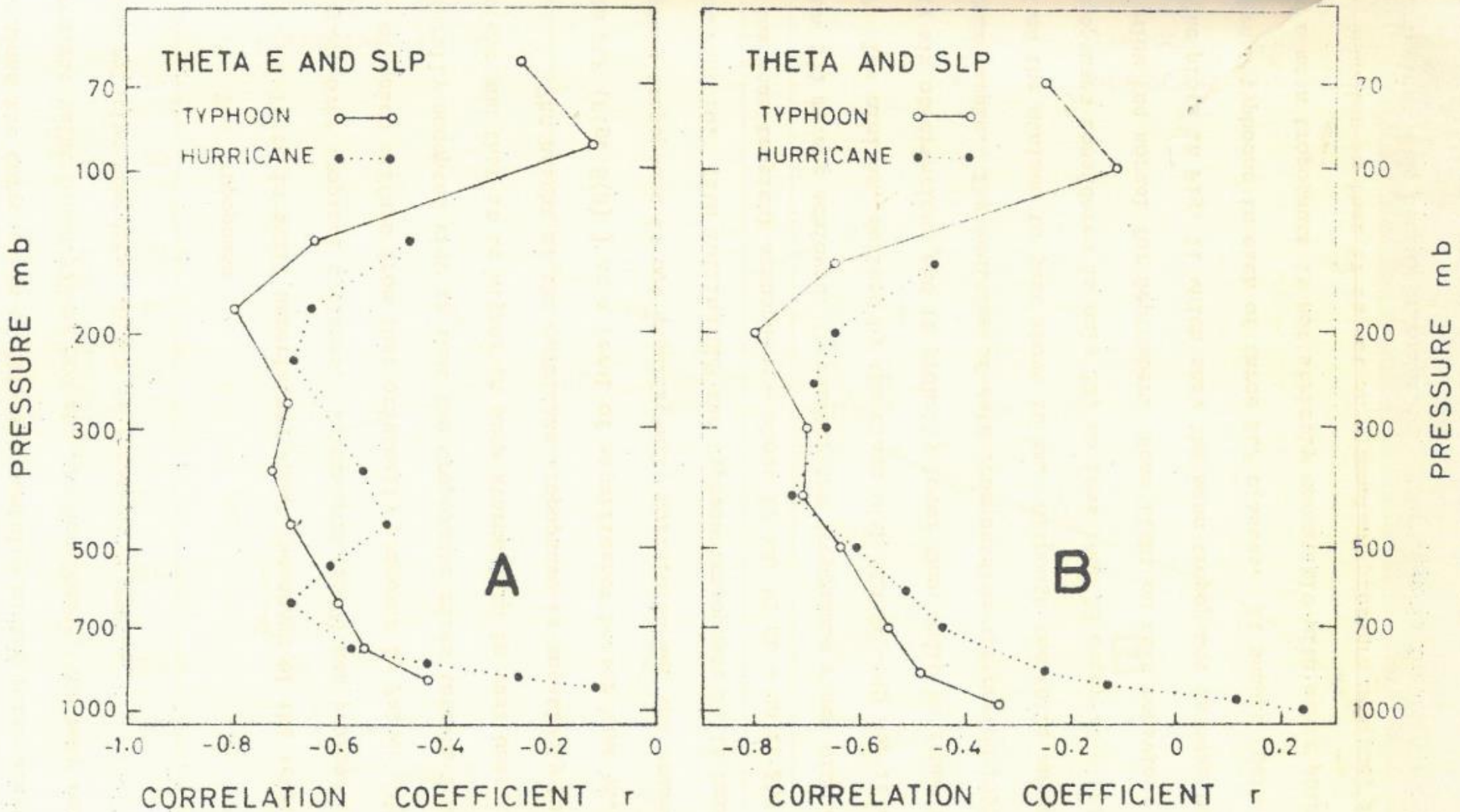

Fig. 9 Variation with altitude of the correlation coefficient between

(A) θ_e and SLP and

(B) θ and SLP

typhoon sounding, cooler air appears between 100 and 140 mb and a tropopause is formed at a lower level close to that of the equivalent hurricane. The reason for the drop in temperature of the 100-140 mb layer is not clear, it is unlikely to be caused by penetrative convection in this particular group of soundings alone. Temperatures at 70 mb and 100 mb remain unchanged in the typhoons but fall in the hurricanes. The typhoon group with SLP of 990-994 mb is compared with the group of hurricanes having SLP below 995 mb in Fig.11(C). The upper troposphere in the hurricane continues to rise in temperature with falling SLP and is accompanied by a rising tropopause. In the typhoon group there is a return of warm air in the layer from 100 to 140 mb. Fig. 11(D) contains only typhoon soundings. They are for the classes having SLP of 985-989 mb, less than 985 mb and for an eye sounding in typhoon Alice.

Ascents in the eye of typhoon Alice and hurricane Arlene are compared in Fig. 12 and for two storms of similar intensity the differences are remarkable. It is unfortunate that Arlene was at 30N and under westerlies (Koteswaram, 1967) when the ascent was flown for this makes it a less typical hurricane and reduces its value in comparison with Alice or other tropical cyclones in lower latitudes. Arlene's relatively high latitude probably enhanced the features which differentiate most hurricanes from typhoons i.e. the colder upper troposphere, lower tropopause and higher stratospheric temperatures. Although the tropopause in the eye of Arlene was lower than indicated by the trend of the curve for hurricanes, Fig. 10, it should be noted that even in hurricane Isbell (968 mb) at 25N, Gentry (1967) found that over or near the eye, the tropopause height was only 16 km (102 mb, -83C). Isbell's tropopause was lower than indicated for hurricanes in the class with SLP $<$ 995 mb (Fig. 10) and very much lower than in the weaker typhoon Alice or equivalent typhoon Shirley, Table 14.

Table 14

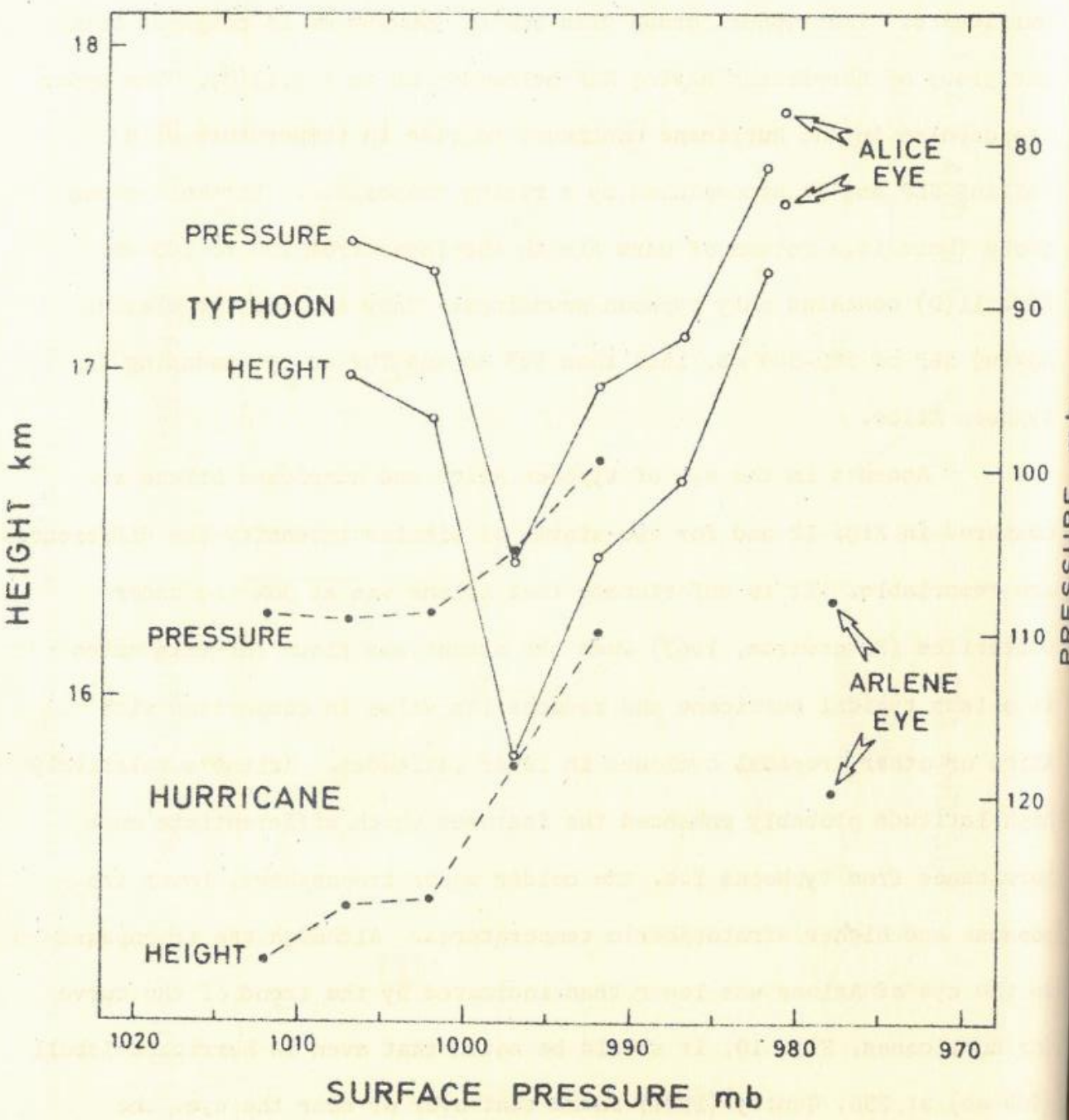

Fig. 10. Variation in the height of the tropopause (left scale) and pressure of the tropopause (right scale) in mean hurricanes and mean typhoons in different classes of SLP as a function of SLP. Points corresponding to the tropopauses above the eyes of typhoon Alice and hurricane Arlene are indicated.

Over the eye, the data in Table 14 and that from Isbell are not in accord with current models because both Arlene and Isbell have tropopauses lower than those found in convective areas with SLP around 990-995 mb (Fig. 10), and the tropopauses in, or near, the eyes of Alice and Shirley are lower than at some distance further out.

10. Regression Equations for Typhoon SLP

Some correlation coefficients in Table 2 are quite large and may have practical use over the range of SLP values used in this study ($>$ 970 mb). The regression equations for SLP for those cases in which r $\geqslant$ 0.8 are therefore given below using the usual symbols:-

$$P = 0.115\, h_{850} + 835 \qquad r = 0.981 \quad \text{S.E. } 1.69 \text{ mb} \qquad (1)$$

$$P = 0.122\, h_{700} + 624 \qquad r = 0.961 \quad \text{S.E. } 2.42 \text{ mb} \qquad (2)$$

$$P = 0.1205 h_{500} + 298 \qquad r = 0.847 \quad \text{S.E. } 4.69 \text{ mb} \qquad (3)$$

$$P = -1.43\, \theta_{e200} + 1504 \qquad r = -0.799 \quad \text{S.E. } 5.42 \text{ mb} \qquad (4)$$

$$P = -2.26\, T_{200} + 886 \qquad r = -0.797 \quad \text{S.E. } 5.44 \text{ mb} \qquad (5)$$

On the assumption that hurricanes do not disturb the mean tropical atmosphere above 100 mb, Malkus and Riehl (1960) computed that for moist adiabatic ascent with equivalent potential temperature θ_e, as in the eye-wall region, the SLP will be linearly related to θ_e such that

$$P = -2.5\, \theta_e + C \qquad (6)$$

where C is a constant depending on the environmental conditions. Riehl (1963) confirmed this relation using measurements taken in the eye-wall at 235-250 mb by B-47 aircraft. Although none of the soundings used in this paper were in the eye-wall, the mean sounding curves approximate to saturated adiabats up to about 250 mb and so the slope of the line in Eq. (4) would therefore be expected to be nearly the same as that found by Riehl (1963) Eq. (6). When the 101 points were plotted it was found that they were widely scattered at SLP values greater than 995 mb. The mean values of SLP (Tables 3 to 8) were therefore plotted against the corresponding mean values of θ_e and they displayed a good linear relationship. To ensure that each sounding was in its correct class the group with SLP $<$ 985 mb (Table 8) was subdivided into four 5-mb classes down to $<$ 974 mb. Regression equation, (7), was determined from the mean θ_e for each pressure class

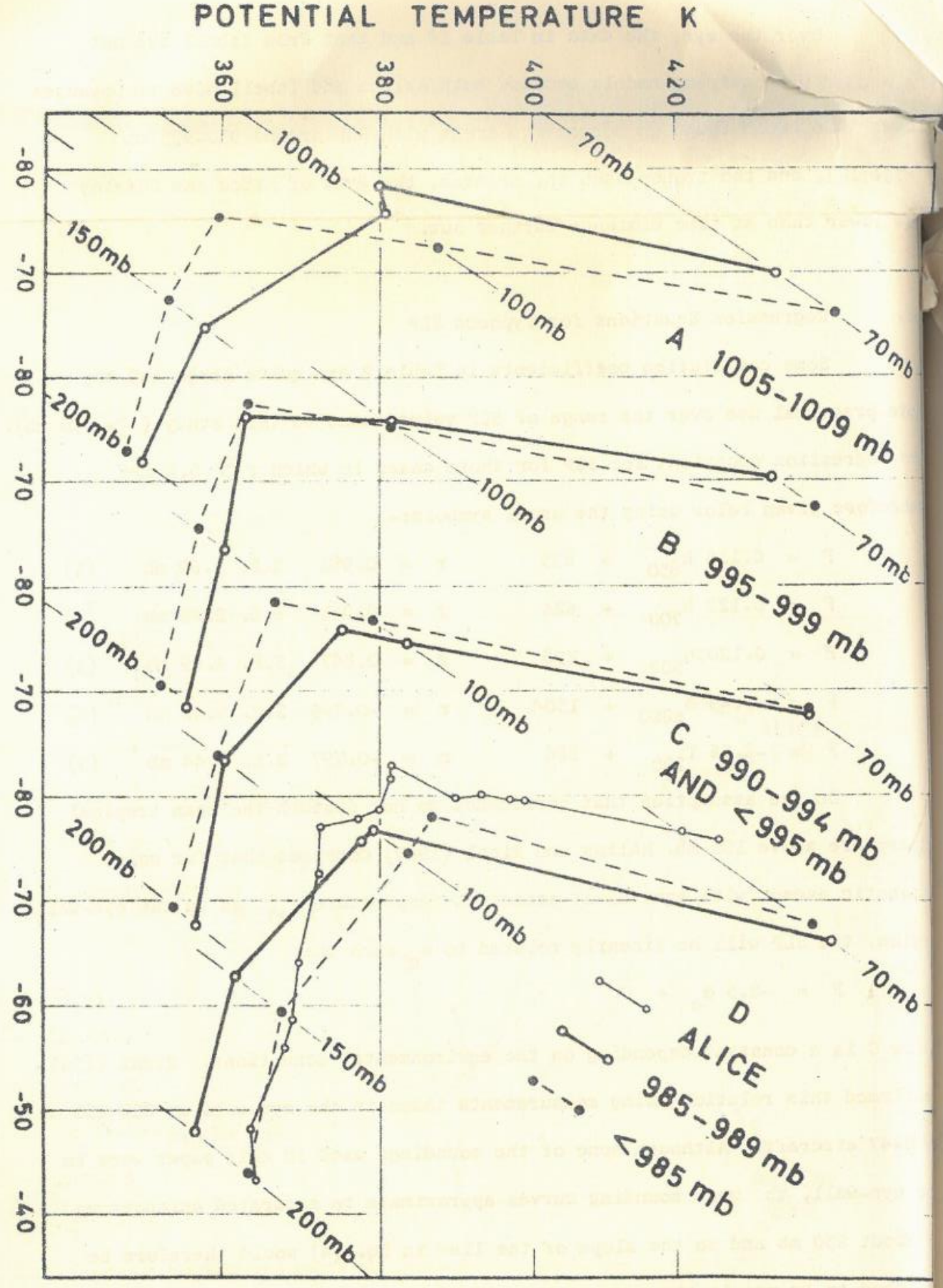

Fig. 11. Tephigrams of the 200 mb to 70 mb regions of mean typhoons (full lines) and hurricanes (dashed lines) for the SLP classes shown. In (D) all the curves are for typhoons as indicated. The isothe are equally spaced at intervals of 10C but have been so labelled as to define the temperature of each mean tropopause.

$$P = -2.247\,\theta_e + 1794 \qquad \text{S.E.} = 2.64 \text{ mb} \quad (7)$$

This line is not as steep as is required by (6) and it lies above Riehl's (1963) line so that the same θ_e yields surface pressures higher by about 6 mb at SLP of 965 mb falling to 2 mb at SLP of 1010 mb. These differences probably result from a combination of effects due to the departure of soundings from saturated adiabats, the advection of air of higher θ_e at 200 mb from the eye-wall, the extension of typhoons above 100 mb and environmental factors. Mean values of T_{200} were also used to determine the regression equation:

$$P = -3.578\,T_{200} + 821 \qquad \text{S.E.} = 2.66 \text{ mb} \quad (8)$$

Sheets (1969) did not give data for individual soundings therefore it is not possible to compute regression equations similar to (1) to (5) for hurricanes. However, the heights of isobaric surfaces for each mean sounding were plotted against the mid-point value of each class of SLP for both hurricanes and typhoons. At 850 mb the regression lines for typhoons and hurricanes were very close, but they were significantly different at all other levels from 700 to 200 mb, with the difference increasing with height. This is to be expected because the troposphere has been shown to be warmer in the mean typhoon sounding than in the corresponding mean hurricane sounding.

