Tropical Cyclones and the Climate of Ceylon

Introduction

THE role of the monsoons has been so much over emphasised in respect of the climate of Ceylon, that other features basic to the island's weather have been paid less attention. The present writer has on previous occasions[1] attempted to bring out in some detail the main characteristics of the climate of this island. In these papers only passing references were made to the role of tropical cyclones in the total climatic theme. An attempt is therefore made here to analyse the significance of tropical cyclones in inducing typical weather situations in Ceylon.

There once prevailed the erroneous contention that the island of Ceylon was located "far too south" (close to the Equator) and hence was not influenced noticeably by tropical atmospheric disturbances. This attitude may be explained away in terms of the fact, that within the equatorial atmosphere there was least evidence of the operation of the coriolis force or otherwise known as the deflecting force. Vertical air movement dominates the equatorial atmosphere and hence all weather phenomena were attributed to be either convectional in origin or at other times due to the monsoons. However, in recent times it has been conceded that the weather of the North-east monsoon (NE monsoon) period i.e., between December and February, is markedly influenced by cyclonic activity. It also came to be evident that during October and November, the normal convectional weather theme was strongly modified by definite cyclonic activity. But there has been little evidence to suggest that cyclonic activity does at times influence South-west monsoonal (SW monsoonal) weather. If such activity occurs during the SW monsoonal weather proper, the main influence seems to be an accentuation of such weather. On the other hand, cyclonic activity during the end-phase of the SW monsoon, may bring about a reestablishment of such weather even in October. This was brought out in an earlie paper[2] with reference to the weather in the University Park. To the layman, it is of real significance that disastrous floods in the island may be traced to

1. THAMBYAHPILLAY, G.—*The Climates of Ceylon.* (M.A. Thesis: University of California, 1952), p. 258 "The Rainfall Rhythm in Ceylon," *University of Ceylon Review*, vol. xii, No. 4, (October, 1954), pp. 224—273.

2. THAMBYAHPILLAY, G.—"The Rainfall Rhythm:....*op. cit.*, p. 260.

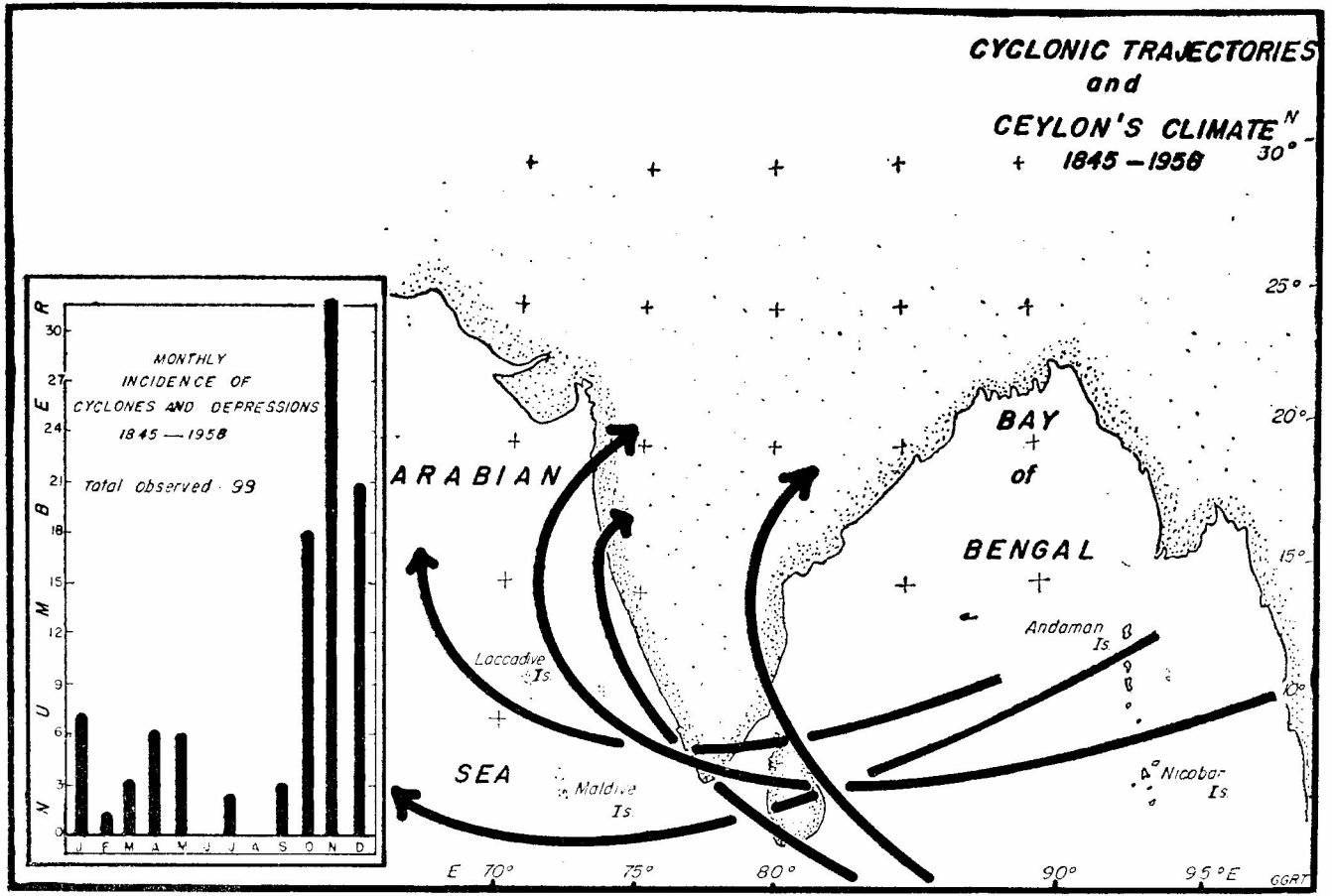

FIG. 1—Generalized trajectories of cyclones and depressions strongly influencing Ceylon's climate between the period 1845 to 1958. Inset shows monthly incidence of cyclones and depressions over Ceylon between 1845 and 1958.

the incidence of cyclonic activity. Atmospheric disturbances of this type, may be felt either as weak low pressure waves, mild depressions or as severe cyclones.

It may be pointed out here, that there is real difficulty in the forecasting of such phenomena well ahead in the tropics, because very often most of these incipient cyclonic systems do not mature. An examination of synoptic charts prepared for most months, would show the existence of such low pressure waves which are potential cyclones. Many of them dissipate or "die off" by the time they reach the southern Bay of Bengal. Some of them, may even approach the island to within a few hundred miles of the eastern coast of Ceylon and move north or northwest towards the Indian coast without moving across the island. Some of them on the other hand, may approach close to the island as weak depressions and within twenty-four hours may intensify into cyclones and change direction of travel and thus, may actually traverse the island causing untold misery in the form of floods and gales. Such fickle behaviour of tropical cyclones, often inhibits the forecasting of an imminent cyclone reaching our shores. Furthermore, in the tropics and particularly in an island of such small dimension as Ceylon with no weather ships positioned east of the island in the Bay of Bengal, there is insufficient data forthcoming to facilitate the plotting of 'cyclonic storms' on the synoptic chart. In this connection the allegation is often made that if temperate cyclones could be forecast at least 72 to 48 hours ahead, why it is not possible for the Ceylon Meteorological Department to forecast cyclones approaching the island. This is but a layman's standpoint and it is least realized that fundamentally the circumstances, relating to the formation of these two atmospheric phenomena are not truly similar.

It must also be pointed out here, that the meteorological *modus operandi* responsible for tropical cyclogenesis, is yet in a controversial stage and research is in progress in an attempt to provide a completely satisfactory hypothesis.

Terminology

There seems to prevail much confusion in respect of the terminology employed, in discussions on tropical weather 'disturbances.' Terms that have been used to describe these phenomena have ranged through "depressions," "cyclones," "typhoons," "hurricanes," "low pressure centres," "low pressure waves" and simply "storms." In view of the variety of 'storms' that have been observed within the tropical atmosphere, American

meteorologists have tended to designate all such " disturbances " as *Tropical Storms*. Yet other meteorologists have attempted to be more precise and hence the adoption of the term, *Tropical Revolving Storms*. The latter term is widely accepted, since it does with certainty refer to storms exemplifying revolutionary motion and which are confined to the tropical atmosphere.

It is paradoxical that today, the term, ' cyclone,' is associated with atmospheric storms that persist in the mid-latitudes, though this very term was first suggested by Piddington in respect of the storms of the Bay of Bengal. It is truly within the tropics, that storms do exhibit that characteristic of being ' cyclonic.' In some modern textbooks on meteorology and climatology, distinction is often made between temperate (mid-latitude) and tropical cyclones. It is also observed, that often reference is made to cyclonic (low pressure) and anti-cyclonic (high pressure) systems, with special connotation in respect of the mid-latitude atmosphere. It is unfortunate that despite the long period that has elapsed since the acceptance of the frontal hypothesis, mid-latitude ' storms ' continue to be designated ' cyclones.'