In Fig. 4 to 6, anomalies below about 150 mb are seen to progress relatively smoothly with decreasing SLP and even the anomalies in the eye soundings tend to have a similar form although low-level subsidence often enhances the warm anomalies below 500 mb. In the case of the eye sounding in Alice (SLP 981 mb) there is very little low-level subsidence and so the anomalies, below 150 mb, are very close to the mean curve 7 for typhoons having SLP $<$ 985 mb. Up to 300 mb the eye sounding in Alice Fig. 12 lies very close to a saturated adiabat (362.6K) . These similarities between the anomalies in the inner convective regions and in the eye suggest that the regression equations may also have some limited application to eye soundings. Jordan's (1958b) equations for determining the SLP in the eyes of typhoons ($\hat{P}_c$) from the heights of isobaric surfaces are:-

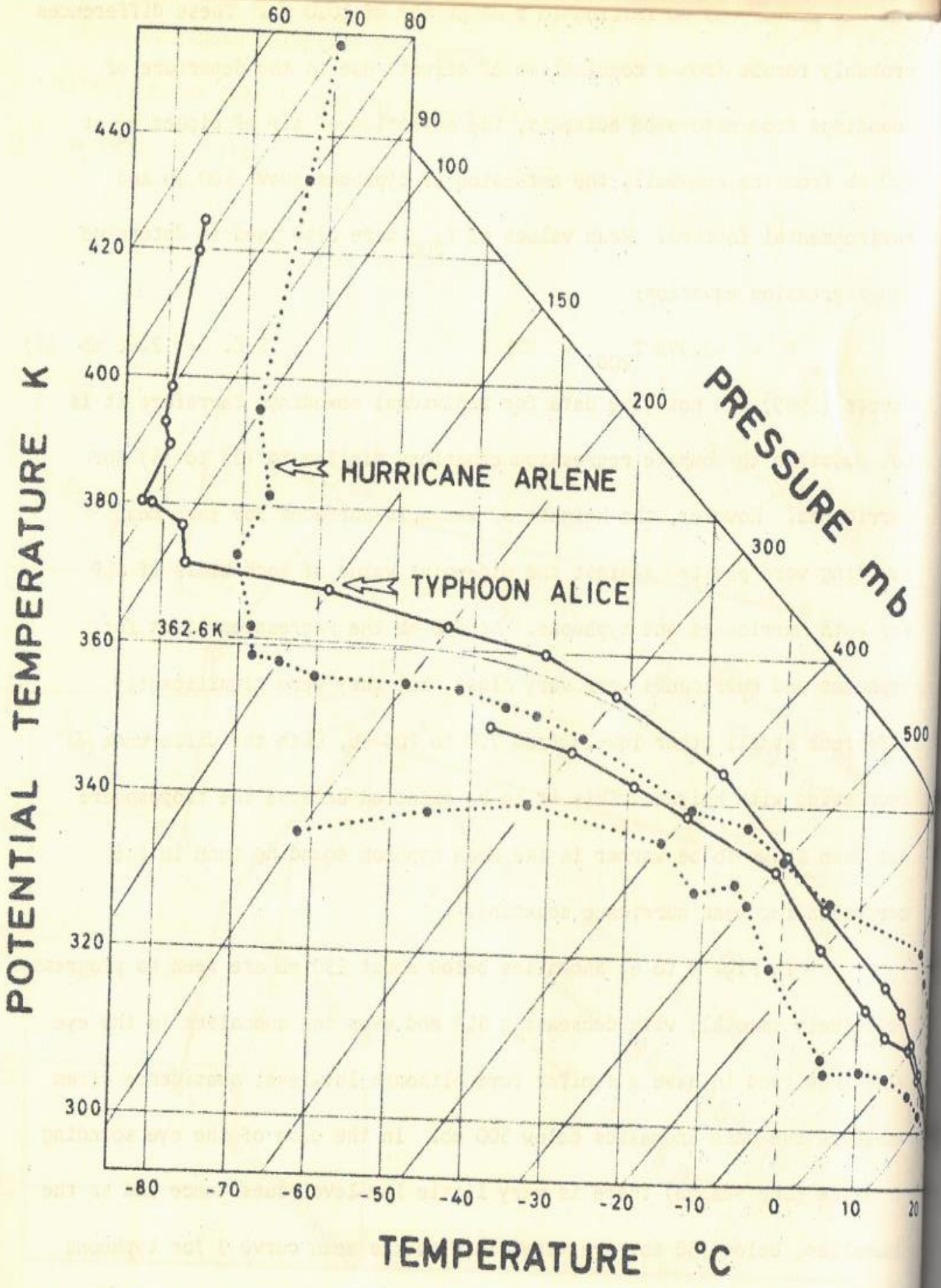

Fig. 12. Eye ascents in typhoon Alice (981 mb) and hurricane Arlene (9

The 362.6 K saturated adiabat is also shown.

$$P_c = 0.115\, h_{850} + 837 \qquad (9)$$

$$P_c = 0.115\, h_{700} + 645 \qquad (10)$$

and for 500 mb from hurricane data:

$$P_c = 0.148\, h_{500} + 141 \qquad (11)$$

Only the constant differs between (1) and (9) so that the former would yield values 2 mb lower than (9). For pressures above about 970 mb, (2) and (10) yield pressures within 1 mb of each other whilst pressures from (3) and (11) are within about 4 mb of each other between 970 and 1000 mb. The errors of the estimates of SLP, derived from the heights of isobaric surfaces in the eye using Eqs. (1) to (3) and (9) to (11), are given in Table 15. It will be seen that the eye soundings in both Arlene and Tampa "46" are anomalous in so far as the regression equations predict lower SLP values than were observed. This arises because the soundings differ from the normal by being relatively much warmer in low levels than in the middle troposphere, Fig. 5.

Table 15

Similar results are obtained when Eqs. (7) and (8) are used for predicting SLP from T_{200} and θ_e in the eye soundings under consideration; calculated SLP values are within $\pm$ 5 mb of the observed value except for Arlene and Tampa "46" where the pressures are too high by 17 and 20 mb respectively.

11. Summary and Conclusions

The troposphere of the mean tropical atmosphere in September over the western North Pacific Ocean is found to be significantly warmer and more humid than that over the West Indies; in addition, the surface pressure is lower, the tropopause higher and the stratosphere cooler, Fig. 1.

The 101 typhoon soundings confirm many of the features of tropical cyclones brought out in Sheets (1969) and earlier work but also indicate significant differences, in the mean, between typhoons

and hurricanes. These differences arise from those in the two environments. Comparisons of the overall mean hurricane and mean typhoon or the mean soundings for corresponding SLP classes show the differences exhibited by the mean September atmospheres, i.e., the typhoon has a warmer and much more humid troposphere, a higher tropopause and colder stratosphere and, in the case of the overall means, a lower SLP, Fig. 2 and 3.

Because the troposphere in typhoons is warmer than in hurricanes with equal SLP, the relative pressure deficit due to the warmer typhoon troposphere must be compensated by a colder stratosphere. This is readily illustrated for the class with SLP of 1007 mb because in this particular case the 70 mb height is the same for both the mean hurricane and typhoon. Relative to the hurricane, the typhoon shows a deficit of 7 mb in the column up to the hurricane tropopause and an excess of 7 mb in the remainder of the column to 70 mb.

Temperature anomalies (Fig. 5) confirm that the more intense hurricanes have an upper cold core which is well developed at 100 mb but which does not appear in the typhoon sample. The intensity of the cold core is correlated with the depth of the hurricane, Fig. 8(A). All the mean hurricane soundings have negative temperature anomalies at 850 mb and below (Sheets 1969) but in typhoons low-level negative temperature anomalies are mainly confined to the surface observations and have been shown to be due to the presence of heavy cloud and rain at land sounding stations as well as to adiabatic cooling. Table 11 indicates that near the centre of typhoons over the western North Pacific Ocean, the air temperature is in excess of 26C and warmer than the mean September temperature of 25.8C at the sounding stations. The reason for the negative temperature anomalies at 850 mb in Sheets' (1969) mean hurricanes has not been determined.

Although height anomalies appear larger in typhoons than hurricanes (Fig. 4) this is mainly a consequence of the typhoons having lower SLP values. Comparisons by SLP classes show that below 100 mb differences are not great. Classes having large low-level negative height anomalies also have large positive anomalies at high levels; this fact is brought out in the normalized presentation (Fig. 7). Figs. 4 and 7 indicate that, at 700 mb, the hurricane retains a greater proportion of the low-level pressure gradient than does a typhoon. Koteswaram's

(1967) hurricane model contains a cold upper core with negative height anomalies above 100 mb and a peripheral ridge with positive anomalies. There is no indication of negative anomalies in typhoons (Fig.4). However, some of the weaker hurricanes slight negative anomalies do appear and, spatial features, they could have been weakened by the averaging process. ither of the hurricane eye soundings which reached 100 mb indicate negative nomalies.

Although the mean Pacific soundings have higher humidity mixing atios than those for the West Indies, the typhoon humidity anomalies Fig.6) are, nevertheless, much greater than in hurricanes. At 700 mb, his statement is true not only for the overall mean but also for all but ne of the SLP classes. Negative anomalies of humidity mixing ratio are ot found in the mean typhoon soundings.

The height of the tropopause in the mean typhoon is 1.2 km igher than that in the mean hurricane. As SLP falls the typhoon ropopause at first falls below that in the normal September atmosphere nd then rises (Fig. 10). A similar fall is not shown by Sheets' (1969) urricane tropopause data although both Simpson (1952) and Koteswaram (1967) ave reported decreased tropopause heights on the peripheries of hurricanes.

The data on the conventional WMO tropopause over, or near, the yes of hurricanes and typhoons are not adequate to draw any conclusion other than that the tropopause is usually higher over a typhoon eye than over a hurricane eye. It is not even possible to state that it is always at a level higher than in the normal atmosphere because, although true for Arlene (Koteswaram 1967) and Isbell (Gentry 1967), it was not true for Alice and Shirley. Table 14 shows that the tropopauses over the eyes of Alice and Shirley were lower than at some distance further out; in Arlene and Isbell it was slightly higher. Even after making allowances for uncertainties about whether the Isbell and Shirley soundings were exactly in the eye, and after noting that Arlene had an anomalous eye structure and had recurved, it is nevertheless clear from Table 14 and Fig. 10 that the topography of the tropopause surface over the central regions of

hurricanes and typhoons is very variable, both in space over individual tropical cyclones and from one to another. These differences may be due to asymmetries in the height of the tropopause surface around the eye.

Regression equations for determining SLP from pressure heights at 850, 700 and 500 mb in the convective region of typhoons can also be used in the eye, and give results comparable with those obtained from Jordan's (1958b) equations. The similarity of the shape of some of the anomaly curves (Figs. 4 to 6) in eye soundings and in the convective area of moderate storms is remarkable; Alice, for example, had tropospheric temperature anomalies in the eye very close to those of the mean typhoon sounding of equivalent SLP. In the detailed reconnaissance of hurricane Isbell, Gentry (1967) observed that at 850 and 700 mb "temperatures in the eye-wall were as high as those in the eye". On occasions, there will be subsidence in the lower levels which will warm the eye appreciably as in Arlene (Fig. 12), but these are not so frequent as to be reflected in Jordan's (1957) mean eye sounding for a moderate hurricane for this lies close to a saturated adiabat, as do the soundings in the eyes of typhoons Alice and Shirley.

Since the values of many parameters in typhoon soundings are related to SLP, the mean data in Tables 2 to 8 can be arranged spatially - in accordance with a typhoon SLP profile - to provide a model of a moderate typhoon. Additional points can be generated by using the regression equations. Further data are required before the normal profile of the tropopause over and around the eye can be defined.

12. Acknowledgements

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L E G E N D S

Fig. 1. Mean September tropical sounding for the West Indies region (Jordan, 1958a) and a mean September sounding for the tropical western North Pacific Ocean from the results in Table 9.

Fig. 2. Mean soundings from 101 typhoons and 92 hurricanes. The temperatures of the tropopauses have been plotted at the corresponding mean pressures.

Fig. 3. Mean soundings from hurricanes and typhoons having SLP between 1005-1009 mb. Mean tropopauses included.

Fig. 4. Anomalies of the height of isobaric surfaces (from their respective normal September atmospheres) in the mean soundings of hurricanes and typhoons by 5-mb classes of SLP. The heavy lines denote the overall mean hurricane and typhoon soundings whilst the dashed lines refer to eye soundings as indicated.

Fig. 5. As Fig. 4 but for anomalies of temperature.

Fig. 6. As for Fig. 4 but for anomalies of humidity mixing ratio.

Fig. 7(A). Mean pressure-gradient force per unit mass in mean typhoons and hurricanes expressed as a percentage of the surface value.

(B). Similar curves but for individual eye-ascents.

Fig. 8. The variation with altitude of the correlation coefficient:

(A). between temperature and SLP, and

(B). between the height of isobaric surfaces and SLP. The points T and H are for the tropopause in typhoons and hurricanes respectively.

Fig. 9. Variation with altitude of the correlation coefficient between

(A) θ_e and SLP, and

(B) θ and SLP.

Fig. 10. Variation in the height of the tropopause (left scale) and pressure of the tropopause (right scale) in mean hurricanes and mean typhoons in different classes of SLP as a function of SLP. Points corresponding to the tropopauses above the eyes of typhoon Alice and hurricane Arlene are indicated.

Fig. 11. Tephigrams of the 200 mb to 70 mb regions of mean typhoons (full lines) and hurricanes (dashed lines) for the SLP classes shown. In (D) all the curves are for typhoons as indicated. The isotherms are equally spaced at intervals of 10C but have been so labelled as to define the temperature of each mean tropopause.

Fig. 12. Eye ascents in typhoon Alice (981 mb) and hurricane Arlene (978 mb). The 362.6K saturated adiabat is also shown.

Table 1. - Details of Sounding Stations

tion	Station Number	Latitude	Longitude	Height	Type of Sounding Instrument used
ton	59:287	23° 10'N	113° 20'E	18 gpm	Vaisala type
k	98:327	15° 10'N	120° 34'E	196	U.S.A.F.
Okijima	47:918	24° 20'N	124° 10'E	7	Japanese
Kong	45:004	22° 19'N	114° 10'E	66	Kew MK IIB/Vaisala
Jima	91:115	24° 47'N	141° 19'E	114	U.S.A.F.
na	47:931	26° 21'N	127° 45'E	78	U.S.A.F.
	47:909	28° 23'N	129° 33'E	295	Japanese
ei	46:692	25° 02'N	121° 31'E	9	U.S.A.F.

Table 2 - A Noon Typh

	Pressure Levels (mb)										
	Surface	850	700	500	400	300	200	150	100	70	Tropopause
Temp (C)	25.2	18.6	11.2	-2.4	-12.3	-26.3	-48.6	-63.3	-75.4	-68.6	-77.0
Std. Dev.	1.9	1.7	2.0	2.1	2.2	2.6	3.2	3.1	3.3	3.9	3.5
Cor. Coef.	-.080	-.492	-.579	-.612	-.719	-.702	-.797	-.645	-.121	-.254	.039
No. of Cases	99	101	100	100	93	96	90	85	76	50	32
Heights (gpm)	-	1393	3044	5794	7533	9675	12471	14298	16697	18795	16667
Std. Dev.	-	74	69	62	60	52	53	67	95	119	778
Cor. Coef.	-	.981	.961	.847	.755	.578	.091	-.230	-.346	-.370	-.256
No. of Cases	-	101	101	94	88	96	91	85	77	52	32
Mixing ratio(g/kg)	18.8	14.5	10.0	5.0	2.5	0.9	-	-	-	-	Pressure 101.4 mb
Std. Dev.	1.9	2.1	2.1	1.5	1.1	0.5	-	-	-	-	12.8
Cor. Coef.	-.319	-.517	-.513	-.579	-.538	-.374	-	-	-	-	.239
No. of Cases	99	100	99	95	84	73	-	-	-	-	32
Theta E (K)	353.8	349.1	347.2	347.1	348.2	352.7	355.6	360.9	381.7	437.5	378.2
Std. Dev.	8.0	7.7	8.8	6.5	6.5	5.2	5.0	5.3	6.4	8.3	13.0
Cor. Coef.	-.342	-.552	-.601	-.691	-.723	-.698	-.799	-.645	-.116	-.248	-.207
No. of Cases	99	100	99	95	84	73	90	85	76	50	32
Theta (K)	298.7	305.6	314.8	329.3	338.9	348.1	355.6	360.9	381.7	437.5	378.2
Std. Dev.	2.1	1.8	2.3	3.8	3.0	3.7	5.0	5.3	6.4	8.3	13.0
Cor. Coef.	-.433	-.484	-.547	-.633	-.709	-.702	-.799	-.645	-.116	-.248	-.207
No. of Cases	99	101	100	100	93	96	90	85	76	50	32

Table 3 - Mean Sounding

	Pressure Levels (mb)										
	Surface	850	700	500	400	300	200	150	100	70	Tropopause
Temp (C)	25.3	17.8	9.9	-3.8	-14.1	-28.5	-51.7	-64.9	-75.5	-69.9	- 78.3
Std. Dev.	1.2	0.8	0.8	1.2	0.9	1.4	1.6	2.6	2.0	4.2	3.9
No. of Cases	12	13	12	13	12	13	12	11	9	7	2
Heights (gpm)	-	1479	3122	5855	7585	9716	12483	14285	16678	18771	16980
Std. Dev.	-	15	14	15	17	22	34	48	71	69	580
No. of Cases	-	13	13	12	11	13	12	11	9	7	2
Mixing ratio (g/kg)	18.7	13.3	9.5	4.4	2.1	0.7	-	-	-	-	Pressure 96.0 m
Std. Dev.	1.6	1.0	0.7	0.7	0.6	0.3	-	-	-	-	8.5
No. of Cases	12	13	12	12	11	10	-	-	-	-	2
Theta E(K)	352.9	344.9	343.3	343.3	343.9	347.6	350.8	358.2	381.6	434.5	380.2
Std. Dev.	5.9	2.8	2.9	2.6	3.0	2.7	2.5	4.4	3.8	9.0	2.6
No. of Cases	12	13	12	12	11	10	12	11	9	7	2
Theta (K)	298.0	304.8	313.4	328.4	336.6	345.2	350.8	358.2	381.6	434.5	380.2
Std. Dev.	1.2	0.8	0.9	1.5	1.2	2.0	2.5	4.4	3.8	9.0	2.8
No. of Cases	12	13	12	13	12	13	12	11	9	7	2

Table 4 - Mean Sounding

	Pressure Levels (mb)										
	Surface	850	700	500	400	300	200	150	100	70	Tropopause
Temp (C)	25.0	18.0	10.1	-3.6	-13.5	-27.6	-50.5	-65.0	-76.0	-68.6	-77.7
Std. Dev.	2.0	1.7	1.9	1.6	1.8	2.2	1.8	2.4	4.2	4.2	4.1
No. of Cases	30	31	31	30	29	30	26	25	24	13	8
Heights(gpm)	-	1444	3089	5826	7561	9691	12469	14281	16664	18755	16849
Std. Dev.	-	19	24	37	48	49	54	67	92	146	862
No. of Cases	-	31	31	29	28	30	27	25	24	14	8
Mixing ratio(g/kg)	18.2	14.0	8.6	4.1	2.0	0.8	-	-	-	-	
Std. Dev.	2.0	1.7	2.3	1.5	1.0	0.5	-	-	-	-	Pressure 97.9 mb
No. of Cases	30	31	31	29	24	18	-	-	-	-	13.2
											8
Theta E (K)	351.2	346.6	341.0	342.9	344.2	350.6	352.6	358.0	380.7	437.8	
Std. Dev.	8.0	6.6	8.3	6.0	5.1	4.5	2.8	4.1	8.1	8.4	380.8
No. of Cases	30	31	31	29	24	18	26	25	24	13	17.9
											8
Theta (K)	298.0	304.9	313.7	328.1	337.4	346.3	352.6	358.0	380.7	437.8	
Std. Dev.	2.0	1.7	2.1	3.6	2.5	3.1	2.8	4.1	8.1	8.4	380.8
No. of Cases	30	31	31	30	29	30	26	25	24	13	17.9
											8

Table 5 - Mean Sounding with Surface Pressure of 995 - 999 mb

	Pressure Levels (mb)										
	Surface	850	700	500	400	300	200	150	100	70	Tropo...
Temp (C)	25.0	18.4	11.2	-2.2	-12.5	-27.0	-48.7	-63.7	-75.5	-70.1	-76.1
Std. Dev.	2.1	1.5	1.7	2.2	1.9	1.4	2.6	2.8	3.0	5.2	3.9
No. of Cases	19	19	19	19	17	17	17	16	15	12	6
Heights (gpm)	-	1406	3056	5807	7547	9678	12472	14297	16690	18773	15812
Std. Dev.	-	18	22	36	47	51	68	88	118	136	561
No. of Cases	-	19	19	17	15	17	17	16	15	13	6
Mixing Ratio(g/kg)	18.5	14.2	10.5	5.1	2.4	0.9	-	-	-	-	Pressure 115.7 mb
Std. Dev.	1.7	2.0	1.1	1.1	0.8	0.4	-	-	-	-	11.6
No. of Cases	19	19	19	19	17	14	-	-	-	-	6
Theta (K)	352.7	347.9	348.2	347.1	347.4	351.2	355.1	360.3	381.6	434.5	366.3
Std. Dev.	7.5	7.1	4.6	4.1	3.8	3.4	4.1	4.8	5.9	11.5	5.7
No. of Cases	19	19	19	19	17	14	17	16	15	12	6
Theta (K)	298.3	305.4	314.9	329.0	338.7	[illegible]7.3	355.1	360.3	381.6	434.5	366.3
Std. Dev.	2.1	1.6	1.9	4.4	2.5	[illegible]	4.1	4.8	5.9	11.5	5.7
No. of Cases	19	19	19	19	17	17	17	16	15	12	6

Table 6 - Mean Sounding with Surface Pressure of 9[illegible] - 994 mb

	Pressure Levels (mb)										
	Surface	850	700	500	400	300	200	150	100	70	Tropopause
Temp (C)	26.0	18.8	11.6	-2.5	-12.1	-25.0	-47.6	-63.1	-74.4	-67.6	-75.8
Std. Dev.	2.5	1.9	1.3	1.4	1.8	2.1	1.1	1.0	1.6	1.8	2.2
No. of Cases	14	14	14	14	13	13	12	11	10	8	6
Height (gpm)	-	1364	3017	5781	7513	9663	12469	14306	16706	18828	16432
Std. Dev.	-	23	27	40	31	31	34	35	28	44	489
No. of Cases	-	14	14	13	12	13	12	11	10	8	6
Mixing ratio(g/kg)	19.5	14.4	10.6	5.2	2.9	1.1	-	-	-	-	Pressure 105.0 mb
Std. Dev.	2.1	1.8	1.6	1.4	1.2	0.5	-	-	-	-	8.6
No. of Cases	14	13	13	13	11	11	-	-	-	-	6
Theta E (K)	355.3	348.7	349.2	348.2	350.1	355.0	357.2	361.4	383.4	439.6	375.6
Std. Dev.	10.4	6.1	4.6	4.7	5.7	3.8	1.8	1.9	4.1	3.8	7.2
No. of Cases	14	13	13	13	11	11	12	11	10	8	6
Theta (K)	299.4	305.9	315.1	329.8	339.2	350.0	357.2	361.4	383.4	439.6	375.6
Std. Dev.	2.5	2.0	1.6	2.0	2.4	3.0	1.8	1.9	4.1	3.8	7.2
No. of Cases	14	14	14	14	13	13	12	11	10	8	6

Table 7 - Mean Sounding with Surface Pressure of 985 - 989 mb

	Pressure Levels (mb)										Tropopause
	Surface	850	700	500	400	300	200	150	100	70	
Temp (C)	25.0	19.3	12.5	-0.5	-10.6	-25.4	-47.8	-62.8	-76.6	-66.1	-75.8
Std. Dev.	1.9	1.2	2.3	1.7	1.4	1.3	0.8	1.0	3.6	2.1	1.9
No. of Cases	9	9	9	9	7	8	8	7	6	6	3
Heights (gpm)	-	1332	2987	5754	7505	9656	12464	14299	16696	18809	16660
Std. Dev.	-	17	21	30	34	39	38	40	48	54	777
No. of Cases	-	9	9	9	7	8	8	7	6	6	3
Mixing ratio(g/kg)	19.4	14.6	10.0	5.1	2.0	0.8	-	-	-	-	Pressure 102.0 mb
Std. Dev.	1.7	2.1	2.0	1.5	0.8	0.2	-	-	-	-	13.5
No. of Cases	9	9	9	7	6	6	-	-	-	-	3
Theta E (K)	356.2	350.1	352.7	349.6	348.0	352.8	356.9	361.9	379.5	442.6	379.0
Std. Dev.	7.4	6.2	11.2	5.9	3.2	2.8	1.3	1.9	7.0	4.4	10.8
No. of Cases	9	9	9	7	6	6	8	7	6	6	3
Theta (K)	299.2	306.3	315.9	330.5	341.1	349.6	356.9	361.9	379.5	442.6	379.0
Std. Dev.	1.8	1.3	2.7	5.2	1.9	1.9	1.3	1.9	7.0	4.4	10.8
No. of Cases	9	9	9	9	7	8	8	7	6	6	3

Table 8 - Mean Soundings with Surface Pressure less than 985 mb

	Pressure Levels (mb)										
	Surface	850	700	500	400	300	200	150	100	70	Tropopause
Temp (C)	25.4	20.2	13.4	-0.3	-9.4	-23.0	-43.9	-59.3	-74.4	-67.6	-78.0
Std. Dev.	1.3	1.8	1.6	1.3	1.3	2.0	2.7	2.7	3.3	1.7	4.4
No. of Cases	15	15	15	15	15	15	15	15	12	4	7
Heights (gpm)	-	1261	2924	5696	7456	9623	12468	14332	16775	18960	17305
Std. Dev.	-	51	49	58	55	58	68	78	104	72	447
No. of Cases	-	15	15	14	15	15	15	15	13	4	7
Mixing ratio(g/kg)	19.7	17.1	12.3	6.9	3.7	1.3	-	-	-	-	Pressure 91.4 mb
Std. Dev.	1.9	2.0	1.8	0.8	1.0	0.6	-	-	-	-	6.3
No. of Cases	15	15	15	15	15	14	-	-	-	-	7
Theta E (K)	358.2	358.9	356.5	356.2	357.4	358.8	363.1	367.8	383.8	439.4	386.7
Std. Dev.	6.6	7.9	6.8	3.6	4.5	4.1	4.2	4.7	6.3	3.7	12.0
No. of Cases	15	15	15	15	15	14	15	15	12	4	7
Theta (K)	300.2	307.2	317.1	331.5	342.7	352.9	363.1	367.8	383.8	439.4	386.7
Std. Dev.	1.6	1.7	2.0	4.1	1.8	2.8	4.2	4.7	6.3	3.7	12.0
No. of Cases	15	15	15	15	15	15	15	15	12	4	7

Table 9 - Summary of Mean September Soundings

Location	Years	SLP	Surface		850 mb			700 mb		
			T	T_d	h	T	T_d	h	T	T_d
		mb	C	C	gpm	C	C	gpm	C	C
Hong	1956-65	1008.2	26.5	20.6	1489	17.8	13.9	3132	10.2	3.0
Clark	1947-65	1009.2	25.6	22.6	1492	18.2	14.4	3134	9.8	4.1
Guam	1961-65	1010.5	24.7	22.3	1511	17.9	14.5	3155	10.8	1.8
Iwo Jima	1965-68	1009.5	26.3	22.4	1489	17.0	13.7	3128	10.5	0.9
Taipei	1959-66, 1968, 1970	1009.4	25.8	22.4	1498	17.4	14.4	3141	10.6	3.4
W. Pacific		1009.6	25.8	22.1	1495	17.8	14.2	3137	10.2	3.2
East Indies		1014.0	26.2+	23.7+	1539	17.7	13.0	3176	8.9	1.8

500 mb			400 mb			300 mb			200 mb	
h	T	T_d	h	T	T_d	h	T	T_d	h	T
gpm	C	C	gpm	C	C	gpm	C	C	gpm	C
5861	-4.6	-13.8	7585	-14.8	-25.3	9699	-29.5	-39.7	12467	-51.5
5865	-5.2	-11.5	7575	-15.4	-22.6	9686	-30.3	-36.8	12434	-53.1
5869	-4.1	-15.1	7619	-15.6	-26.8	9730	-30.9	-39.7	12472	-52.2
5872	-4.0	-17.0		-		9701	-31.2	-42.3	12442	-52.7
5874	-4.2	-13.2		-		9724	-29.1	-38.1	12495	-50.2
5866	-4.7	-13.2	7585	-15.3	-24.0	9703	-30.0	-38.4	12458	-52.0
5883	-6.7	-15.3	7592	-17.3	-26.8	9683	-32.7	-	12405	-54.9

150 mb		100 mb		70 mb		TROPOPAUSE		
h	T	h	T	h	T	h	P	T
gpm	C	gpm	C	gpm	C	gpm	mb	C
14279	-65.0	16656	-78.8	18720	-72.0	16910	96	-79.6
14230	-67.7	16584	-78.0	18630	-69.1		-	
14275	-64.9	16682	-74.5	13793	-67.7		-	
14281	-65.7	16614	-77.8	-			-	
14314	-63.9	16724	-74.6	-			-	
14283	-65.9	16641	-77.1	18680	-69.7		-	
14185	-67.7	16569	-73.9	18681	-66.9		-	

+ For 1000 mb not surface.

Table 10 - Mean SLP over Western North Pacific and Western North Atlantic Oceans.

Western North Pacific:

Month	Hong Kong	Taipei	Naze	Ishigakijina	Manila	Mean
	mb	mb	mb	mb	mb	mb
Jun	1006.1	1007.0	1008.8	1007.7	1009.3	1007.6
Jul	1006.3	1006.1	1008.7	1007.0	1009.3	1007.4
Aug	1005.1	1006.0	1007.8	1006.3	1008.2	1006.7
Sep	1008.2	1009.4	1010.5	1009.5	1009.2	1009.6
Oct	1014.3	1015.3	1015.1	1013.9	1010.1	1014.3
Years	51 - 60	31 - 60	31 - 60	31 - 60	51 - 60	

Overall - mean SLP during typhoon season (Jun to Oct) : 1009.1 mb

Western North Atlantic:

Month	Miami	Swan Island	San Juan	Mean
	mb	mb	mb	mb
Jun	1016.1	1012.3	1016.3	1015.2
Jul	1017.4	1013.6	1016.8	1016.2
Aug	1016.0	1012.5	1015.1	1014.8
Sep	1014.3	1011.0	1013.9	1013.3
Oct	1014.6	1011.1	1012.9	1013.1
Years	31 - 60	41 - 60	31 - 60	

Overall - mean SLP during hurricane season (Jun to Oct) : 1014.5 mb

Table 11 - Mean Air and Sea

S.L. Pressure	mb	985	985-990	990-995	995-1000	1000-1005	1005-1010
Air Temperature	C	27.3	27.0	26.5	26.6	26.5	26.6
Sea Temperature	C	27.5	28.7	27.0	27.4	27.7	27.7
Mean distance from centre	deg.lat.	0.73	1.47	1.05	1.21	1.28	1.37
No. of observations		4	4	8	15	15	14

Mean air temperature for all 60 observations 26.6C

Correlation coefficient between SLP and air temperature is - 0.097

Table 12 - Mean of All Observations of Surface Temperature at the Time the Typhoon Soundings were made

Altitude of Station	m	7	9	13	66	78	114	196	295
Mean surface temp.	C	26.9	26.6	24.0	25.0	25.9	26.1	23.2	24.0
Number of observations		7	14	2	18	19	7	11	21

Table 13. - Values of r from an Uncorrelated Population

No. of Pairs	Significance level		
	0.10	0.01	0.001
25	0.337	0.505	0.618
50	0.235	0.361	0.452
100	0.165	0.256	0.324

Table 14 - Comparison of Tropopause Data from Arlene, Alice and Shirley

Before the eye				In the eye				After the eye			
H km	P mb	T C	Θ_e K	H km	P mb	T C	Θ_e K	H km	P mb	T C	Θ_e K
17.88	82	-86	382	17.52	88	-83	381	18.19	78	-84	392
16.66	101	-81	370	16.66	101	-81	370	17.79	83	-87	379
15.64	119	-70	373	15.71	118	-71	372	15.17	129	-70	365

Table 15 - The Errors of SLP Estimates Derived from Eye Sounding Data and Regression Equations (Jordan's in brackets)

	Actual SLP	Derived from Heights at		
		850 mb	700 mb	500 mb
	mb	mb	mb	mb
Alice	981	-2 (0)	-1 (-1)	+3 (+3)
Shirley	969	-1 (+1)	0 (+2)	+5 (+2)
Arlene	978	-1 (+1)	+3 (+3)	+10 (+10)
Tampa "44"	967	-4 (-2)	-5 (-4)	+3 (-1)
Tampa "46"	990	+8 (+10)	+10 (+9)	+9 (+15)
Inez	989	-2 (0)	-2 (-2)	+1 (+2)

FOR PARTICIPANTS ONLY

WRD/TC.5/15
15 November 1972

ORIGINAL : ENGLISH

UNITED NATIONS ECONOMIC COMMISSION FOR ASIA AND THE FAR EAST
AND
WORLD METEOROLOGICAL ORGANIZATION

Typhoon Committee
Fifth session
15-21 November 1972
Bangkok

INTERNATIONAL ACTION FOR THE MITIGATION OF THE HARMFUL EFFECTS OF STORMS 1/

1/ Resolution adopted with minor amendments by the First Committee of the United Nations General Assembly, twenty-seventh session.