In tropical meteorology, the term ' cyclone ' is employed with reference to a ' storm ' of a revolving type, that is to be observed in a specified locality. Thus similar revolving storms are designated in respect to their geographical areas of occurrence. Hence :—

CYCLONE : N. Indian Ocean, Bay of Bengal, Arabian Sea.
TYPHOON : W. Pacific Ocean, China Sea, Sea of Japan.
HURRICANE : E. Pacific Ocean, Atlantic Ocean, Caribbean Sea, Gulf of Mexico, S. Indian Ocean.

More localized terms : Baguois : Philippines.
Willy-Willy : Australia.
Tuffoon : East Indies, China Coast.
Lyfoonge : China Sea.
Aracan, Huiranvucan : Mexican Coast.
Vuthan : Patagonia.

It will therefore, be noted that there is no confusion in the use of the afore-mentioned terms, since they mean the one and the same meteorological phenomenon in the tropics. However, there is yet confusion with regard to the proper use of the terms, ' cyclone ' and ' depression.' From the

strictly meteorological standpoint, the latter term refers to the barometric depression or a fall in pressure and hence when applied to an atmospheric phenomenon, clearly distinguishes a low pressure centred storm. Thus, any clearly defined low pressure area that could be distinguished on a synoptic chart, may be designated a depression. In the description of tropical storms, reference is often made to 'a depression intensified into a cyclone.' One may hence suggest here, that a 'cyclone' is definitely an intensified 'depression'; the original 'depression' having exhibited increasing isobaric gradients with consequent strengthening of winds to gale force, matures to be qualified to be designated a 'cyclone.' It may be here pointed out that such a 'cyclone' exhibits no frontal surfaces and is therefore, clearly distinct from its mid-latitude counterpart with definite frontal surfaces. In the present paper therefore, a 'depression' and a 'cyclone' are distinguished and referred to, in respect of the degree of barometric intensity. There has been also reference made in this paper, to 'low pressure wave' and 'low pressure centre,' both of which are but incipient and potential depressions, and therefore may or may not develop to maturity. Such phenomena are characterised by gentle barometric gradients, not steep enough to be designated depressions. When the isobars are closed it is designated a 'low pressure centre' and when open a 'wave' within the Trades.

Hypotheses of Tropical Cyclone Genesis

There have been a number of hypotheses postulated to provide explanations for the genesis of tropical cyclones and related phenomena. Despite the still prevailing controversy in this connection, there are available at least four hypotheses that in particular respects seem to be acceptable.

1. *The Thermal Convectional Hypothesis* : This is the classical thermodynamic (convective) hypothesis and invokes the simple requirement of thunderstorm development by thermal convection ; a large number of thunderstorms and rain-squalls would provide rain-clouds, which by coalescence would 'grow.' It is suggested that eventually a cyclonic circulation is initiated at the ground because of convergence ; this would however, be possible only if such convergence takes place sufficiently far from the equator. This hypothesis, while it provides for the required tremendous energy to maintain the cyclonic circulation, suffers from certain inherent inconsistencies. No starting mechanism is offered ; it does not explain the pressure fall, for the postulated convergence can only lead to pressure rise at the surface. Furthermore, this hypothesis does not explain how mass removal

of air takes place aloft, for convectional air movement must necessarily continue so as to maintain the system. It is also known that often, such tropical disturbances producing marked weather deterioration are not truly 'cyclonic.' Thus, while convection is basic for the generation of tropical cyclones, it does not in itself provide the total mechanism.

2. *The Frontal Hypothesis* : This hypothesis represents a more probable *modus operandi* for the genesis of tropical cyclones. Ever since the frontal hypothesis, propounded by the Norwegian School of Meteorologists, had come to be accepted as a satisfactory explanation of the mid-latitude (temperate) cyclone, the attempt has been made to apply it to the genesis of the tropical counterpart. Thus, in 1921 such an attempt was made substituting the convergence zone of the Trades for the polar-front of the mid-latitude cyclogenesis.[3] This theory, invokes the existence of shearing waves along inclined density discontinuities (fronts) between the Trades of the relatively warmer and colder hemispheres. Thus, this hypothesis at least provides a starting mechanism with a satisfactory energy source. The main objection to this hypothesis is that, while in some observed instances there has been cyclone generation along a 'front', in numerous instances the situation is contrary, namely that cyclones have developed without any evidence of frontogenesis. Some meteorologists have in their enthusiasm suggested a triple-point origin[4] based on three air-masses. Here again, in many instances during cyclogenesis, no such air-mass interaction was found to take place. Furthermore, it has also been observed that the fundamental difference between deepening cyclones in high and low latitudes is, that air entering the orbit of the latter ascends in the core, while outside the tropics the polar air sinks in disturbances and only tropical air rises. Therefore, the entry of polar air in respect of cyclogenesis must necessarily inhibit the deepening of an incipient cyclone.

3. *The Dynamic Instability Hypothesis :* This was suggested by Sawyer[5] invoking pressure gradient to maintain certain flow patterns in the upper atmosphere. In a paper in 1949 Sawyer himself expressed some of the shortcomings of his theory.[6] This hypothesis needs no serious comment since it does incorporate certain unproven assumptions, too involved to be discussed in this paper.

3. BROOKS, C. E. P. AND H. W. BRABY,—" The Clash of the Trades in the Pacific, " *Quart. J. R. Met. Soc.*, vol. 47 (1921), pp. 1—13.

4. PACK, S. W. C.—*Weather Forecasting*, London : Longmans Green (1948).

5. SAWYER, J. S.—" Notes on the Theory of Tropical Cyclones," *Quart. J. R.Met. Soc.*, vol. 73 (1947), pp. 101—126.

6. SAWYER, J. S.—" The Significance of Dynamic Instability in Atmospheric Motions," *Quart. J. R. Met. Soc.*, vol. 75 (1949), pp. 364—375.

4. *The 'Waves in a Baroclinic Easterly Current' Hypothesis :* In this hypothesis there are invoked certain external circumstances aloft to produce the initial divergence. A basic easterly current increasing with height, with temperature warmer on the poleward than on the equatorial side of the current, would aid in the development of divergence which would facilitate cyclogenesis.

While all these theories have been shown to possess certain inherent shortcomings so as to be unable to satisfy all conditions of tropical cyclogenesis, they nevertheless have provided some of the answers. It was pointed out that convection is basic to tropical cyclogenesis. Similarly, the points suggested in the other theories also have been observed in some, if not in all tropical cyclones.

An attempt will now be made to analyse in some detail, the more important tropical depressions and cyclones, that have either traversed or reached the island's environs close enough to have had noticeable effect on Ceylon's weather. In the light of the analyses, certain conclusions will be arrived at, in respect of seasonal incidence, characteristics and of the circumstances that led to cyclogenesis.

Some of the Important Depressions and Cyclones (Storms) Affecting the Weather and Climate of Ceylon : 1845 - 1958.

The data pertaining to the depressions, cyclones and 'storms' considered here, have been compiled from a number of sources listed below :—

1. *General*

Journal of the Asiatic society of Bengal (1842-1890).

India Meteorological Memoirs, Part VI, Vol. II : 1877-1881 (1886)—H. F. Blanford.

India Meteorological Memoirs, Part IV, Vol. IV : 1882-1886 (1887)—J. Eliot.

Weather Charts of the Bay of Bengal and the adjacent seas north of the Equator : 1855-1878 (1886)—J. F. Blanford.

Weather Charts of the Arabian Sea and the adjacent portion of the North Indian Ocean : 1855-1878 (1888)—J. Eliot.

A Practical Guide to the Climates and Weather of India, Ceylon and Burma and the Storms of Indian Seas (1889)—H. F. Blanford.

Cyclone Memoirs, Vols. I-V (1890-1893)—J. Eliot.

Handbook of Cyclonic Storms in the Bay of Bengal, Vol. I, and Vol. II (1900)—J. Eliot.
Annual Report of the Director, Kodaikanal and Madras Observatories (1904-1955).
Climatological Atlas of India (1906)—J. Eliot.
The Imperial Gazeteer of India, Vol. I, (1907)—Hemraj.
Memoirs of the Indian Meteorological Department, Vols. XXIV and XXVI (1921-1939).
Indian Journal of Meteorology and Geophysics, Vols. I (1950) to IX (1958).

2. *Ceylon*
Sessional Papers : 1873-1931 (Government of Ceylon).
Ceylon Journal of Science (Section E) : Bulletins of the Colombo Observatory (Vol. I : 1926 and Vol. II : 1936).
Reports on the Colombo Observatory (1925-1957), Department of Meteorology, Ceylon.
Manuscript Records (1869-1924) at the Colombo Observatory, Department of Meteorology, Ceylon.

Trajectory, main characteristics and noteworthy effects on the weather of the island of Ceylon

Date

1845: November 29th—December 5th. The cyclone was first observed in the Bay of Bengal northeast of Ceylon ; the centre passed over Batticaloa affecting the weather (heavy rain) along the north-eastern coast between Jaffna and Batticaloa. Rapidly passing over the island, the cyclone appeared over Cape Comorin and appeared to ' dissipate ' on the 5th of December over the Laccadive Islands about 13 °N 60 °E. (Figure 9)

1847: April 14th—18th. This ' storm ' reaching hurricane force, appeared to have originated close to the Equator and travelled northwards in the Arabian Sea. According to Thom, " the circular direction of the storm could be traced over an extensive tract of sea and land, including the island of Ceylon.... the tempestuous part of the hurricane was more than 200 miles around its centre but winds affected a much larger area." This ' storm ' appearing off the west coast of Ceylon certainly produced heavy rain, as it moved north along the coast towards Cape Comorin. The Laccadive Islands were completely inundated and the H. M. *Cleopatra* with fifty lives on board was lost.

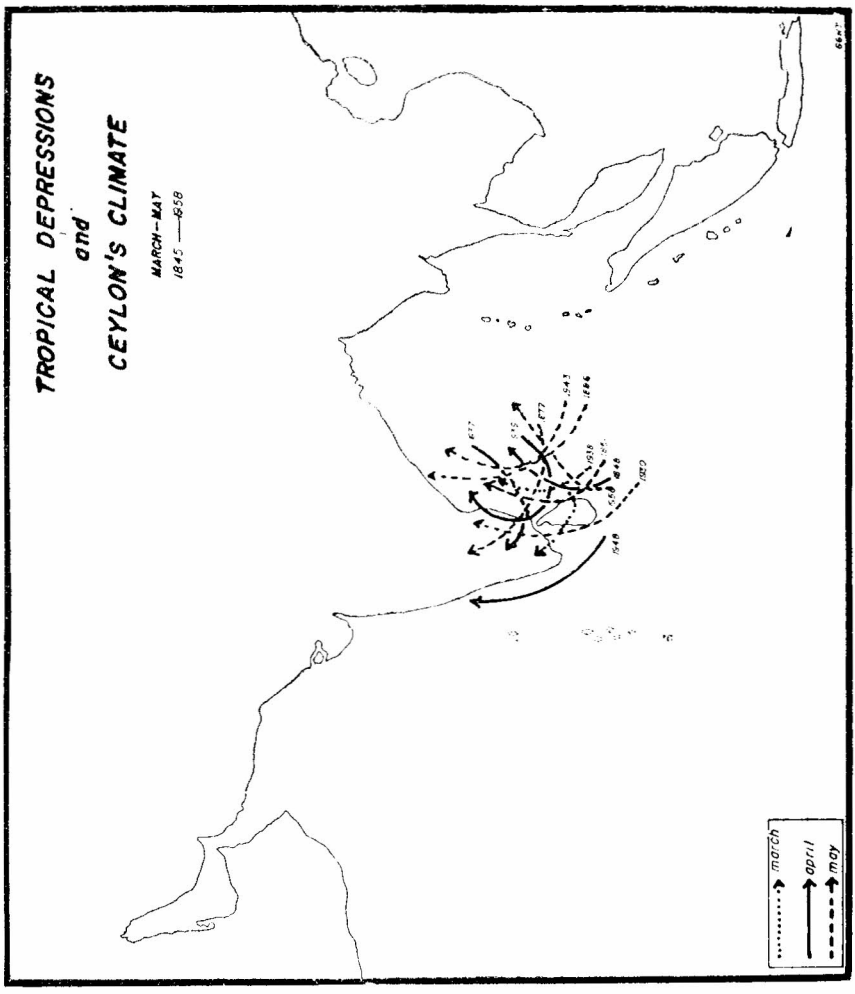

FIG. 2—Trajectories of the more important cyclones and depressions affecting the climate of Ceylon during the convectional-convergence weather period (March-May) between 1845 and 1958.

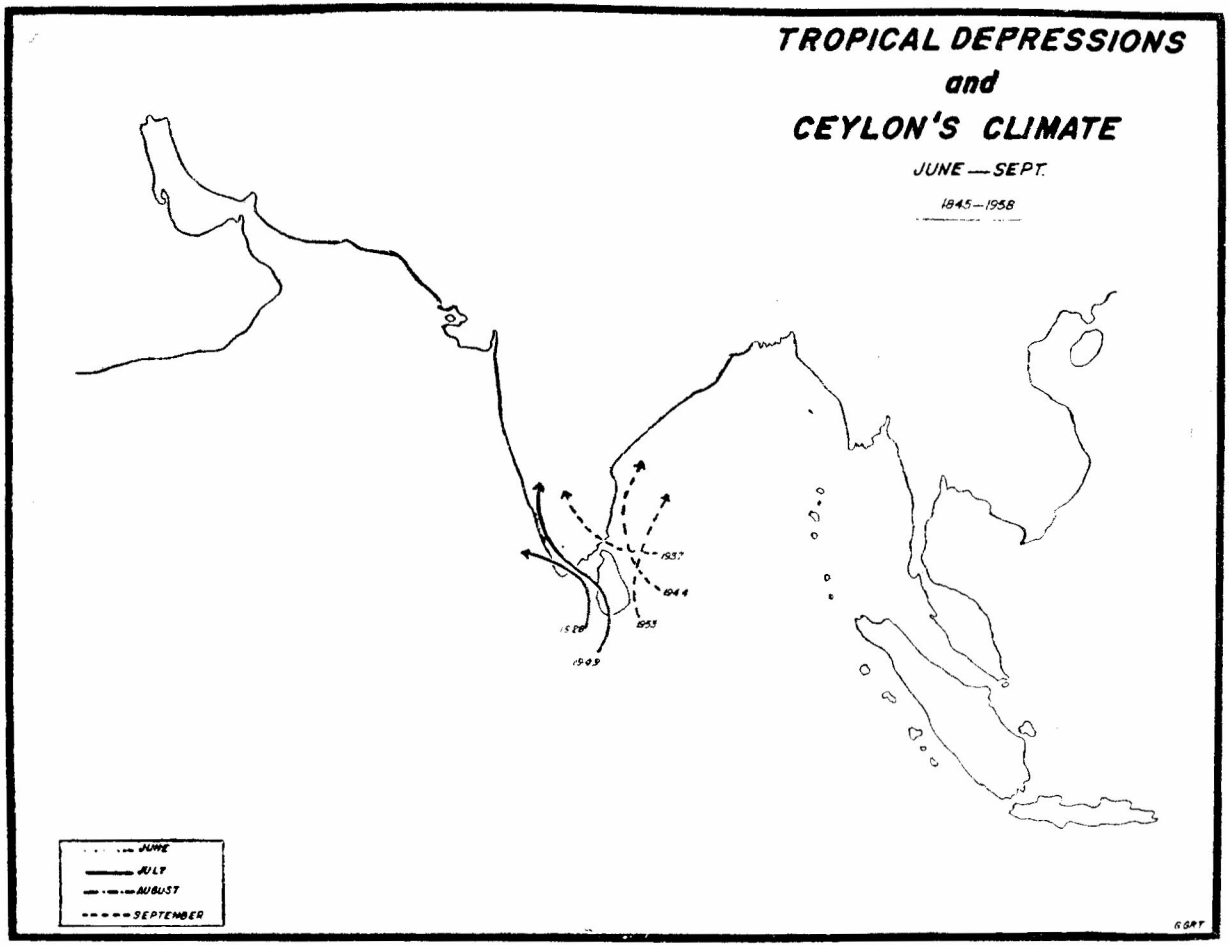

FIG. 3—Trajectories of the more important cyclones and depressions affecting the climate of Ceylon during the SW monsoonal weather period (June-September) between 1845 and 1958.