UNITED NATIONS

GENERAL ASSEMBLY

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17 October 1972

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Twenty-seventh session
FIRST COMMITTEE
Agenda item 28

INTERNATIONAL CO-OPERATION IN THE PEACEFUL USES OF OUTER SPACE

International action for the mitigation of the harmful effects of storms

Australia, Iceland, Indonesia, Japan, Kenya, Madagascar, Malaysia, Mauritius, New Zealand, Philippines, Thailand and United States of America: revised draft resolution

The General Assembly,

Aware of the continuing harmful effects of storms and the devastation they cause, particularly to developing countries, whose economies and developmental efforts are thereby seriously impaired,

Concerned over recent calamities inflicted by storms resulting in tremendous losses in life and property in various parts of the world,

Believing that recent advances in science and technology have opened up new avenues towards moderating the effects of these destructive natural forces,

Recalling its resolutions 1721 (XVI) of 20 December 1961, 1802 (XVII) of 14 December 1962 and 2733 D (XXV) of 16 December 1970 and noting the work being undertaken and the progress achieved in response to them,

Taking into account the views expressed by the Committee on the Peaceful Uses of Outer Space at its recent fifteenth resumed session,

Bearing in mind the recommendations of the United Nations Conference on the Human Environment in the field of natural disaster prevention and the measures adopted in resolution 2816 (XXVI) of 14 December 1971 with a view to improving the co-ordination and effectiveness of international efforts to deal with natural disaster and stressing the importance of pre-disaster planning,

Noting the on-going work of the Joint WMO/ECAFE Typhoon Committee and the large degree of collaboration between the World Meteorological Organization and other national, regional and international organizations in matters relating to tropical cyclones,

1. Notes with appreciation the report of the World Meteorological Organization entitled "Tropical cyclone project, plan of action", 1/ prepared by its Executive Committee Panel of Experts on Tropical Cyclones in response to General Assembly resolution 2733 D (XXV), in which the Assembly requested the World Meteorological Organization to find ways and means of mitigating the harmful effects of tropical storms;

2. Endorses the recommendation of the Committee on the Peaceful Uses of Outer Space that the plan of action should be brought to the attention of Member States;

3. Requests the Secretary-General to invite Member States to co-operate to the fullest possible extent with the World Meteorological Organization with a view to achieving the objectives laid down in resolution 2733 D (XXV);

4. Requests the World Meteorological Organization to pursue actively the implementation of its tropical cyclone project, continuing and intensifying its other related action programmes, including the World Weather Watch and, especially, the efforts being undertaken towards obtaining basic meteorological data and discovering ways and means to mitigate the harmful effects of tropical storms and to remove or minimize their destructive potential;

5. Calls upon Member States that are concerned to undertake or intensify research, as well as operational projects, towards this end and requests other Member States to contribute and assist in these projects;

6. Recommends integrated action through increased co-operation and co-ordination between the World Meteorological Organization, the United Nations Development Programme, and the United Nations Disaster Relief Co-ordinator and the United Nations programme for the environment in the field of United Nations natural disaster assistance, particularly the preparedness for, and the prediction, detection, prevention and control of, natural disasters;

7. Requests the World Meteorological Organization to submit a report through the Secretary-General to the Committee on the Peaceful Uses of Space at its next session, to the Economic and Social Council and to such other United Nations bodies as may be appropriate on the progress achieved and on the co-operation measures and other steps taken pursuant to this and other relevant resolutions.

1/ A/AC.105/105.

FOR PARTICIPANTS ONLY

WRD/TC.5/CR.1
16 November 1972

ORIGINAL : ENGLISH

NOMIC COMMISSION FOR ASIA AND THE FAR EAST
D
RLD METEOROLOGICAL ORGANIZATION

phoon Committee
fth session
-21 November 1972
ngkok, Thailand

PROPOSED AMENDMENT TO THE STATUTE
OF THE TYPHOON COMMITTEE

(Item 10 of the revised provisional agenda)

Note by the ECAFE, WMO and TCS secretariats

In order to permit the Typhoon Committee to widen the scope of its ctivities and in particular to engage in the promotion of community reparedness and disaster prevention, and in order to permit wider rticipation by interested organizations, it is proposed to amend rticles 6, 9 and 10 of the Committee's Statute and to amend the func- ons and duties of the Typhoon Committee secretariat in conformity th these amendments.

In addition to these amendments, it is proposed to delete Article 12 hich became superfluous with the convening of the inaugural session of e Committee in 1968 and to delete the reference to the Fifth Congress WMO in the concluding sentence of Article 6, which is no longer plicable.

/The proposed

The proposed revised Statute, rules of procedure and functions and duties of the Typhoon Committee secretariat are attached. Comparison may be made with the present Statute, rules of procedure and functions and duties of the secretariat by reference to Appendices 1 and 2 of the draft request to UNDP for institutional support.

In accordance with Article 11 any amendment made by the Committee will take effec t when approved by all participating Governments.

Appendix 1

1. STATUTE OF THE TYPHOON COMMITTEE

Establishment

Article 1

The Typhoon Committee (hereinafter referred to as the Committee) is established by the Governments of regional ECAFE member countries affected by typhoons (hereinafter referred to as the participating Governments) under the auspices of the United Nations Economic Commission for Asia and the Far East (hereinafter referred to as the Commission) in co-operation with the World Meteorological Organization with a view to promoting and co-ordinating efforts to minimize typhoon damage in the ECAFE region.

Membership, composition and organization

Article 2

The Committee shall be composed of a representative from each of the participating Governments desiring to participate in co-operative efforts to minimize typhoon damage in the ECAFE region. The Executive Secretary of ECAFE and the Secretary-General of WMO or their representatives shall be ex-officio members of the Committee.

Article 3

The Committee shall have a technical secretary and a secretariat which will serve as its executive body. The functions and duties of the Typhoon Committee secretariat shall be determined by the Committee.

Article 4

The Committee shall be assisted, when necessary, by an Advisory Group consisting of qualified experts from within and outside the region.

Co-operation with the Secretariats of the Commission (ECAFE) and the World Meteorological Organization (WMO)

Article 5

The secretariat of the Commission and the secretariat of the World Meteorological Organization shall co-operate with the Committee in the performance of the latter's functions.

Functions

Article 6 (≠ from original)

The functions of the Committee are to promote and to co-ordinate the planning and implementation of measures required for minimizing typhoon damage in the ECAFE region. It shall, to this end:

(a) Review regularly the progress made in the various fields of typhoon damage prevention;

(b) Recommend to the participating Governments concerned plans and measures for the improvement of meteorological and hydrological facilities needed for typhoon damage prevention;

(c) Recommend to the participating Governments concerned plans and measures for the improvement of community preparedness and disaster prevention;

(d) Promote the establishment of programmes and facilities for training personnel from countries of the region in typhoon forecasting and warning, flood hydrology and control within the region and arrange for training outside the region, as necessary

(e) remote, prepare and submit to participating Governments and other interested organizations plans for co-ordination of research programmes and activities concerning typhoons;

(f) Consider, upon request, possible sources of financial and technical support for such plans and programmes;

(g) Prepare and submit, at the request and on behalf of the participating Governments, requests for technical, financial and other assistance offered under the United Nations Development Programme and by other organizations and contributors

/In carrying

In carrying out these functions, the Committee will ensure that the plans adopted by the appropriate bodies of WMO including the implementation programme established by WMO as part of the World Weather Watch Plan, are fully respected at all times.

General Provisions

Article 7

The Committee shall adopt its own rules of procedure .

Article 8

The Committee shall take no action in respect of any country without the agreement of the Government of that country.

Article 9

The Committee shall have authority, subject to established United Nations procedures and practice, to invite representatives of Governments, the United Nations specialized agencies and recognized governmental and non-governmental organizations to attend specific meetings of the Committee in the capacity of observers or in a consultative capacity ~~on agenda items of interest to those Governments, agencies and organizations.~~ * (slightly ≠ of original)

Article 10

The Committee shall submit annual reports to participating Governments, the Commission and the World Meteorological Organization. Such reports, or summaries thereof, may be made available to other Governments, the United Nations specialized agencies and recognized governmental and non-governmental organizations on the recommendation of the Committee.

/Article 11

* ≠ from original

Article 11

Amendments to the present statute which may be proposed by any participating Government shall be examined by the Committee and shall take effect when approved by all participating Governments.

2. RULES OF PROCEDURE OF THE TYPHOON COMMITTEE = to Unified

Rule 1

The Committee shall hold at least one session annually. The venues and dates of its sessions shall be decided by the Committee.

Rule 2

The Executive Secretary of ECAFE shall, in consultation with the Secretary-General of WMO and the Chairman of the Committee, issue a notice convening each session of the Committee, together with copies of the provisional agenda, at least six weeks before the commencement of the session.

Rule 3

The Executive Secretary of ECAFE, in co-operation with the Secretary-General of WMO, shall provide the necessary servicing of the Committee's meetings.

Rule 4

All meetings shall be held in private unless the Committee shall decide otherwise.

Rule 5

English and French shall be the working languages of the Committee.

/Rule 6

Rule 6

The Committee shall, at its first meeting of the year, elect from among its representatives a chairman and a vice-chairman, who shall hold office until their successors are elected. They shall be eligible for re-election.

Rule 7

A simple majority of the government members of the Committee shall constitute a quorum.

Rule 8

Decisions of the Committee shall be made by a majority of the government members present and voting.

Rule 9

In the event of any matter arising which has not been foreseen by the present Rules, the pertinent rules of the United Nations Economic Commission for Asia and the Far East shall be applied.

3. FUNCTIONS AND DUTIES OF THE TYPHOON COMMITTEE SECRETARIAT

The secretariat will be the executive arm of the Typhoon Committee and through the Committee, as may be appropriate, will advise the participating countries on the technical and administrative co-ordination of plans for the implementation of improved meteorological, hydrological and other facilities needed for the prevention of typhoon damage. It will assist the Committee by carrying out the day-to-day co-ordination of all related activities undertaken at the request of the Committee by the United Nations and specialized agencies, as well as under bilateral or multilateral programmes. The secretariat will report to the Committee at regular intervals on the progress of the work. In the performance of these duties the secretariat will maintain close liaison with the ECAFE and WMO secretariats. Specifically its functions will be as follows:

(a) to advise and assist countries in the international exchange of meteorological and hydrological data, distribution of typhoon forecasts and warnings;

(b) to advise and assist countries in the operation and improvement of meteorological observing networks, telecommunication systems and facilities as required for typhoon forecasting and warning, including storm surge forecasting;

(c) to advise and assist countries in the operation and improvement of existing and new hydrological stations required for flood forecasts and warnings;

(d) to advise countries on arrangements for the most effective means of disseminating typhoon and flood warnings within the country and to assist in organizing measures for the improvement of community preparedness and disaster prevention;

(e) to advise and assist countries in organizing their programmes of training and research in typhoon forecasting and warning, flood hydrology and flood control measures;

/f. to keep

(f) to keep under constant review and circulate information on the progress achieved in the latest research studies relating to typhoons, storm surge and flood forecasting;

(g) to encourage and to promote co-operation in research activity aimed at gaining a better understanding of typhoons and, hence, at improving forecasting methods;

(h) to conduct, under specific instructions from the Typhoon Committee, studies on such specific problems concerning typhoons as would facilitate carrying out more effectively the advisory functions stipulated under (a) to (e) with a view to supporting the action programme;

(i) to assist the countries, on request, in the preparation of applications for technical, financial and other assistance for typhoon damage control

In carrying out its responsibilities under (a), (b) and (c) above, the secretariat will ensure that the plans adopted by the appropriate bodies of WMO, including the implementation programme established by the WMO Congress as part of the World Weather Watch Plan, are fully respected at all times.

Annex II

Progress made by the Typhoon Committee during the period 1968-1971

Implementation of the action programme

1. The action programme followed by the Typhoon Committee is that adopted at its first session in 1968. It will be recalled that this programme consists of four components, meteorological, hydrological, complementary protective measures, and training and research. Within the meteorological component of this programme the Committee has also set forth at each of its annual sessions a list of the meteorological and telecommunication facilities to which priority of implementation should be given. Information given below under each of the four components of the programme is intended to show the main achievements over this three-year period.

(a) Meteorological component

2. The meteorological and telecommunication facilities for which some implementation action has been requested under the Typhoon Committee's programme are listed below. In each case the present status of implementation is given:

Observing facilities		Implementation status
(i) Upper-air stations (Radiosonde/radiowind)		
Hong Kong	- Kings Park	Implemented
Japan	- Torishima	Station replaced by ship during typhoon season because of volcanic eruption. Implemented.
Korea	- Pohang	Implemented

/Laos

Laos	- Vientiane	Under implementation
Philippines	- Cebu	Not yet begun
	- Laoag	Not yet begun
	- Zamboanga	Not yet begun
(ii) Weather radar		
Korea	- Seoul	Implemented
	- Kwang-ju	Not yet begun
Laos	- Vientiane	Not yet begun
Philippines	- Basco	Planned for 1972-1973
	- Guian	Implemented
	- Puerto Princesa	Not yet begun
Thailand	- Bangkok	Not yet begun
	- Songkhla	Implemented
(iii) APT stations		
Korea	- Seoul	Implemented
Laos	- Vientiane	Planned for 1972-1973
Philippines	- Manila	Implemented
Thailand	- Bangkok	Implemented
(iv) Ocean weather station	- at 16°N, 135°E	Partly implemented during typhoon season
(v) Automatic marine weather station	- at 18°N, 128°E	Not yet begun

/Telecommunication

Telecommunication facilities

(i) National collection

Korea Laos Philippines	Improvements in the collection of national data have been made in all these countries. Further improvements are still necessary.

(ii) Regional telecommunications

Point-to-point links between:

Bangkok	-	Hong Kong	Implemented
Bangkok	-	Vientiane	Under implementation
Bangkok	-	Saigon	Not yet begun
Seoul	-	Tokyo	Implemented

(iii) Other telecommunication facilities

Strengthening of Regional Telecommunications Hub (RTH), Bangkok
Under partial implementation

(b) Hydrological component

4. The progress made in development of comprehensive plans and implementation of pilot flood-forecasting systems may be summarized as follows:

Philippines : Implementation in progress with assistance from Japan.

Thailand : Comprehensive plan developed; implementation awaiting provision of equipment.

Korea :) Available data under study;
Laos :) Comprehensive plans yet to be developed.

/5. In addition,

5. In addition, training seminars on flood forecasting and warning services were held in Tokyo in 1969, 1970 and 1971 to help member countries of the Typhoon Committee. These seminars were organized and supported by the Government of Japan.

(c) Complementary protective measures

6. Insufficient attention was given by the Committee to this component of its programme until 1971. Although it was realized early on that the services of a disaster prevention and community preparedness expert would be necessary to help the member countries, it was not until late in 1971 that the services of an expert were obtained as a result of negotiations between WMO and the League of Red Cross Societies (LRCS). During the last four months of the year the expert visited all the member countries to survey the local arrangements for disaster prevention. His report contains many recommendations and action to follow them up is being taken by WMO and the LRCS, as well as in the countries themselves.

7. Prior to the survey the Typhoon Committee Secretariat had collected information on the existing national arrangements for the distribution of warnings and for protective measures. A note summarizing this material was prepared and distributed.

(d) Training and research

8. The TCS has carried out a survey of the training requirements in member countries and has drawn up a tentative five-year plan to meet them. Offers of assistance for training of personnel have been made by a number of countries outside the typhoon area. Training seminars in flood forecasting and warning organized by Japan as part of the Typhoon Committee's

/programme

programme have already been mentioned under the hydrological component. In addition, the telecommunication and electronics expert of the TCS provided on-the-job training in the operation and maintenance of storm-warning radar in two member countries.

9. As regards co-ordination of research activities, the Committee decided that member countries should be kept informed of current research relating to typhoons by bringing published research papers to their attention. Arrangements for the distribution of such papers were reviewed and an agreed exchange system was introduced. Hong Kong's plan for producing typhoon movement forecasts by various objective techniques with the help of a computer has been brought to the attention of all member countries. Liaison was maintained with Hong Kong in connexion with the experimental building erected there to study the effects of typhoons on building design and structures.

Assistance received by the Typhoon Committee under the WMO Voluntary Assistance Programme (VAP) and through bilateral aid

10. During the past three years the Typhoon Committee has received substantial assistance from the WMO Voluntary Assistance Programme (VAP) and through bilateral aid, mainly from countries outside the typhoon area. The main items provided from these sources are listed below:

(i) Voluntary Assistance Programme

Laos	- Radiosonde/radiowind equipment for Vientiane
	- Telecommunications equipment for link Vientiane-Bangkok

/Thailand

Thailand	- Automatic Picture Transmission (APT) equipment for reception of satellite photographs
	- Telecommunications equipment for the Regional Telecommunication Hub (RTH) at Bangkok

(ii) Bilateral aid

From Australia	- Telecommunications equipment for the Philippines
	- Telecommunications equipment for RTH, Bangkok
	- Training facilities (offered)
From Federal Republic of Germany	- Special reports from research vessels operating in typhoon area in 1971 and 1972
From France	- APT for Vientiane, Laos (offered)
	- Training facilities for Laos (offered)
From Japan	- Three seminars in flood-forecasting in 1969, 1970 and 1971. A fourth is promised for 1972
	- Complete equipment for flood-forecasting system in the Pampanga River, Philippines
From USSR	- Ocean Weather Ships stationed in typhoon area for 2 months in 1970, 3-4 months in 1971 and a further period promised in 1972.