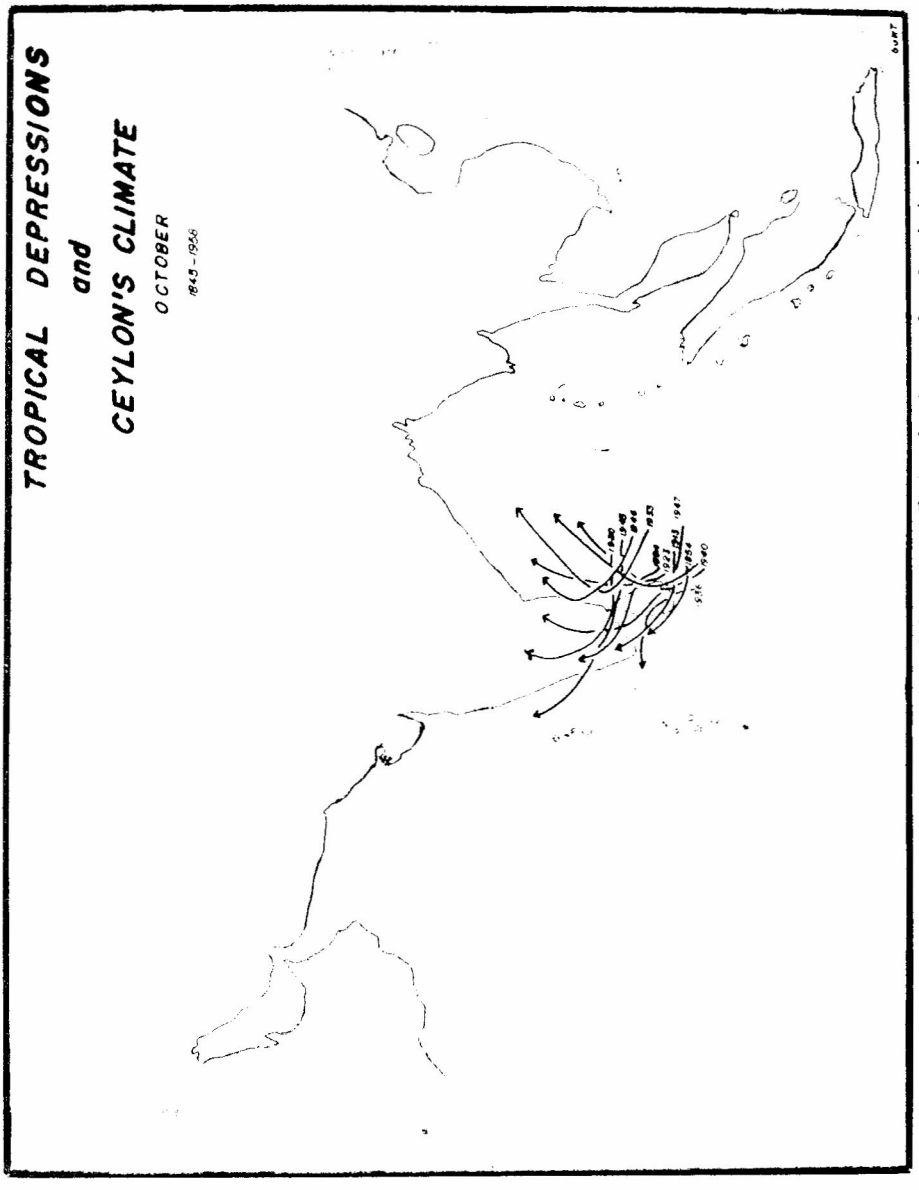

FIG. 4—Trajectories of the more important cyclones and depressions affecting the climate of Ceylon during the convergence-convectional-cyclonic weather period (October) between 1845 and 1958.

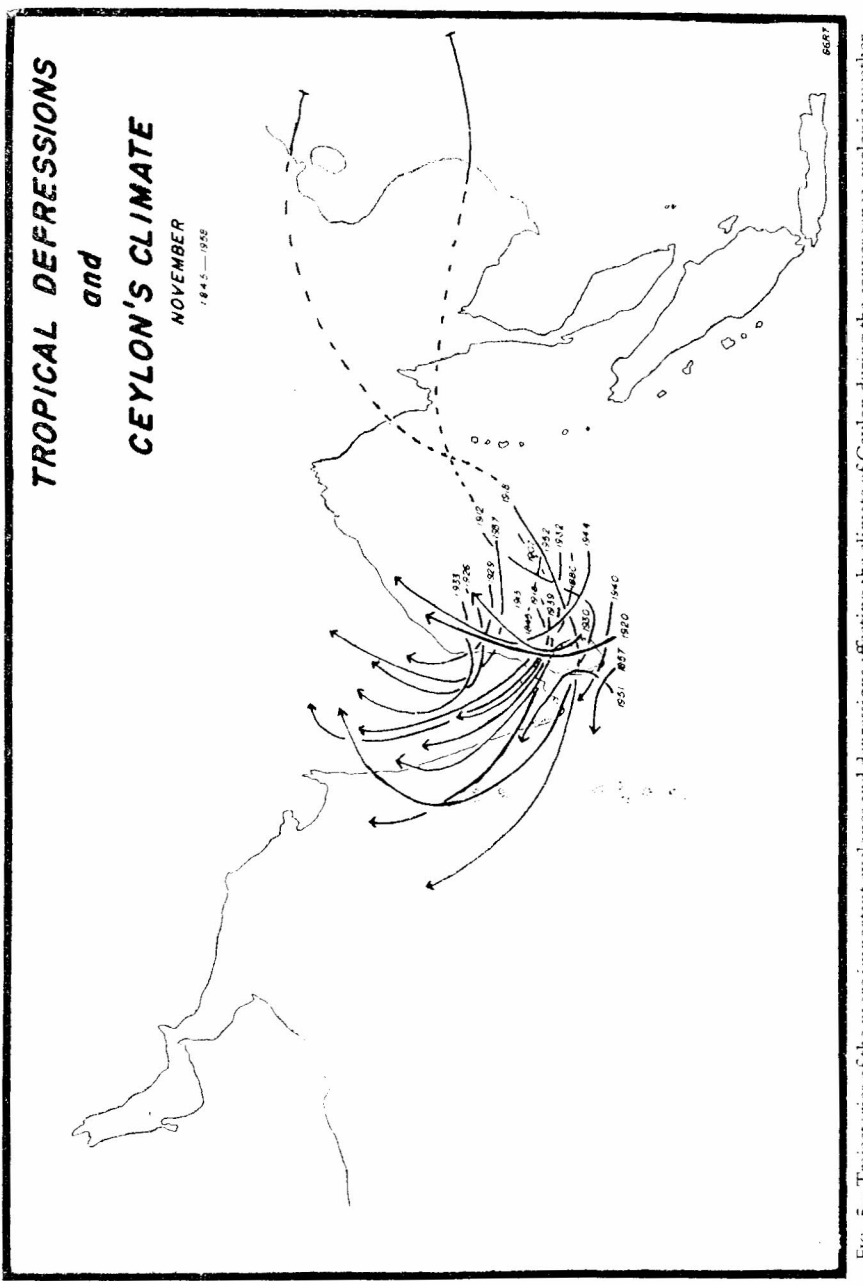

FIG. 5—Trajectories of the more important cyclones and depressions affecting the climate of Ceylon during the convergence-cyclonic weather period (November) between 1845 and 1958.

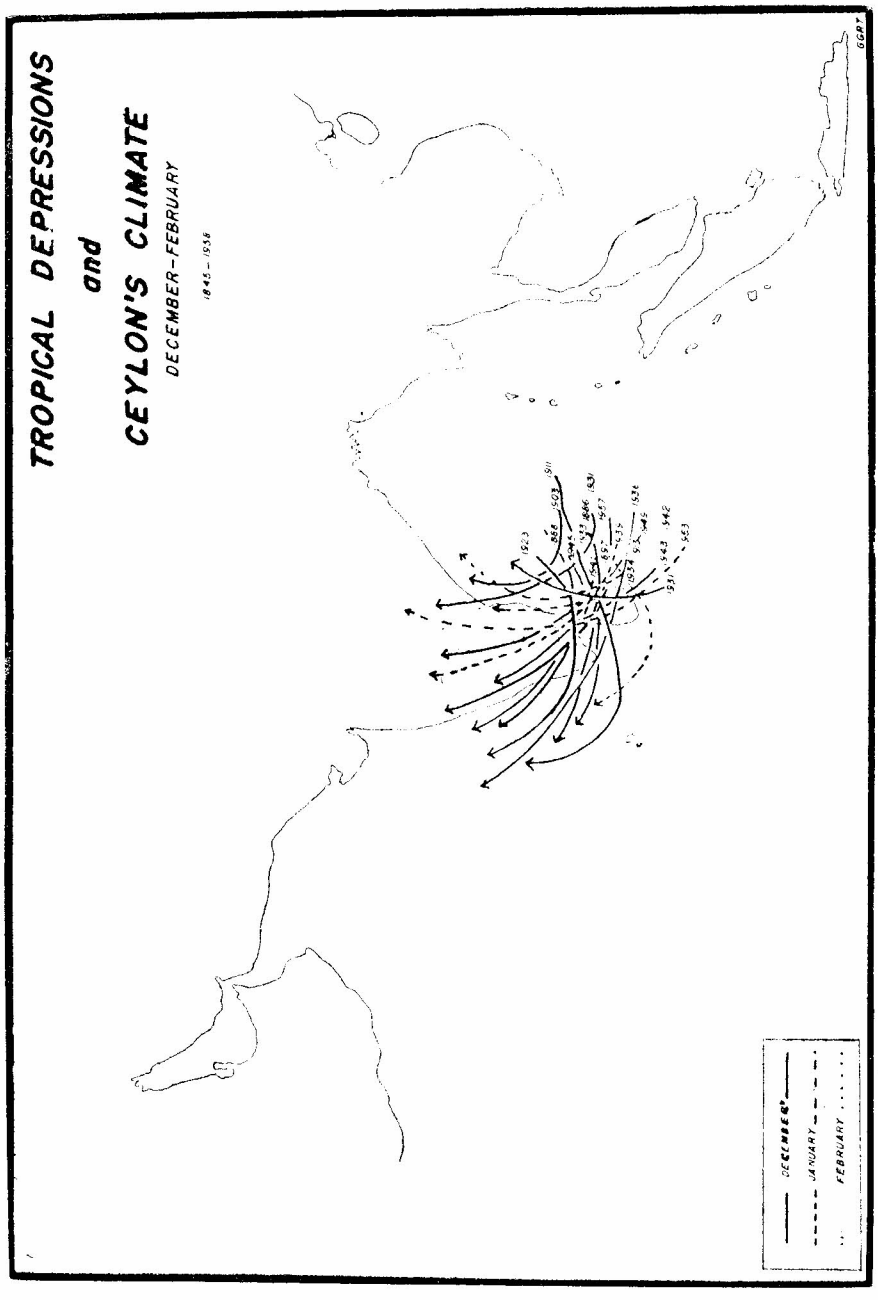

FIG. 6—Trajectories of the more important cyclones and depressions affecting the climate of Ceylon during the NE monsoonal weather period (December-February) between 1845 and 1958.