11. The total value of the VAP and bilateral aid already provided is of the order of US$ 1.5 million.

FOR PARTICIPANTS ONLY

WRD/TC5/17
15 November 1972

ORIGINAL : ENGLISH

ECONOMIC COMMISSION FOR ASIA AND THE FAR EAST
AND
WORLD METEOROLOGICAL ORGANIZATIONS

Typhoon Committee
Fifth session
15-21 November 1972
Bangkok, Thailand

TYPHOON RESEARCH IN THE PHILIPPINES

by

the Project Manager,
WMO/UNDP Project
"Meteorological Training and Research"

INFORMATION PAPER

TYPHOON RESEARCH IN THE PHILIPPINES

Submitted by

Project Manager, WMO/UNDP Project
"Meteorological Training and Research"

Typhoon Research in the Philippines

Introduction

The WMO/UNDP Project in Meteorological Training and Research in Manila will terminate on 31 July 1973. During its five year span it will have assisted the Government of the Philippines in developing the educational facilities and the training components of the National Weather Service. One phase of the Project has been directed toward the expansion of the Department of Meteorology of the University of the Philippines, another towards the establishment of the Institute of Meteorology within the Philippine Weather Bureau. Experts in tropical meteorology, radar meteorology, agrometeorology, hydrometeorology, data processing and instruments have all contributed towards the realization of the Project's activities as described. During the period a total of 14 technical notes have been published. Others are in the course of preparation including one on monsoon rainfall distribution authored by a student from Thailand who obtained his MSc degree under our program. Several technical notes have been devoted to studies of typhoons and tropical storms.

An important sub-project is in the primary stages of execution. Telemetering equipment for the reporting of stream flow and rainfall intensity in the Marikina Valley and adjacent mountains to the east of Manila is at present being installed. The observation will be transmitted to the Central Forecast office at Quezon City and will serve as a basis for a pilot flood warning service. The system is expected to commence full time operation before the onset of the rainy season. However research studies of the results cannot commence in earnest during the lifetime of the existing project.

Follow on Project

A draft request has been submitted to UNDP for a follow on project in instrment workshop organization and instruments maintenance and repair, including radar repair and maintenance. The proposed project also includes a hydrometeorological component to ensure that the pilot flood warning system described is effectively carried through to a successful conclusion. The follow on project is basically a continuation of two components of the existing project with the addition of an expert in radar repair and maintenance.

Proposal for a Typhoon Research Programme

During the past year thought has been devoted to ways in which a continuation of research in tropical meteorology could be continued. Long before the occurrence of the devastating floods in Central Luzon last July and August ideas were crystallized that the primary research effort should be directed towards ways and means of mitigating the destruction brought about by typhoons, and that to achieve this aim we must first arrive at a better understanding of the real nature of the phenomenon.

Referring to page 23, paragraph 81 of Working paper TC5/6 it may be remembered that a proposal was made by the UNESCO seminar on "wind effects on buildings and structures" that a Typhoon Research Institute should be established in the Philippines. Although for technical reasons the proposal did not constitute a formal seminar recommendation it was clear that the delegates from seven member Typhoon Committee countries felt there was an urgent need for work to be carried out in this field.

The summer flood disaster served to emphasize this need, but to encompass monsoon rains and their causes in the overall field of study. In this respect it is mentioned that a typhoon disturbance

was only partly responsible for the excessive monsoon rains of July 1972 which occurred during a well developed cross equatorial pressure gradient between the Australian sub-tropical winter anticyclone and a typhoon centered south of Japan. Our existing project is at present conducting a major post mortem investigation of the entire meteorological situation of the five day period when over 1000 mm of rain fell in Manila.

The proposed programme of activities for a future typhoon research project would consist of a theoretical or academic component (33%) and an applied research component (67%). The former component would be undertaken by students and staff of the University of the Philippines while the latter could be undertaken by the existing Institute of Meteorology in collaboration with the University. A certain amount of basic training equipment would be supplied to the University.

The typhoon research project would attack the problems of typhoon genesis, development, movement, structure and damaging mechanism theoretically (a) by mathematical, physical and numerical studies using the existing project's IBM computer and practically from the use of (b) Weather radar (c) APT Satellite photographs (d) aircraft reconnaissance observations. Assistance would be sought from UNDP in terms of experts and high quality equipment in these four areas. Very detailed and extensive studies would be made of radar screens resulting from a continuous documentation of echoes by single frame cine camera time lapse techniques. Trials of a similar nature could be made on the satellite photographs in addition to conventional analysis techniques. A few fellowships would be included for young research scientists.

The Government of the Philippines are making plans in the general area of typhoon studies with the possible aim of undertaking typhoon moderation activities in the future.

It is considered that a WMO/UNDP Project along the lines described would be of the greatest benefit in assisting the Government with their plans. A project lasting 3 years with a UNDP input of $500,000 would represent 0.7% of the average storm monetary loss for that period.

The Committee is invited to comment on the merits of a draft request to UNDP along the lines described.

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FOR PARTICIPANTS ONLY

WRD/TC.5/18
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ORIGINAL : FRENCH

ECONOMIC COMMISSION FOR ASIA AND THE FAR EAST
AND
WORLD METEOROLOGICAL ORGANIZATION

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Fifth session
15-21 November 1972
Bangkok, Thailand

EXAMPLES OF METHODS AND MACHINERY FOR ALERTING THE PUBLIC AND PROVIDING PROTECTION IN ZONES SUBJECT TO TYPHOONS

(Agenda item 7)

Note submitted by France

INTRODUCTION

In France methods and machinery for warning and protecting the population in the event of serious disasters and for organizing relief are planned in advance and embodied in a fixed plan (which is, however, subject to amendment on the basis of the experienced acquired) whose short title is the "ORSEC Plan" (OR and SEC being the first letters of the French words for organization and relief). The way in which the plan is applied will naturally vary according to the nature of the disaster.

An outline of the ORSEC plan for tropical cyclones follows.

/GENERAL

GENERAL PRINCIPLES OF THE PLAN

If the plan is to be effective, a system of warning messages must be drawn up, before the typhoon strikes, the dissemination of which will automatically bring about the taking of certain measures, laid down in advance, by the responsible official departments and authorities, also designated in advance.

This is the object of the ORSEC Plan, which is ordinarily applicable in the relatively large territorial unit called a Département, the highest administrative authority in which is the prefect.

Responsible department and authorities, and general organization

The country is divided into a number of zones, each comprised of certain number of communes (the commune, the smallest territorial unit, is administered by a mayor). Each commune has an ORSEC plan based on the characteristics of the zone of which it is a part.

Over-all command is in the hands of the prefect, assisted by a general staff, which is itself under the orders of a relief director appointed by the prefect.

This general staff includes:

- A command post (C.P.) at the prefecture;
- If necessary, one or more operational command posts at the sites of the disaster. These command posts are staffed as follows:
  (a) Officials of the administration (Secretary-general of the prefecture, manager of the prefect's office, etc.);
  (b) The heads of the gendarmerie's liaison and communications service and of the police and similar organizations;

/(c) Heads

(c) Heads of the relief and rescue services: the fire and civil defence services, forestry service (mountain relief operations), navy recruitment service (relief at sea);

(d) Those responsible for medical aid and mutural assistance: health inspectorate, health emergency authority;

(e) The departmental heads responsible for transport, clearing roads and railways, re-establishing routes: /Ministry of/ Highways, Army.

In each commune of the zone a command post under a zone chief (sub-prefect) and the mayors is organized on the same pattern, but with fewer staff. The mayors are instructed to form their own teams of dynamic and hardworking persons.

Instructions

Each commanding officer, departmental head and mayor receives a standard list of instructions to be followed throughout the cyclone period and when each phase of the alert is announced.

WARNING SYSTEM

There are six types of alert:

"A" ALERT: Placing the security services in stand-by status.

Announced: when the country is threatened by a cyclone.

Measures

Broadcasting: announced to the public;

Message A telephoned to the security service and other communications authorities;

Message A telegraphed to sub-prefect and mayors.

/Purpose

Purpose

Every individual, community and administrative unit is to take his or its own safety measures;

Setting up an information office (skeleton C.P.) at the prefecture.

"B" ALERT: Preparedness warning

Announced: when the cyclone is approaching.

Measures

Broadcasting: announced to the public;

Message B telephoned to the security services and other communications authorities;

Message B telegraphed to the sub-prefect and mayors.

Purpose

Installation at the C.P. - prefectures of radio sets of the gendarmerie and civil defence, and of the radio staff (testing communications);

Installation of the C.P.'s equipment;

Designation of and assignment of duties to the first of the preparedness staff and the C.P. staff;

Testing of radio cars.

"C" ALERT: Immediate danger

Announced: when cyclone is passing.

Measures

Broadcasting: announced to the public;

Message C telephoned to the security services and other communications authorities;

Message C telegraphed to sub-prefects and mayors;

Gendarmerie radio network repeats Message C telegrams to sub-prefects and mayors.

/Purpose

Purpose

All officials of the ORSEC general staff immediately go to the prefecture (C.P.);

The population immediately takes shelter;

Movement of pedestrians and vehicles prohibited, except for the security services.

"D" ALERT: Reversion to preparatory measures (B Alert) when the immediate danger alert ends.

Announced: immediate danger has temporarily passed.

This alert cancels the C Alert and maintains the B Alert

Its purpose is to enable relief to be organized as quickly as possible, since a threat still remains (reduced wind speed, indicating the possibility of looping near the country).

"E" ALERT: End of preparatory measures (of the B Alert), the security services maintaining their watch.

Announced: when the cyclone is slowly moving away or a new depression is forming.

This alert cancels the B Alert and maintains the A Alert.

Its purpose, as will be shown below, is to facilitate protection on holidays and non-working days.

"F" ALERT: End of cyclone danger. This Alert cancels the A Alert.

APPLICATION OF THE ALERTS

The A Alert is of great importance just before week-ends. Its announcement serves to warn the people concerned in the security services that they may be required to be on duty during this leisure period and

/should make

should make the necessary arrangements. The same applies to private citizens, who know what the situation is when they make their week-end plans.

The stopping of traffic under the C Alert may be found surprising. In practice, this phase is announced by a bulletin informing the population that work is being halted and that everybody should go home. The movement of pedestrians and vehicles will be halted after a stated time. This practice was found necessary in certain places because of the orographic effects caused by calms in certain well-protected areas. These calms are often interpreted by the public as the end of the cyclone's passage.

A storm moving along the southern coast of the island of Réunion, for example, causes humid weather in the capital with light rainfall and no wind, but the storm, continuing its progress from east to west, sets counterwinds moving from the west which may be very strong and sudden. The population, unaware of the considerable influence of the island's geographical features on the cyclone, tends to go to have a look at the magnificent spectacle of the immense waves crashing on the coast and to be surprised by the wind springing up suddenly. Accidents, particularly car accidents, can then be expected.

CONCLUSION

The aim of this document is not to serve as a guide for community preparedness applicable to all States. Obviously, the machinery described would in any case have to be adapted to suit specific geographical and administrative circumstances, and the peculiar features of typhoons.

/The French

The French system has therefore been outlined only as an example and as an illustration of certain principles. Experience has shown that it enables damage to be reduced to a minimum.

Its chief merit is that the problem of informing and protecting the public has been dealt with in advance in exactly the same way as a plan for, for example, defence against a bombing attack. The analogy has even been indicated in the terminology: general staff, C.P., etc. This produces a powerful and efficient instrument.

Nevertheless, the announcement of the alerts is still a difficult problem. In practice, the announcement is made after various analyses of the possible development of the meteorological situation have been compared and their probability appraised. The decision at that point is taken at the meteorologists' level, and it is for the head of that service to present it to the responsible authorities.

If the system is to be effective, there must be continuous close liaison, even at times other than the typhoon season, between the authorities and the meteorological service.

LIMITED
WRD/MKG/INF/L.532
9 November 1972
Original: English

UNITED NATIONS

ECONOMIC COMMISSION FOR ASIA AND THE FAR EAST

Committee for Co-ordination of Investigations
of the Lower Mekong Basin (Khmer Republic,
Laos, Thailand and the Republic of Viet-Nam)

Fifth Session of the Typhoon Committee
Wednesday 15 November - Tuesday 21 November 1972
Bangkok, Thailand

1972 BASINWIDE FLOOD FORECASTING FOR THE LOWER MEKONG BASIN

Information Note by the Mekong Secretariat

1972 BASINWIDE FLOOD FORECASTING FOR THE LOWER MEKONG BASIN

Introduction

Flood forecasting

The flood forecasting programme for the lower Mekong basin was started during the 1970 flood season on a trial basis and continued in 1971. The Mekong Committee at its 55th session, held in Bangkok, Thailand, 26-31 January 1972, reviewed the 1971 basinwide flood forecasting operation and expressed the wish that the Mekong Secrerariat continue this activity and its efforts to improve the accuracy of the forecasts, especially for longer periods, i.e. five or six days. The Committee also endorsed a proposal to provide facilities for training riparian technicians in flood forecasting operation.

1972 flood forecasting programme

Implementation

After two years of increasingly successful efforts in this activity, and with refinement of the characteristics for watershed and river basin modeling used in the computer programme and the ability to make greater use of weather satellite and radar data, the Mekong Committee dicided to embark upon an intensified though still experimental programme of flood forecasting for the lower Mekong basin during the 1972 flood season, which began on 15 June this year, two months earlier than last year and ended on 20 October, The operation was, for the first time, conducted by Mekong Secretariat staff specialists in river forecasting and hydrometeorological analysis without any advisory assistance. The Director of the Engineering

/Division,

Division, Mekong Secretariat, is responsible for carrying out the flood forecasting programme. The entire 1972 flood forecasting operation will however be the subject of an evaluation by two experts from the U.S. Corps of Engineers, North Pacific Division, and the Portland River Forecast Center of the U.S. National Weather Service. The flood forecasting staff co-ordinates fully with the national services concerned with meteorology and hydrology of the four riparian countries and with the Typhoon Committee Secretariat.

Figure 1 shows the upper and lower Mekong basins and the location of the weather radar, Automatic Picture Transmission (APT) satellite ground receiving, precipitation and hydrologic reporting stations in the four riparian countries.

1972 flood situation

At the beginning of the 1972 flood season, in June and July, the water levels in the Mekong river were very low, particularly in the upper reach. In the first half of July, the water levels at Chiang Saen, Luang Prabang, Vientiane and Nong Khai went below the minimum records; Thakhek, Mukdahan and Paksé were between the historic average and the minimum; and Phnom Penh, Tan Chau and Chau Doc more or less matched the historic averages. The water levels began to catch up with the historic average flows at the end of July. However, due to the heavy rainfall that was confined to the central and lower parts of the lower Mekong basin in late July and in August, the water stages from Thakhek to Pakse were above the historic average stages during this period and up to early September, with the water levels at Mukdahan close to the flood stage and Pakse a little over the flood stage. The water stages in the upper reaches from Chiang Saen to Nong Khai were, for most of the time in August, below the historic averages and were down

/to the

to the minimum levels in September. The water stages in the lower reaches at Phnom Penh, Chau Doc and Tan Chau in the delta area in August were close to the maximum levels and in September a little above the historic levels.

A set of 4 figures shows the summary hydrographs and the 1972 hydrograph at the 4 selected key mainstem stations on the Mekong. Each of the summary hydrographs shows the daily maximum, daily mean, and daily minimum streamflow or water stage for the period of record at the particular station. The observed flow or water stage for 1972 is superimposed on each of the summary hydrographs to show its relation to the historic record of streamflow or water stage.

Figure 14 shows the storm tracks that affected the lower mekong basin during the 1972 flood season. The storm isohyets resulting from the three tropical disturbances, namely, "ELSIE", "FLOSSIE", and "LORNA" are shown respectively in figures 16, 17 and 18.

Flood operation

Input data for a backup and forecast periods are the same as last year. Each forecast computation consists of two parts: (i) a back up period of four days prior to, and (ii) a quantitative precipitation forecast and outlook for the next ten days beyond the current morning. Forecasts are manually adjusted to revise unreasonable and inconsistent estimates pinpointed by the Streamflow Synthesis and Reservoir Regulation (SSARR) programme as computer reruns are not presently feasible. These adjustments consider the most likely error and probable effect on computed forecasts. During the 1972 flood season final forecasts were available for dissemination to the appropriate government agencies of the four riparian countries on a regular basis, seven days a week, around 1130 hours; that

/is 30 minutes

is 30 minutes earlier than last year's operation. Daily river stage forecasts were issued for 12 selected key stations on the Mekong and for one on the Bassac river instead of 10 as was done last year.

The functioning of the Secretariat staff during the 1972 flood forecasting operation is described in annex 1.

It is worth mentioning that this year H.M. the King of Thailand expressed interest in the Secretariat's flood forecasting activities and, in early August, informally requested the Secretariat to send current water stages and forecasts at several key stations in Thailand to assist His Majesty in augmenting his people's readiness in flood fighting.

Forecast results

Table 1 indicates a tabular summary of the median forecast deviations for four selected key stations during the 1970-72 flood seasons.

Table 1 - Median forecast deviations by forecast days 1/

Number of days in advance	Vientiane			Mukdahan		
	1970	1971	1972	1970	1971	1972
1	0.06	0.04	0.04	0.06	0.04	0.07
2	0.12	0.06	0.08	0.12	0.08	0.17
3	0.20	0.12	0.16	0.21	0.15	0.26
4	0.32	0.34	0.19	0.32	0.23	0.37
5	0.42	0.37	0.35	0.43	0.34	0.48

Number of days in advance	Pakse			Phnom Penh		
	1970	1971	1972	1970	1971	1972
1	0.06	0.04	0.11	0.02	0.02	0.02
2	0.09	0.07	0.20	0.03	0.03	0.04
3	0.14	0.14	0.23	0.04	0.04	0.08
4	0.21	0.18	0.29	0.06	0.06	0.12
5	0.30	0.22	0.41	0.09	0.10	0.14

1/ Absolute value of deviation observed minus forecast water stage in metres.