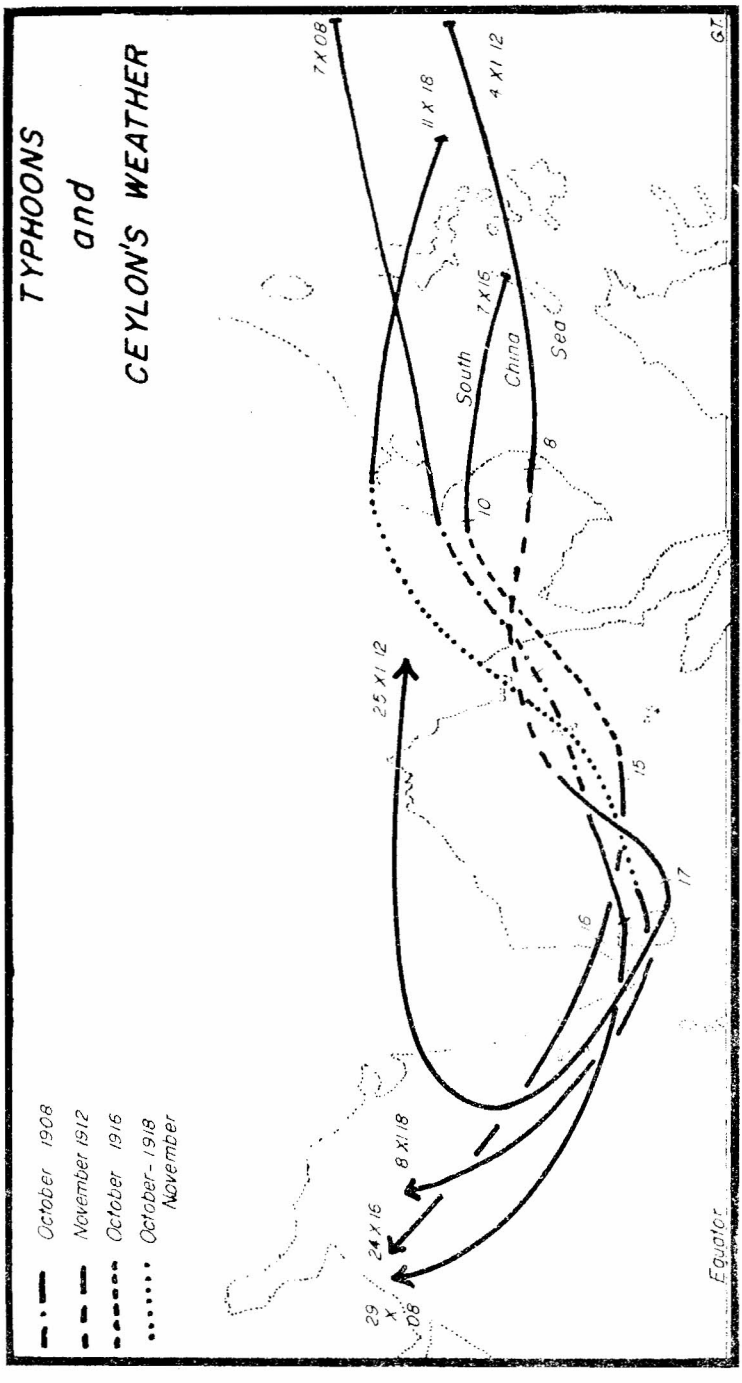

FIG. 7.—Trajectories of four typhoons originating in the China Sea and regenerated in the east Bay of Bengal, reaching Ceylon as true cyclones to strongly influence the pre-NE monsoon and NE monsoonal weather.

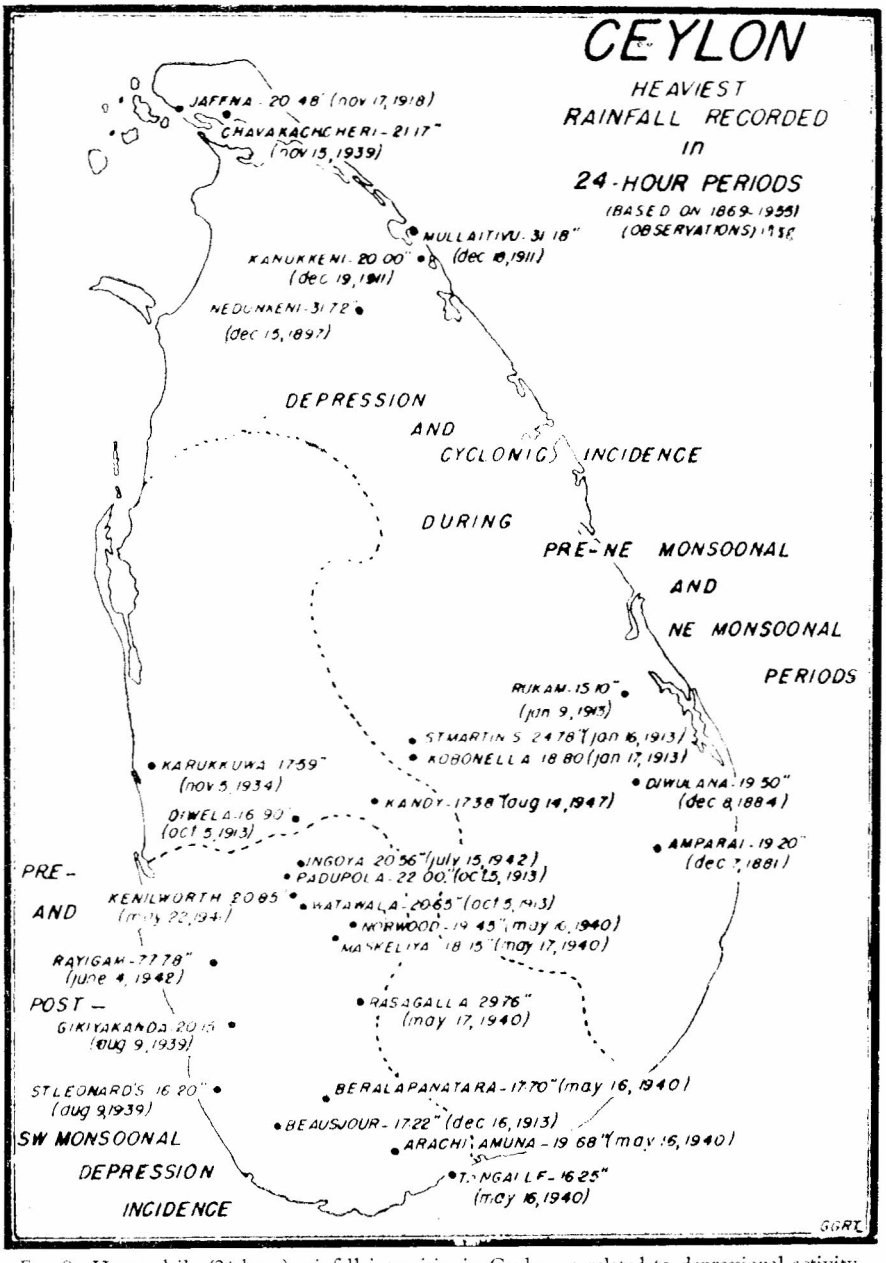

FIG. 8—Heavy daily (24-hour) rainfall intensities in Ceylon as related to depressional activity during the pre- and post-SW monsoonal periods and during the pre-NE monsoonal and NE monsoonal periods. Records based on observations between 1869 and 1958 (inclusive).

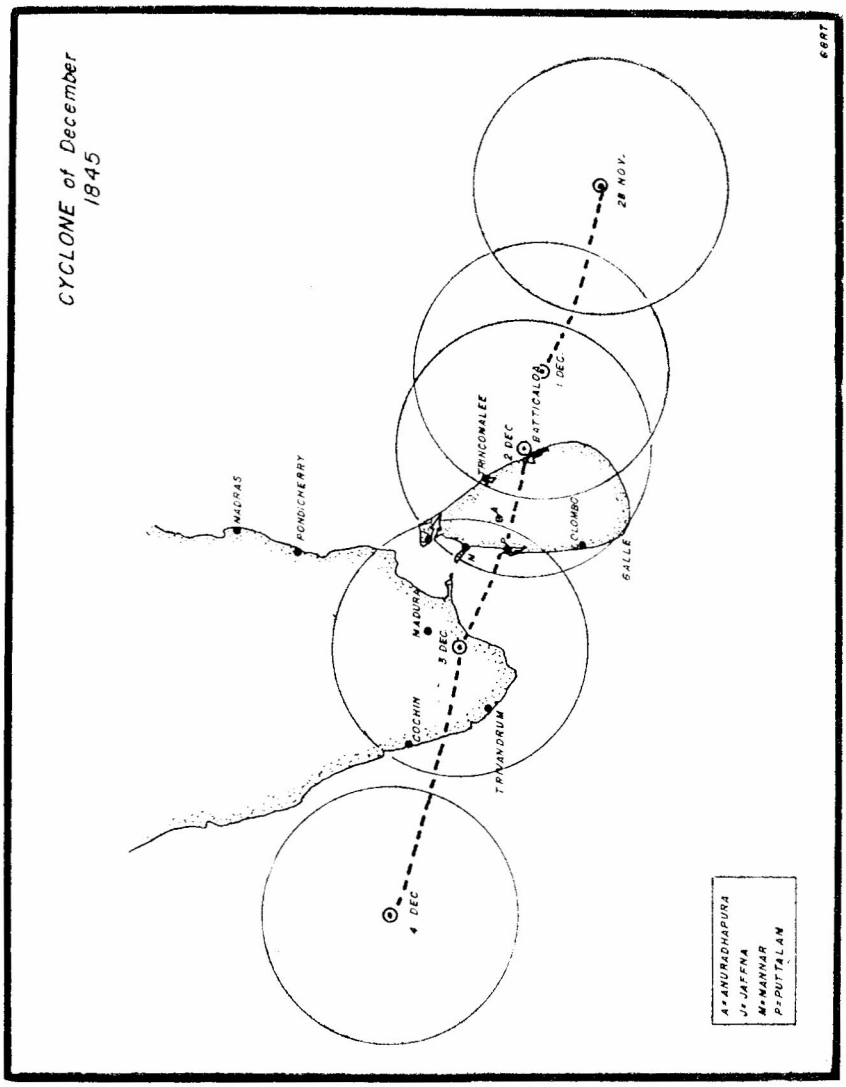

FIG. 9—A detailed representation of the 'track' of the Cyclone of December 1845 (November 28th–December 5th) —the earliest record of a cyclone that affected the weather of Ceylon.

1848: April 23rd. A violent hurricane appearing off the east coast of the island caused heavy rain. No further details known.

1851: May 1st—6th. This furious hurricane raged also off the east cost of Ceylon reaching the Madras coast and finally crossed the Peninsula and ' dissipated.' Heavy rain mainly in the northeast of the island.

1854: October 6th. Another hurricane off the southern coast of Ceylon Apart from affecting the immediate coast this hurricane does not appear to have reached the Indian mainland. It was an unusual period of the year for a ' storm ' to appear off the southern coast.

1857: November 20th. This hurricane, first observed off the west coast of Ceylon, caused heavy rain along the coast and its centre was observed to pass over Nellore (in southern India) on the 21st.

1877: May 14th—22nd. This cyclone was initially observed as a depression in the southern Bay of Bengal, about a hundred miles northeast of Ceylon. (This was one of the most violent cyclones experienced in the southern Bay and came to be known as the Madras Cyclone.) It then moved towards the Madras coast, intensifying in the process and reached Madras in its full fury. In India it was finally responsible for the disastrous famine, while in Ceylon heavy rainfall occurred throughout the island.

1880: November 21st—23rd. This depression first appeared in the southern Bay of Bengal northeast of Trincomalee on the 21st. It rapidly moved northwestwards to strike the Negapatam coast in full strength on the 23rd. The northeastern coastal tract of Ceylon experienced moderate rain.

1881: November 10th—13th. This was a small ' storm ' that was well-defined off the northern coast of Ceylon and advanced westwards towards the Madras coast. Heavy rainfall was experienced in northeast Ceylon but no extraordinary weather effects were felt in Madras.

1881: December 7th. A depression off the eastern coast of Ceylon caused heavy rain in the Gal Oya area (Amparai : 19.20 inches : Fig. 8).

1884: October 15th—18th. This was a small ' storm ' which formed in the Bay of Bengal northeast of Ceylon, on the 15th and moved west

to cross the south Indian coast on the 17th morning. On the 15th, the weather over Ceylon was markedly squally, and heavy rain was experienced in the Jaffna peninsula. The storm lost its distinctness over the Arabian Sea by the 17th evening.

1884: December 8th. A mild depression off the east coast of Ceylon causing local intensification of NE monsoonal rainfall (Diwulana : 19.50 inches; Fig. 8).

1884: December 12th—19th. This cyclone originated as a mild depression about 83°E 30°N in the southern Bay of Bengal east of Trincomalee on the 12th. It gradually intensified and moved northwestward to reach the Negapatam coast on the 18th morning ; it then moved across the peninsula. Heavy rain was experienced in the north of Ceylon and throughout the peninsula.

1886: May 22nd—24th. This ' storm ' originated as a feeble low about 10° 30'N 84°E on the 22nd and moving WNW gradually intensified and eventually struck the coast south of Negapatam in south India. There was heavy rainfall along the eastern coast of Ceylon and in the southern peninsula.

1886: December 7th—9th. This depression centred in the south Bay of Bengal (about 9°N) on the 7th, moved northwestwards to reach the coast north of Madras on the 9th evening. Though no appreciable rainfall occurred in Ceylon, the weather was slightly influenced.

1888: December 12th—15th. The depression off northeastern Ceylon was responsible for some rain in the Jaffna peninsula.

1897: December 14th—16th. A fairly strong depression originated in the south Bay of Bengal and on the 14th was located northeast of Ceylon. The depression moved across the Island on the 15th to produce heavy rain along its path (Nedunkeni: 31.72 inches; Fig. 8) and in the north and eastern parts of Ceylon.

1903: December 27th—29th. This depression accentuated the NE monsoonal rainfall, particularly in the northern part of the Island.

1907: May 9th—10th. A very severe cyclone struck the southeastern coast of Ceylon, particularly around Batticaloa. The cyclone appeared to

have travelled along the eastern coast causing tidal waves and gale force winds causing great damage. The rainfall was however, not very heavy when compared to rainfall resulting from less violent 'storms.'

1907: November 9th—12th. A low pressure centre in the southern Bay of Bengal intensified into a depression, causing fairly moderate rainfall in the northern part of the island. The NE monsoonal rainfall was thus accentuated.

1907: December 15th—16th. A 'storm' from the Bay of Bengal traversed the northern half of Ceylon causing fairly heavy rainfall on the 15th. (Kalawewa: 15.02 inches, Maha Illupallama: 14.80 inches and Maradankadawela: 13.71 inches). A great portion of the North-Central Province was flooded, consequent upon the damage to a number of irrigation tanks.

1908: October 22nd—27th. A depression centred off the Andaman Islands about the 20th, intensified into a 'storm' and on the 22nd traversed the northern part of the island; it was eventually traced to dissipate itself on the 29th off the coast of Arabia. Subsequent investigation revealed this to be a typhoon from the China Sea that was regenerated in the Bay of Bengal (Fig. 7). Weather in the northern half of Ceylon deteriorated during the passage of the 'storm.'

1911: December 18th—20th. A severe cyclone from the Bay of Bengal crossed the island in the north causing very heavy rainfall in the northern part of Ceylon on the 18th and the 19th (Mullaitivu: 31.18 inches, Kanukkeni: 20.00 inches, Kilinochchi: 12.28 inches and Mankulam: 10.95 inches; Fig. 8).

1912: November 16th—22nd. A mild depression traversed the island in a SSE/NNW direction but not causing abnormality in the usual weather of the month. On the 19th the depression was located over Ceylon (Fig. 7).

1912: December 15th—18th. A well-defined cyclone approached the coast on the 16th (after having been observed as a low pressure centre on the 15th) from the Bay of Bengal and traversing the island from the southeast to northwest, had moved into the Arabian Sea on the 18th morning. Heavy rainfall fell over a greater part of Ceylon, though the amounts for 24-hour periods were not comparable to previous record-falls. On the 19th morning the cyclone had definitely 'filled up.'

1913: January 9th—17th. This depression seemed to have accentuated the NE monsoonal rainfall and caused abnormal excess-falls almost everywhere. Out of the 239 stations, no less than 200 stations recorded rainfall greater than that experienced in any previous January. Mostly all the eastern coastal and inland stations recorded the highest monthly rainfall recorded up to that year. (St. Martin's Rangala: 24.78 inches on the 16th; Kobonella: 18.80 inches on the 17th and Rukam: 15.10 inches on the 9th. Fig. 8).

1913: October 5th—6th. A small 'storm' was responsible for heavy rainfall on these two days in the west and south of the island. (Padupola: 22.00; Watawala: 20.65 inches; Ingoya: 20.56 inches and Diwela: 15.90 inches., all being recorded on the 5th. Fig. 8).