Usefulness of forecast

The forecasts, particularly during the severe flooding of 1971, proved to be sufficiently reliable and useful to various government agencies in Vientiane, Laos and in Nong Khai, Thailand in planning flood protection measures. The overall accuracy for 1, 2, 3, 4 and 5 days forecasts in 1972 are indicated in the attached graphs for Vientiane, Pakse and Phnom Penh.

Problems and possible solutions

1. Forecast accuracy for some stations particularly for Chiang Saen and Luang Prabang are not satisfactory, owing to a lack of rainfall data. The available radar rainfall information does not cover areas above Luang Prabang and Chiang Saen. The only solution for Chiang Saen is to obtain current rainfall data for the upper Mekong basin in Burma and China - this is not possible at present. For Luang Prabang, the problem could be resolved by installing a telemeter system and/for a remote-sensing system which at some later date may be interrogated by a geostationary satellite, such as the one proposed for launching during this decade by the Government of Japan. The Secretariat has approached the Government of Japan to consider providing such a system for use in the subbasin between Chiang Saen and Luang Prabang.

2. The 24-hour radar rainfall data do not coincide with the observed 24-hour rainfall data. This sometimes causes difficulties in the assessment of the basin rainfall data.

3. Number of discharge measurements is not enough to justify a good rating curve. The rating of streamflow measuring stations except Thailand has continued to be inadequate. The reasons vary from security problems and shortage of funds and personnel to administrative weaknesses. More efforts should be made to rate continuously and sufficiently the existing stations particularly those on the mainstem.

/4. Intensified

4. Intensified efforts to eliminate reporting errors should be made since this affects the accuracy of the forecasts.

5. In case of a rapid or sharp rising of water stage, the gauge observers should double check to make sure the observed values are correct.

6. When the situation permits, hydrologic activities for major tributaries in Laos and in the Khmer Republic should be resumed. Data from these areas will be of great use in the flood forecasting operation.

7. The riparian countries except Thailand should arrange to send a report of current discharge measurement data to the flood forecasting unit. This sata will be helpful in updating the rating curve.

Summary

The basinwide forecasts have proved to be of value for planning flood protection measures. During the 1971 flood, damages were reduced through timely and fairly accurate forecasts of coming dangerous flood levels.

To compensate for the lack of rainfall data in the mountainous areas the Typhoon Committee may wish to support the Mekong Committee request for installation of a telemeter system and/or a proposal for a remote-sensing system which at some later date may be interrogated by a geostationary satellite and can, thus, fill in some of the gap in basic data-gathering that still limits the accuracy of the forecasts.

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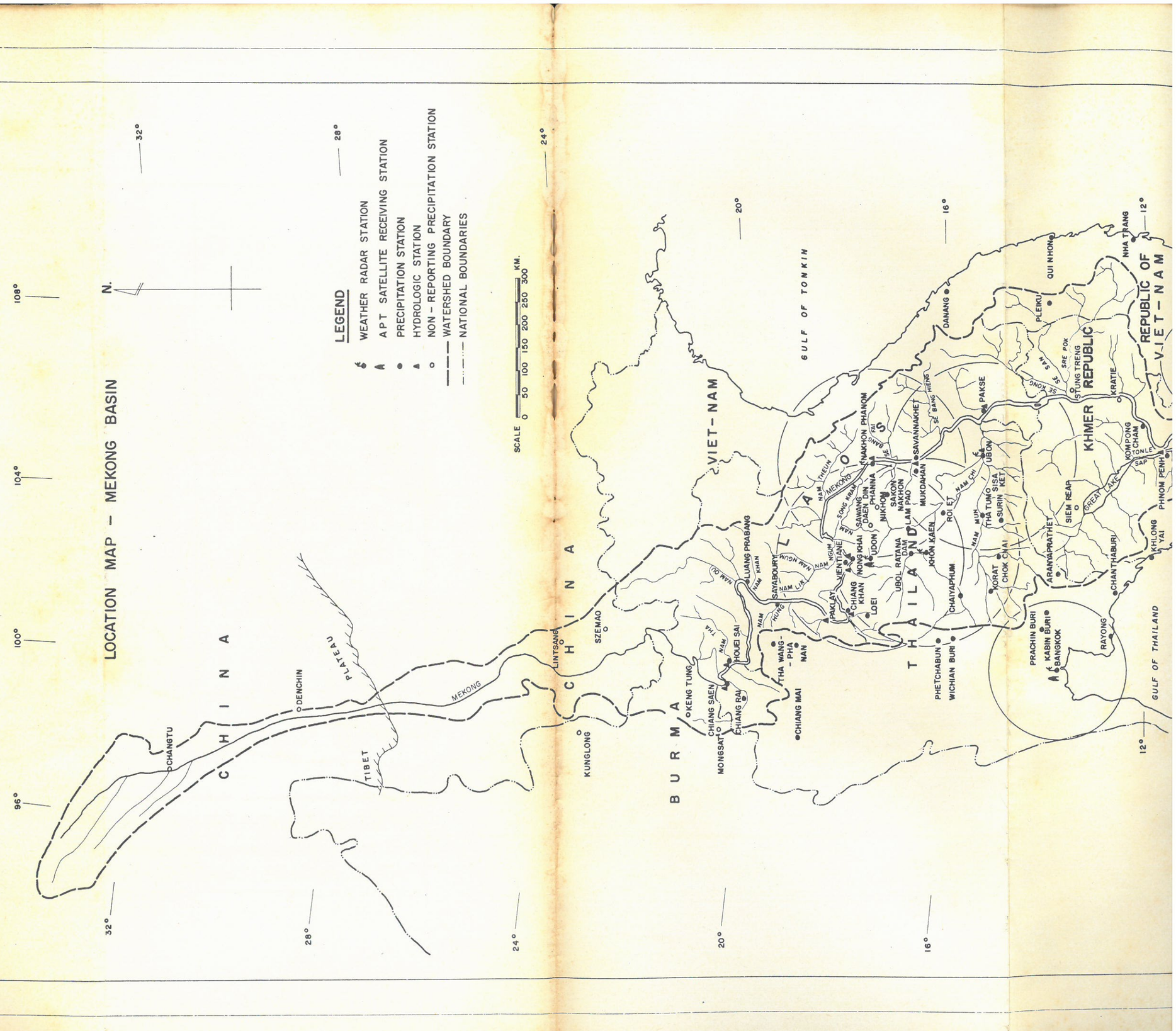
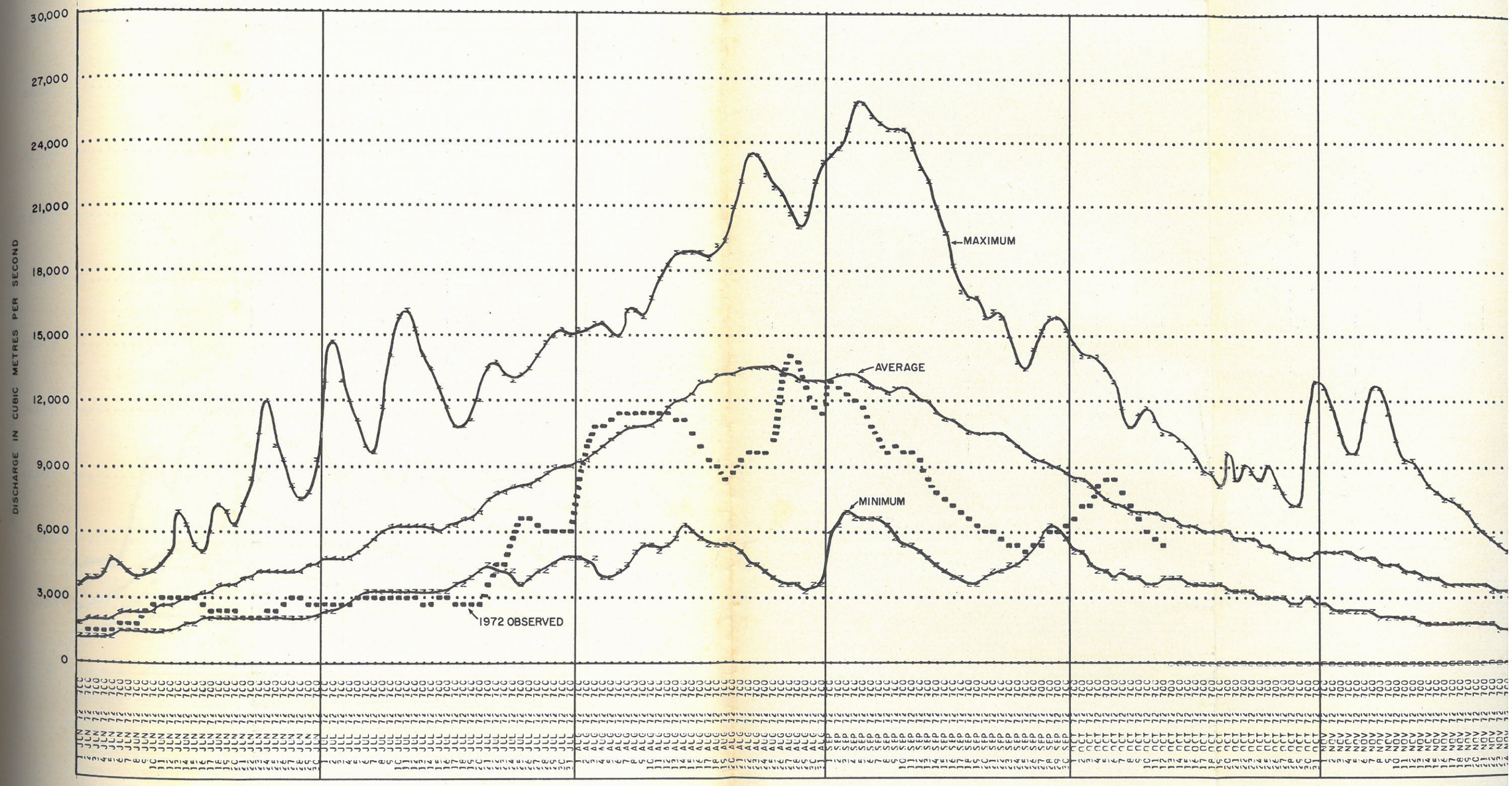
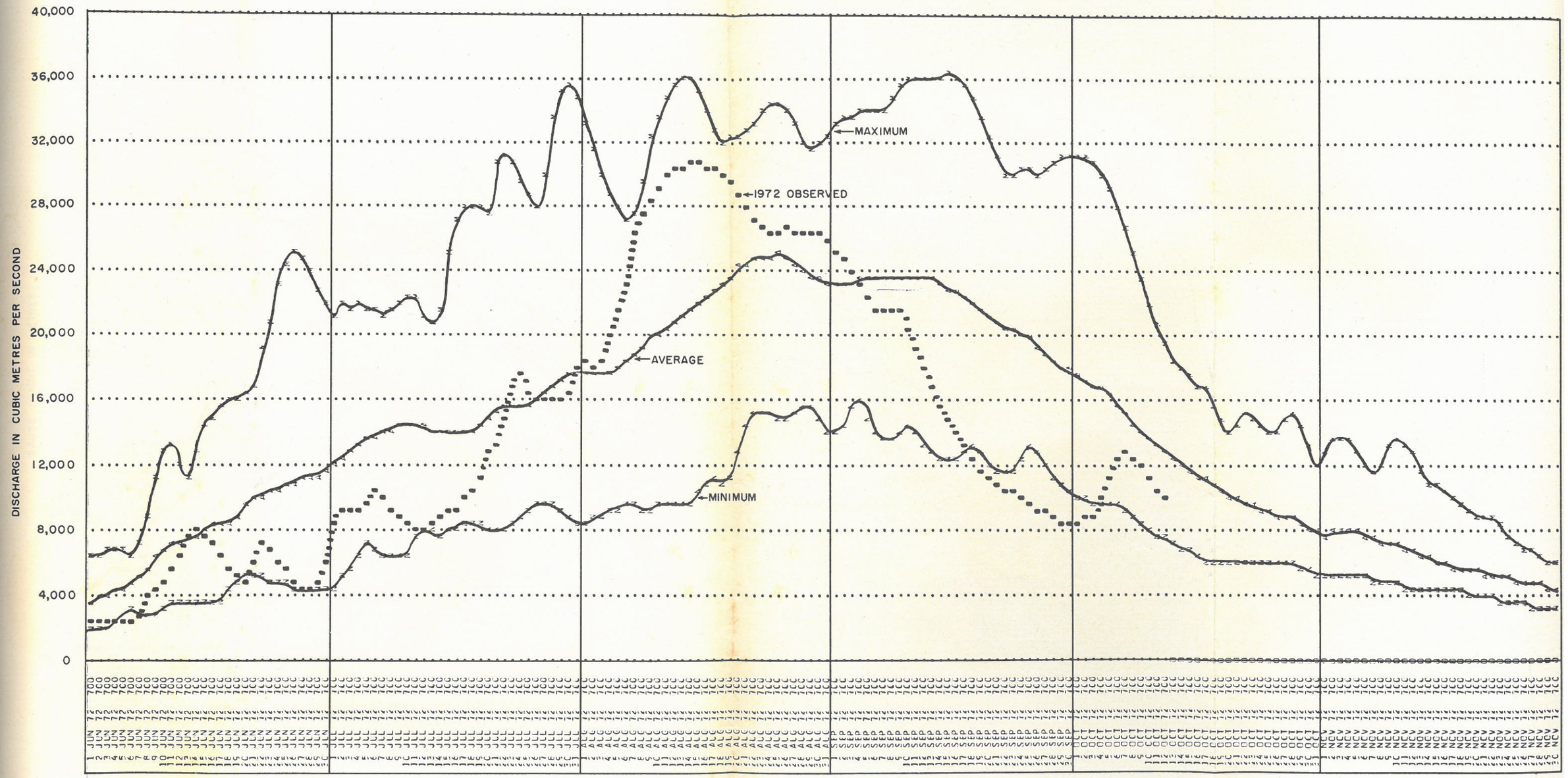


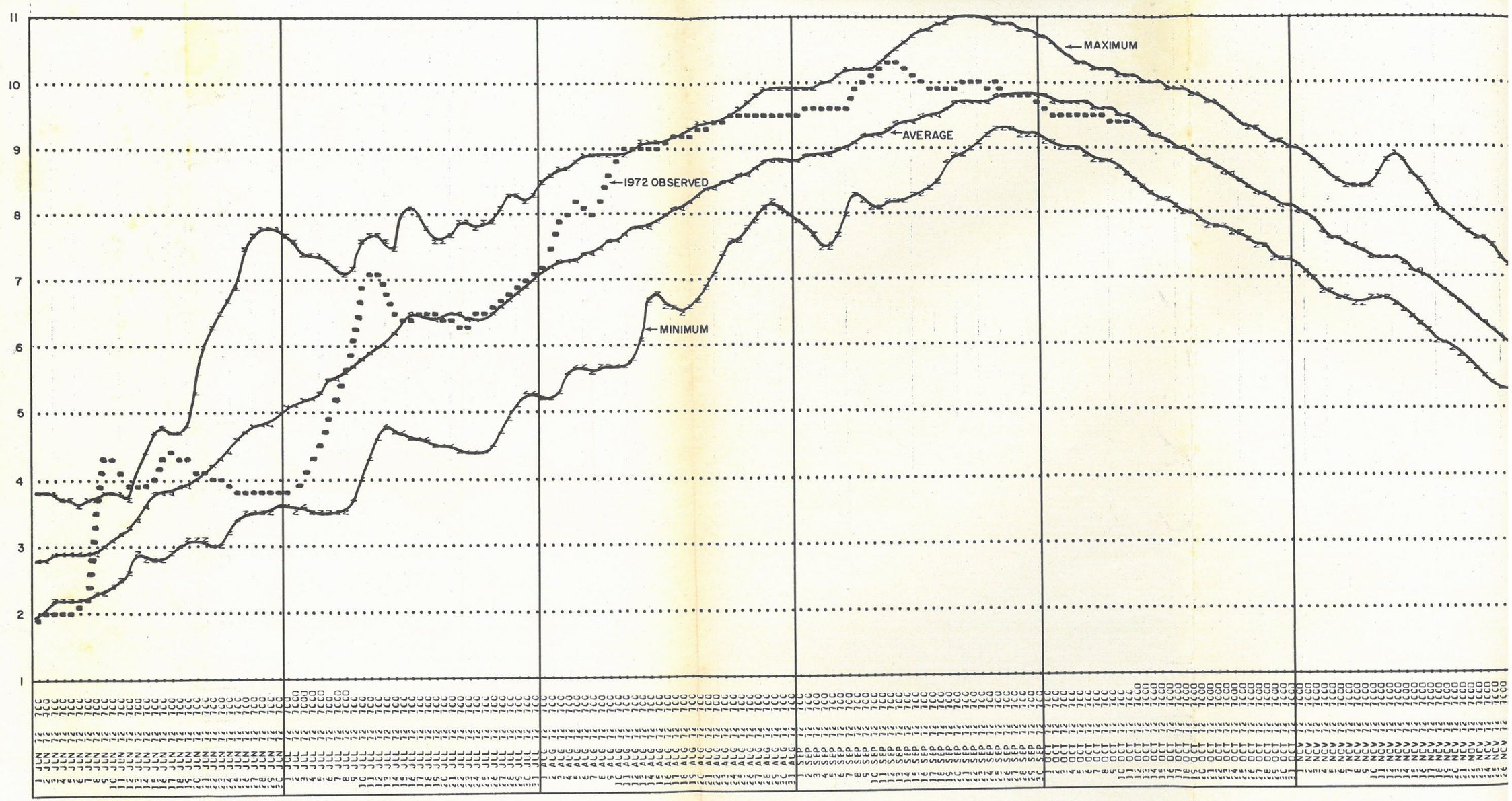
SUMMARY AND 1972 DISCHARGE HYDROGRAPHS
MEKONG AT VIENTIANE