1913: November 7th—11th. This small cyclone brushed the northeastern shoulder of the island on the 7th, after having originated in the southern Bay of Bengal on the 6th; it did not cause much deterioration in the weather of the island except in Jaffna (9.64 inches during the 24 hours between the 7th and the 8th). The centre was located 110 miles east of Nagapatam on the 9th and eventually 'filled up' on the 11th.

1913: December 14th—16th. This was most definitely a cyclone that traversed the island from east to west, causing weather deterioration and great damage along the eastern coast, in the Highland and along the western coast from Galle to Colombo. This cyclone was noteworthy for its severity during the 15th and the 16th. (Beasejour Estate: 17.22 inches; Ledgerwatte Estate: 12.40 inches and Pussellawa: 12.72 inches.)

1916: October 15th—24th. This was a rather weak depression that did not cause unusual influence upon the weather of the island. But it is of interest that this depression was in effect a China Sea typhoon that was regenerated in the southern Bay of Bengal (Fig. 7).

1916: November 29th—30th. A very severe cyclone that caused disastrous weather effects in southern India but was relatively unnoticed in Ceylon. Except for a few stations in the eastern Highland and along the eastern coast which showed moderate excesssof rainfall; the rest of the island was unaffected.

1918: November 9th—23rd. This period was marked by the occurrence of two 'storms' that followed each other in quick succession. On the

9th a weak depression was observed in the south Bay of Bengal and by the 10th had intensified into a cyclone, whose centre was located on the 10th about 300 miles east of Negapatam and by midnight had reached Madras. The effects on Ceylon weather was rather weak. The second 'storm' on the other hand, was felt very strongly in the island particularly in the extreme north (Jaffna: 20.48 inches on the 18th. Fig. 8). First observed in the south of Bay of Bengal on the 15th, the cyclone moved rapidly to occupy a position (centre) 200 miles east of Pamban on the 17th morning. It stagnated close to the south Indian coast until the 21st. It is now known that this cyclone was yet another China Sea typhoon that was regenerated in the southern Bay (Fig. 7). It may be here pointed out that three 'storms' were also observed to affect the weather of Ceylon but slightly.

1919: November 1st—7th. This depression off the eastern coast of Ceylon, did not have undue repercussions on the weather of the island along the northern and eastern coastal areas.

1920: November 19th—30th. This was an unusual depression in respect of its long period of stagnation in proximity to the island. This depression attained the character of a cyclone off the southeastern coast not until the 19th when heavy rain was experienced and this 'bad weather' persisted on and off until the end of the month. On the 20th, the cyclone had reached a position south of the island and by the 21st had appeared off the eastern coast. On the 22nd it had traversed the island and appeared west of Colombo on the 23rd morning ; it again traversed the island to appear in the Bay of Bengal on the 24th and after a period of stagnation off the Madras coast had 'filled up'. This cyclone was noted for its very unusual 'track.' It is interesting to note the rainfall belt during the respective periods while the cyclone traversed eastwards and westwards across the island (Fig. 10). Thus from the 19th to the 22nd, the rain belt had an easterly and northerly extension, while from the 22nd to the 24th the rain belt definitely exemplified a westerly extension.

1921: December 26th—31st. This cyclone is of special interest because it was the first one to be carefully investigated by the Colombo Observatory. On the 26th morning (9.30) there was hardly any barometric evidence of the approaching storm. By the evening (5.30) the pressure drop was noteworthy and appreciable rain was experienced along the

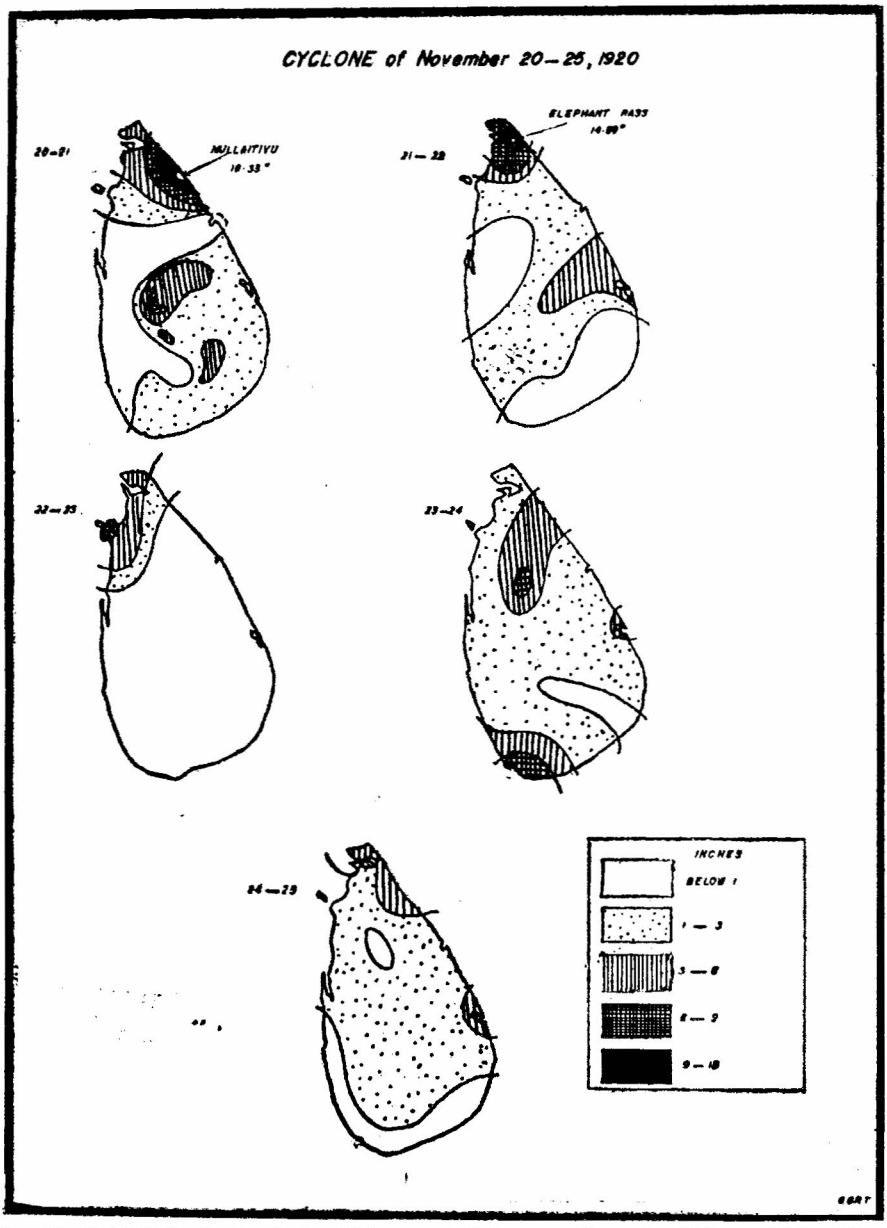

FIG. 10—Rainfall distribution during 24-hour periods between November 20th and 24th, 1920, in Ceylon consequent upon the proximity (20th) and passage (22nd-24th) across the island of an unusual depression.