SUMMARY AND 1972 DISCHARGE HYDROGRAPHS
MEKONG AT MUKDAHAN



SUMMARY AND 1972 STAGE HYDROGRAPHS
MEKONG AT PHNOM PENH



SUMMARY AND 1972 STAGE HYDROGRAPHS
MEKONG AT TAN CHAU

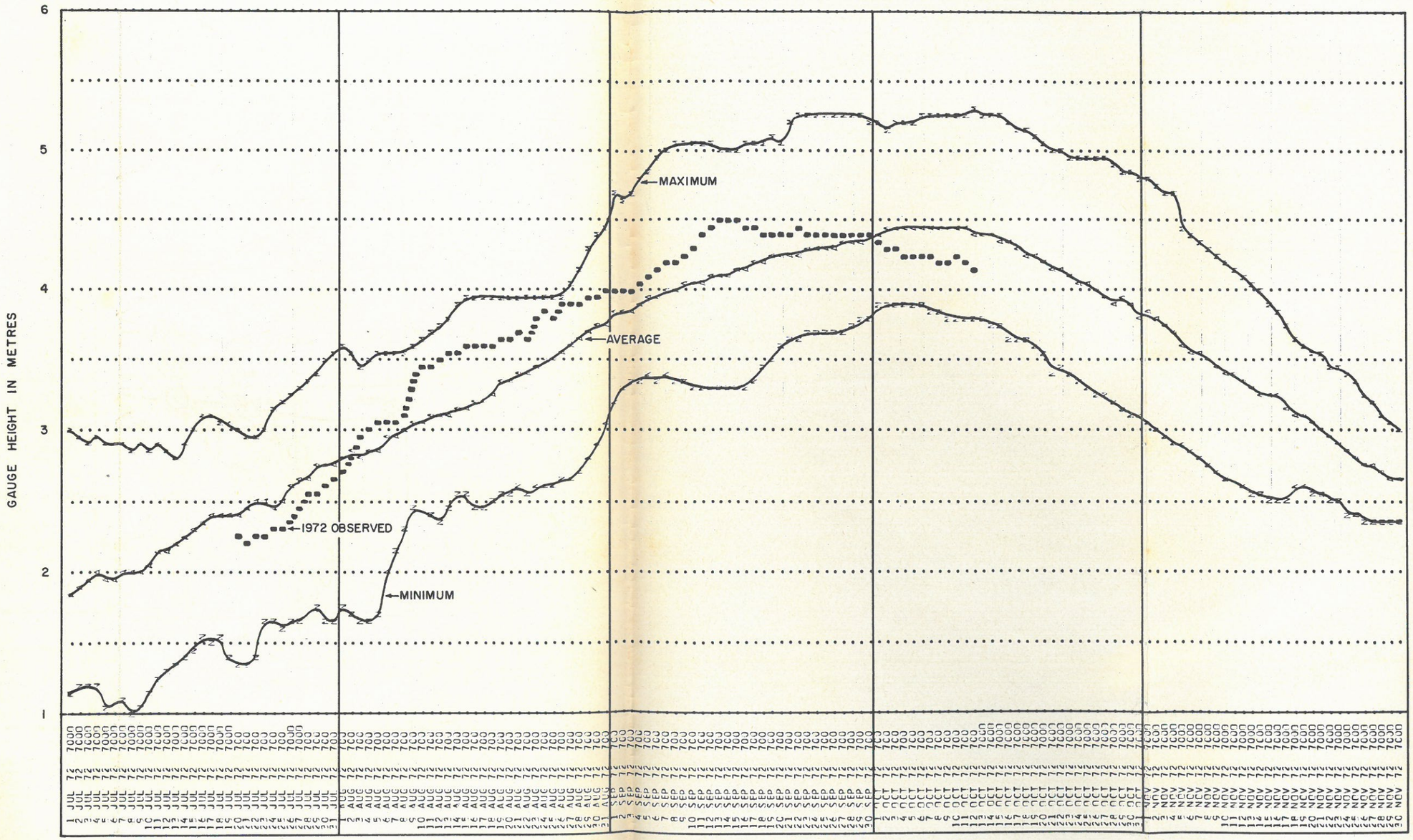
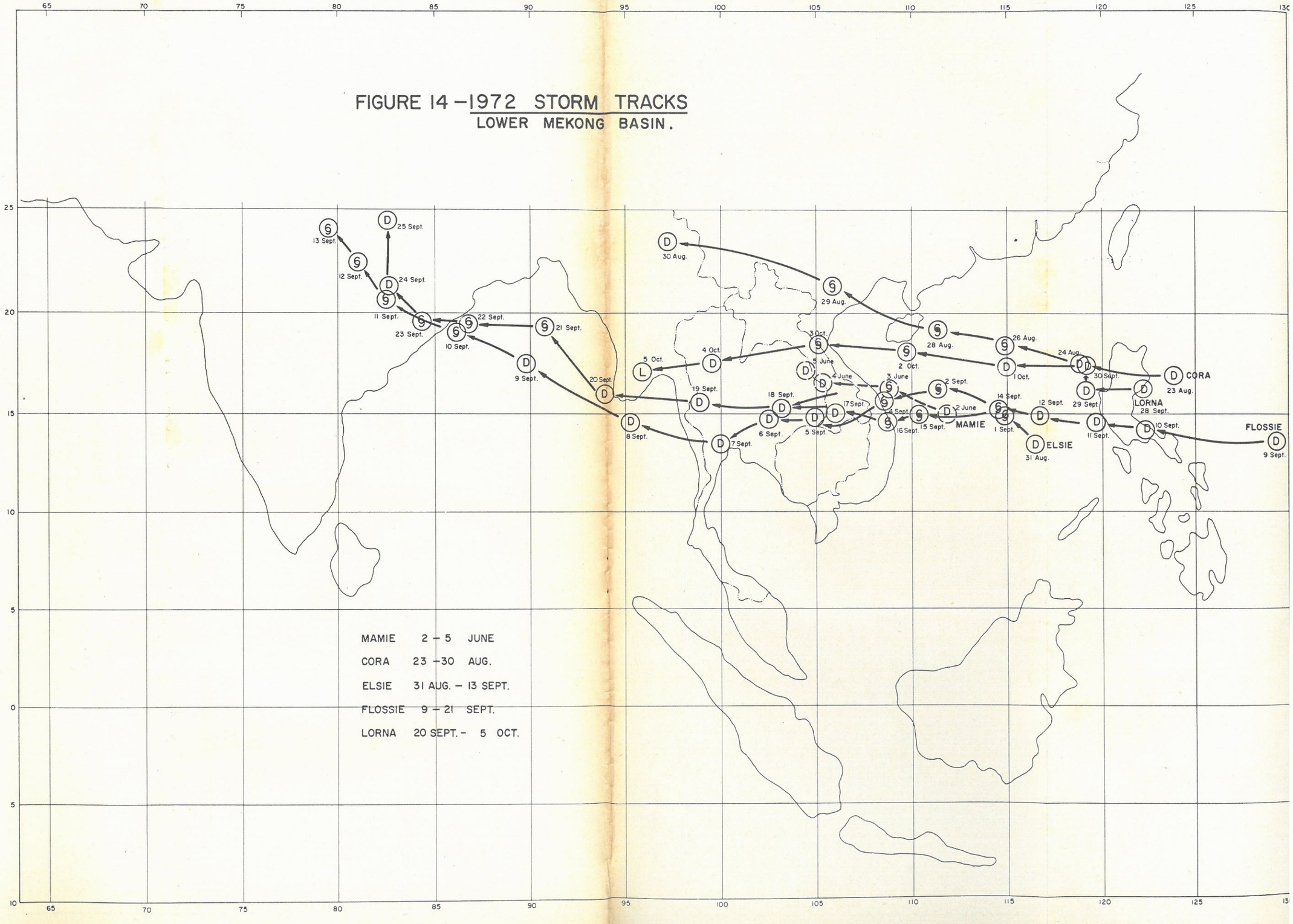


FIGURE 14 – 1972 STORM TRACKS
LOWER MEKONG BASIN.



MAMIE 2 – 5 JUNE

CORA 23 – 30 AUG.

ELSIE 31 AUG. – 13 SEPT.

FLOSSIE 9 – 21 SEPT.

LORNA 20 SEPT. – 5 OCT.

FIGURE 16
TOTAL STORM ISOHYETS
"ELSIE" 4-7 SEPTEMBER 1972

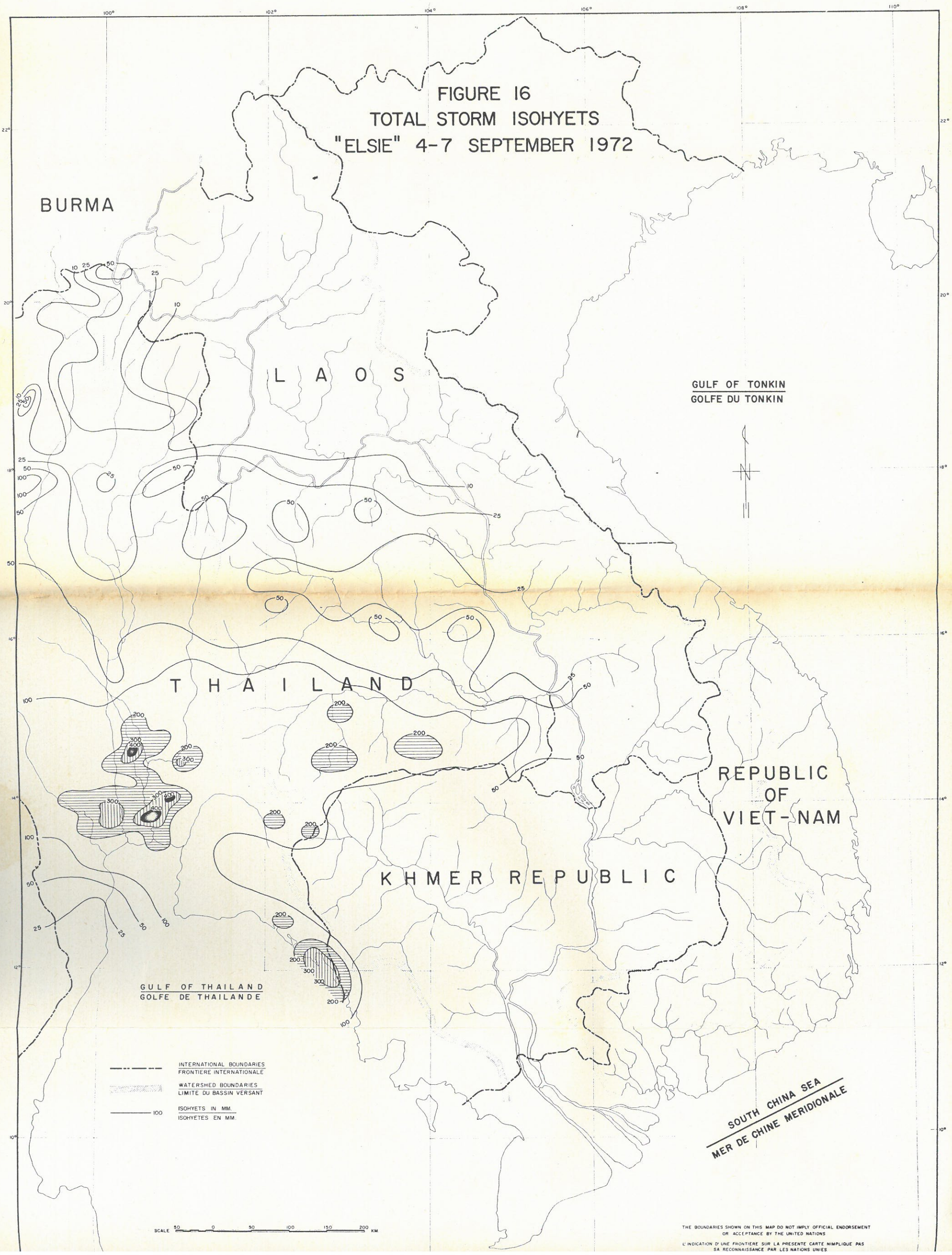


FIGURE 17
TOTAL STORM ISOHYETS
"FLOSSIE" 16-19 SEPTEMBER 1972

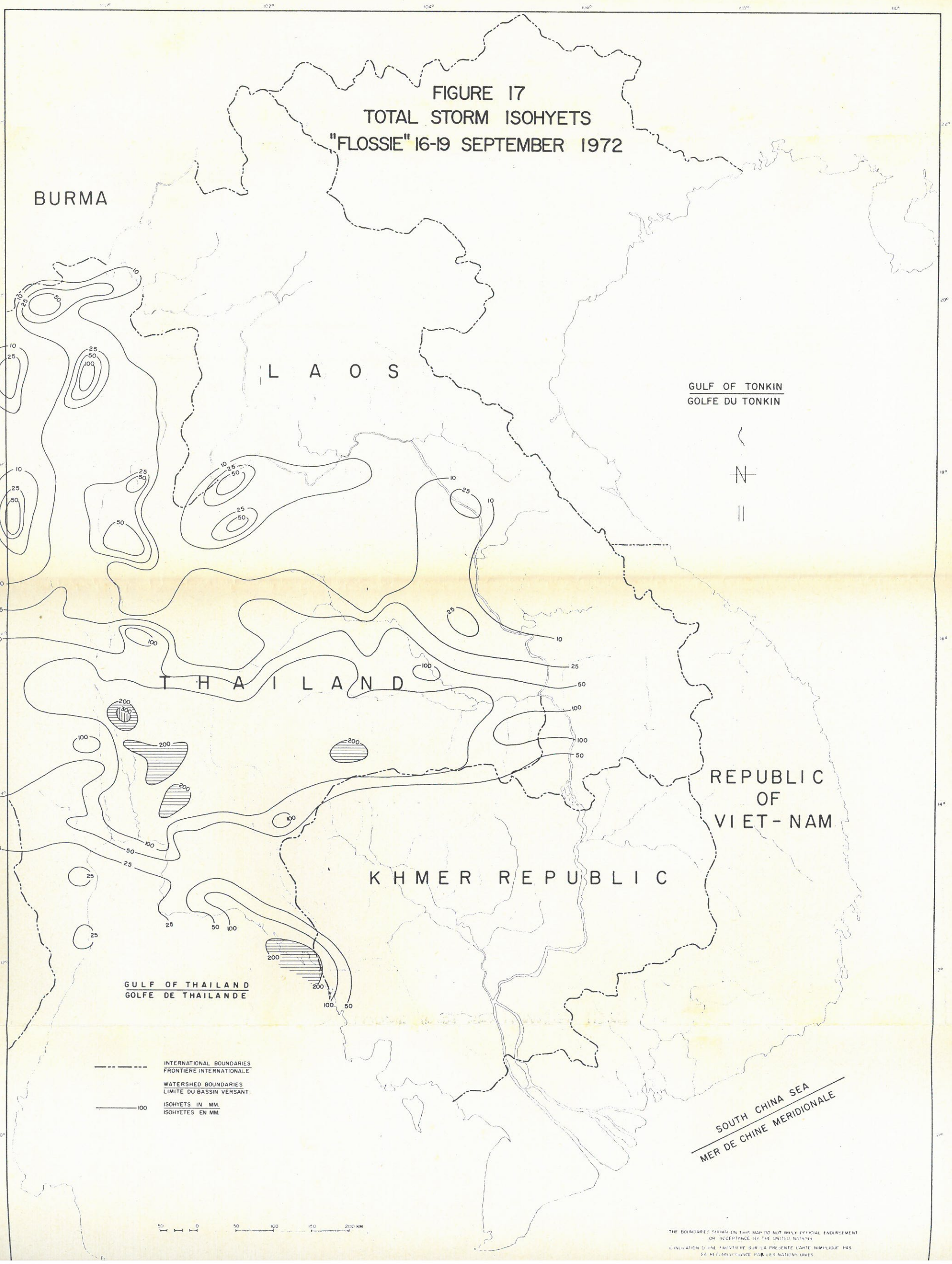
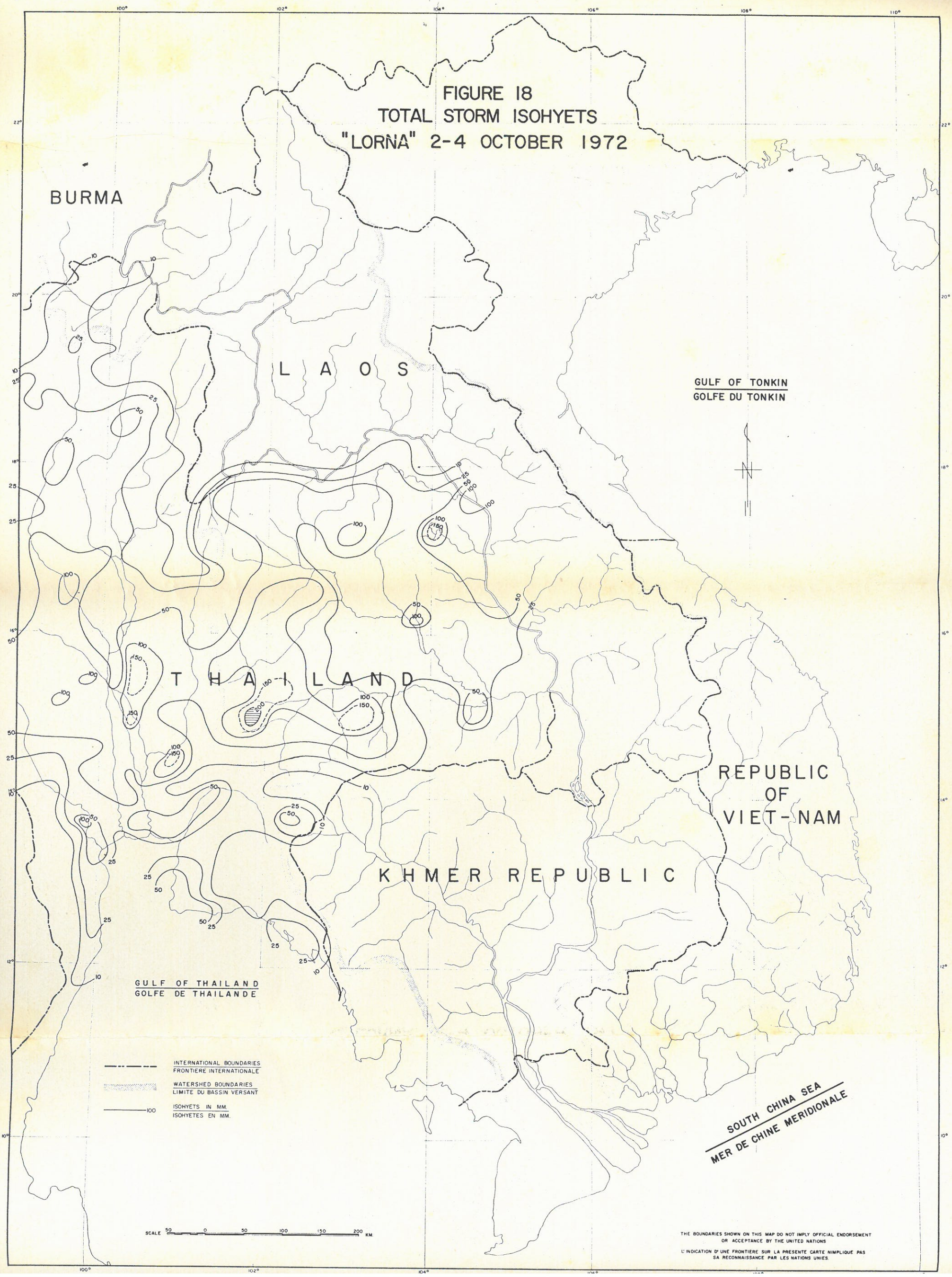
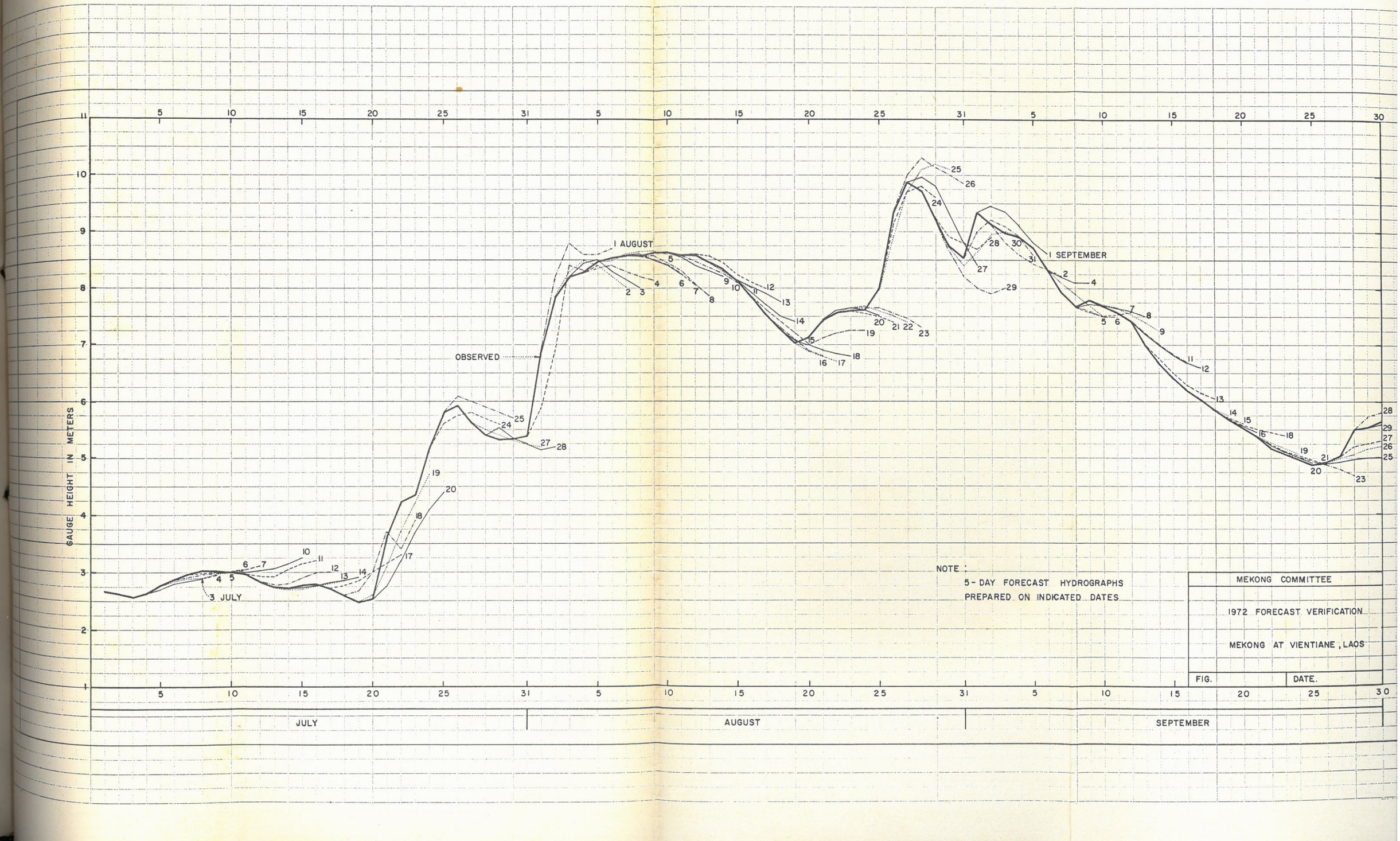


FIGURE 18
TOTAL STORM ISOHYETS
"LORNA" 2-4 OCTOBER 1972





NOTE :
5 - DAY FORECAST HYDROGRAPHS
PREPARED ON INDICATED DATES

MEKONG COMMITTEE

1972 FORECAST VERIFICATION

MEKONG AT VIENTIANE, LAOS

FIG. | DATE.

GAUGE HEIGHT IN METERS

JULY

AUGUST

SEPTEMBER

1 AUGUST

1 SEPTEMBER

3 JULY

NOTE :

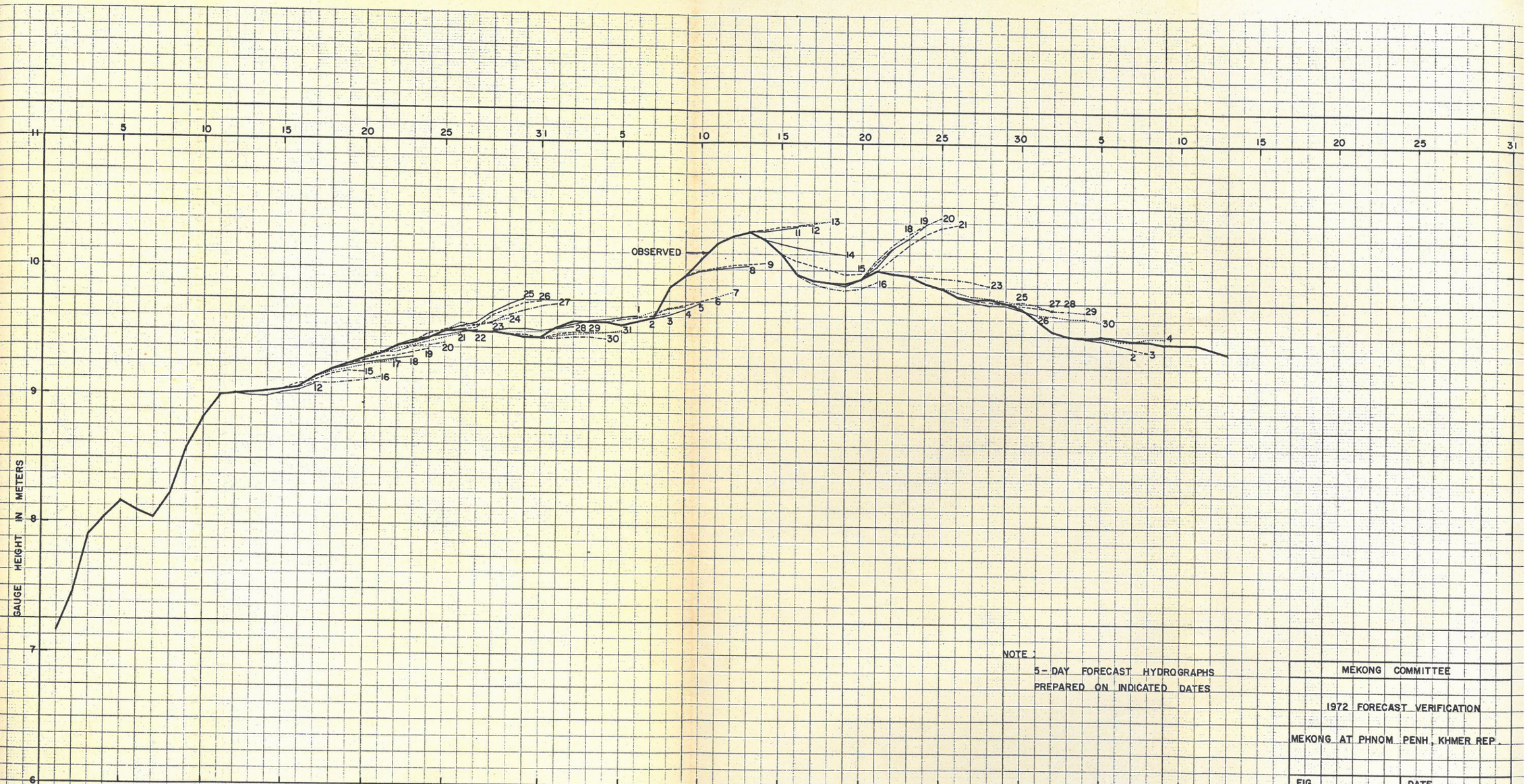
5 – DAY FORECAST HYDROGRAPHS
PREPARED ON INDICATED DATES

MEKONG COMMITTEE

1972 FORECAST VERIFICATION

MEKONG AT PAKSE, LAOS

FIG. | DATE.



NOTE :
5 - DAY FORECAST HYDROGRAPHS
PREPARED ON INDICATED DATES

MEKONG COMMITTEE

1972 FORECAST VERIFICATION

MEKONG AT PHNOM PENH, KHMER REP.

FIG. | DATE.

Annex 1

TEC 322(6-2) 8 June 1972

TO : All Professional Staff
Engineering Division

FROM : Louis A. Cohen, Acting Director
Engineering Division

SUBJECT: Organization, Functions and Staffing for Mekong Basinwide Flood Forecasting Unit - 1972.

Foreword

The Interim Basinwide Flood Forecasting System was initiated to start during the 1970 flood season on a trial basis and continued in 1971 as a result of the recommendations of the Expert Group on Flood Forecasting's Report in December 1969 and their approval by the Mekong Committee at its 45th Session (Plenary) held in Phnom Penh in February 1970. The Director of the Engineering Division is responsible for carrying out the flood forecasting programme.

Based on two years of increasingly successful efforts in this field, and following refinement of the computer programme, and greater use of weather satellite and radar data, the Mekong Committee has decided to embark upon an intensified though still experimental programme of flood forecasting during the 1972 flood season, starting on 15 June. Accordingly the following is provided to furnish an implementation framework for the organization, functions and staffing of the Flood Forecasting Unit within the Mekong Secretariat for 1972.

/Organization

Organization

Pending future establishment of a permanent River Forecast Center, the interim organization will continue to be referred to as the "Flood Forecasting Unit".

The Unit will be located organizationally in the Engineering Division and will be under the general supervisory control of the Director of that Division, who will in turn at his discretion - delegate responsibility for accomplishment of the necessary work.

Two special conditions pertain to the Unit which are unique by virtue of the manner of staffing and its method of operation:

(1) Staffing will be inter-disciplinary. Secondary support from other elements of the Mekong and ECAFE Secretariats is anticipated, but staffing of the Unit will be from the Hydrometeorological Staff and from the Planning Unit, personnel of which normally have other full-time duties.

(2) The Unit will function full-time only during the high flow period of the Mekong, mid-June through mid-October. (This will necessitate neglecting some other items in the Secretariat Work Programme, but improvement of the Mekong Basinwide Flood Forecasting System is believed to be of sufficient importance to justify this sacrifice.) But the Unit will necessarily function part-time during the preparatory and evaluating periods prior to and after the flood season.

/Functions

Functions

The Flood Forecasting Unit will again this year function as an integral part of an overall basinwide flood forecast team, other members being the designated representatives of responsible agencies of the four riparian countries. The Unit will be the central core of a co-ordinated and co-operative effort designed to provide, within the parameters of available data and techniques, reliable information about current and projected river conditions throughout the Lower Mekong Basin.

The primary function of the Flood Forecasting Unit will be to carry out the technical activities needed to prepare and disseminate day-to-day information and data on forecasts of river stage at selected locations along the Mekong and Bassac Rivers.

Activities such as personnel training, calibration of the mathematical models, extension of the hydrometeorological network, and installation and maintenance of measurement equipment may to some extent involve the Unit and its personnel; however, these are not functional responsibilities of the Flood Forecasting Unit, as such, and will be dealt with under separate programmes.

Staff Requirements and Responsibilities

Principal Staff Assigned to the Flood Forecasting Unit:

Assigned full-time

1 - Chief Hydrometeorologist (Mr. Surin Sangsnit), Head of Unit
1 - Hydrologist (Mr. Thaipuck Thammongkol), Deputy Head of Unit
1 - Systems Analysis Engineer (Mr. Pachern Sridurongkatum)

/Supporting

Supporting Staff part-time

1 - Hydrologist (on-call) (Mr. Damras Chongdarakul)

1 - Computer Monitor (Mr. Seubsak Srifar)

1 - Assistant Statistical Clerk (Miss Sripanga Anantasomboon)

In addition, the Chief of Planning Unit will be available to provide advice and assistance, as required.

Expert Advisory and Consultant Service

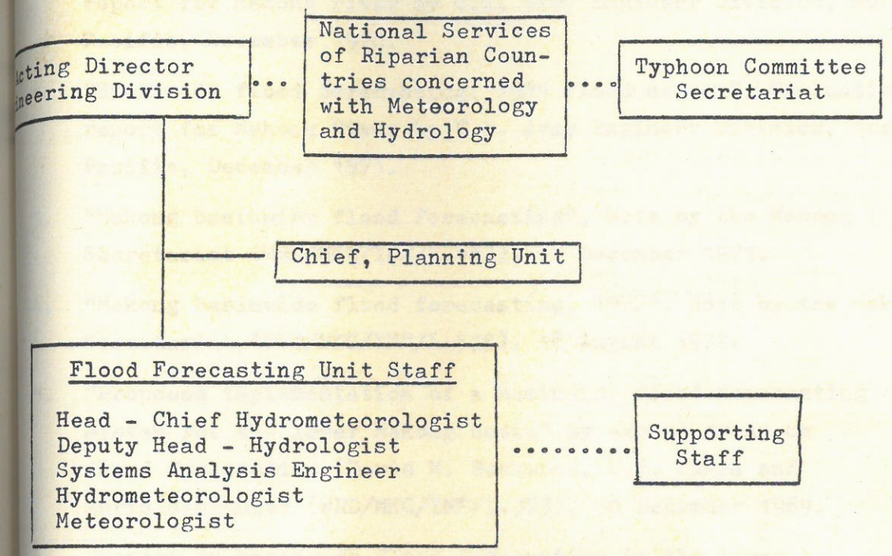
It is anticipated that the entire flood forecasting operation will be the subject of an evaluation, after the completion of the 1972 operation, by experts from the Portland River Forecast Center of the U.S. Corps of Engineers and the U.S. National Weather Service.

The Typhoon Committee Secretariat is located in Manila and carries on work related to the effect of typhoons, including warnings of floods resulting from typhoon. The Flood Forecasting Unit shall co-ordinate fully with the T C S through the Acting Director of the Engineering Division and the Head of the Flood Forecasting Unit.

The Flood Forecasting Unit shall also co-ordinate fully with the national services concerned with meteorology and hydrology of the four riparian countries.

/ORGANIZATION CHART

ORGANIZATION CHART



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