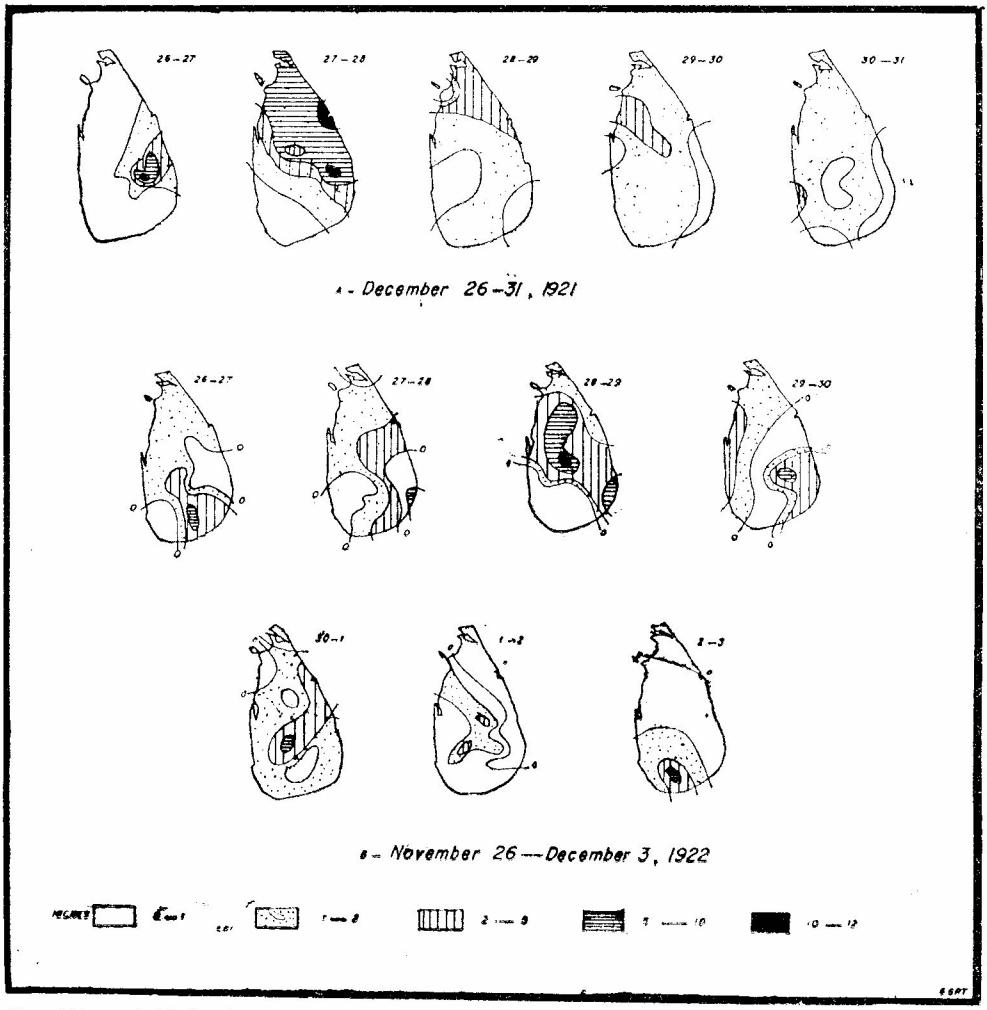

FIG. 11A—Rainfall distribution during the period December 26th to the 31st, 1921, incident upon the passage of a cyclone across northern Ceylon. FIG. 11B—Rainfall distribution for 24-hour periods between November 26th and December 3rd, 1922, associated with the passage of depression over the island on the 28th-29th.

coastal tract in the northeast. By the 27th morning there was clear evidence of the passage of the cyclone across the island accompanied by gale force winds and heavy rainfall. By the 29th morning the centre was off the western coast and by the evening of the 31st weather had returned to normal in the island (Fig. 11). During the 24 hour period between the 27th-28th, the following heavy falls were noted: St. Martin's Rangala: 21.51 inches ; Rukam Tank : 12.84 inches ; Unichchai Tank: 12.30 inches ; Trincomalee 10.11 inches ; Duckwari Estate: 9.76 inches and over nine inches were registered at Allai, Alutnuwara, Marichchukaddi and Murungan.

1922: February 11th—14th. This was an unusual depression in respect of the time of occurrence, for February is rarely frequented by such atmospheric disturbances. It was also unusual because of the narrowness of the area affected and the rapidity of its passage. The weather was normal for February up to the 10th. On the 11th however, a slight pressure fall was experienced in the morning. There were over-an-inch falls of rain on the 11th-12th period of 24 hours, particularly in the north and the east and even as far west as Matale and Kandy. The west coast was virtually rainless, while in the south no appreciable rainfall was recorded. The depression traversed the island rapidly from about Kalmunai, through Vakaneri and Vavuniya to finally leave the island off the Mannar coast. The very narrowness of the area affected may be realised (Fig. 12) from the fact that on the 13th while Mannar and Rukam Tank recorded 11.21 and 8.31 inches respectively, Trincomalee and Puttalam (on either side of the track of the depression) recorded during the same period only 0.84 and 0.65 inches, respectively. Those stations which had severe rainfall on the 13th recorded hardly quarter-inch falls on the 14th instant.

1922: November 4th—9th. This depression did not actually traverse the island but moved northward off the eastern coast. Nevertheless, its effects on the weather during this period and particularly on the 8th-9th were significant. Heavy rainfall occurred on the western side of the island, due to a 'resurgence' of the SW monsoonal currents induced by the passage of this depression off the northeastern coast of the island. Rainfall of over five inches (for the 24-hour period 8th-9th) was recorded at Aturugiriya Estate, Carney Estate, Dunedin Estate, Giriulla, Padupola, Ratnapura, Ruwanwella and at Yatiyantota (10.04 inches).

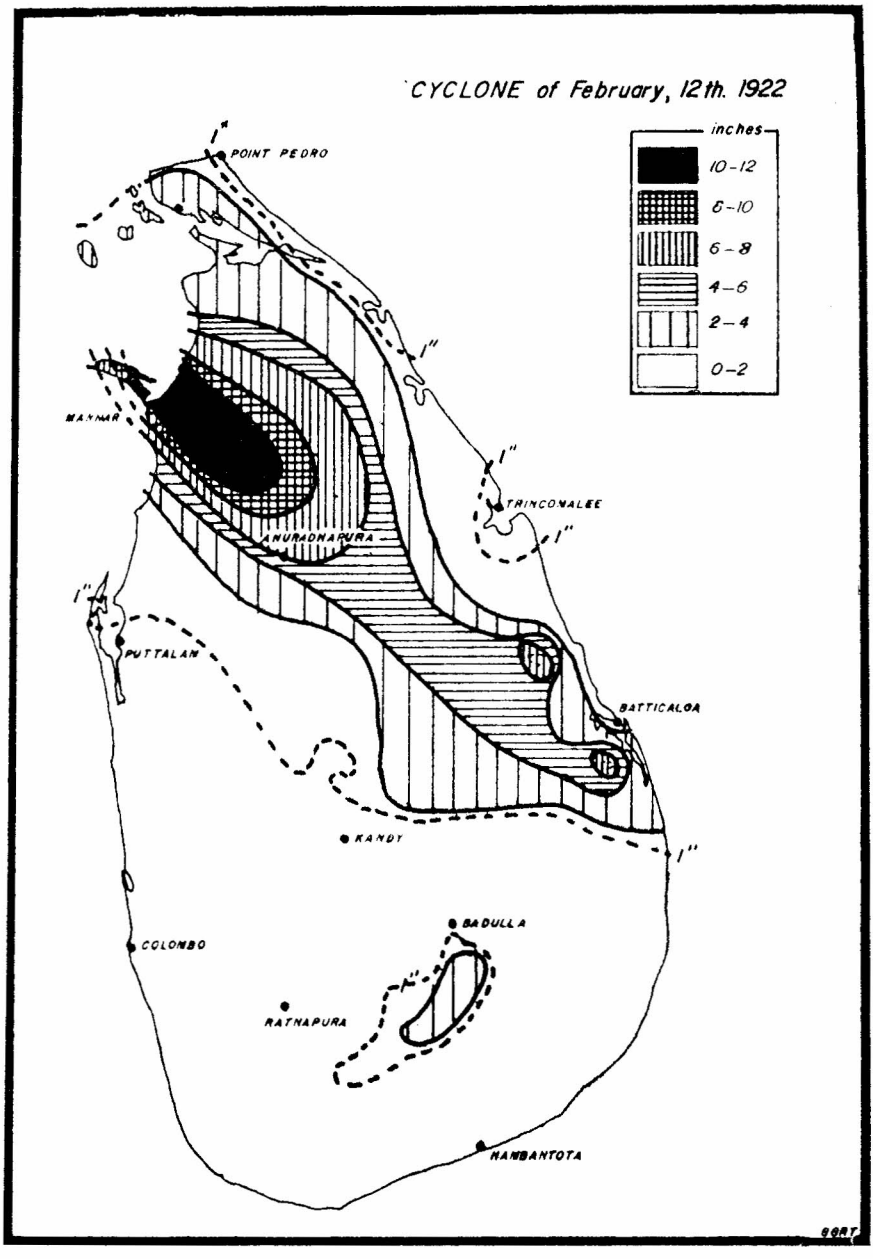

FIG. 12—The distribution of rainfall over Ceylon on February 12th, 1922, associated with the passage of a strong depression (cyclone) across the island from Batticaloa to Mannar.

1922: November 26th—December 2nd. Though there was some barometric evidence on the 26th to suggest pressure-fall, yet it was only on the 27th morning that there was clear indication of an imminent depression. The weather was fine in the morning and the depression crossed the island on the 28th-29th, the centre having traversed somewhat a northern alignment. On the 29th evening, it was definitely centred over the Gulf of Mannar and moved northward into the Arabian Sea until the 2nd December. Rainfalls of over five inches were recorded at Pottuvil, Panama, Maradankadawela, Maha Illupallama and Anuradhapura.

1923: January 7th—15th. This 'storm' was of special interest because of the very unusual circumstances of its passage well to the south of the island. On the 11th the Master of the ss "*Sardinia*" reported noteworthy changes of wind direction and force about a hundred miles south of Dondra Head. The depression nevertheless had strong repercussions upon the island's weather, particularly on the 8th-9th, when heavy rainfall was experienced at Hendon Estate (13.35 inches), St. Martin's, Rangala (12.50 inches) and at Meeriatenne Estate (11.42 inches) with many other stations receiving over five inches during the same 24-hour period. The 'storm' seemed to have strengthened the NE monsoonal circulation (Fig. 13).

1923: April 29th—May 6th. This was a mild depression that traversed the Bay of Bengal northeast of Ceylon. Unlike other depressions, this particular one was responsible for a period of dry weather in the Island.

1923: October 26th—31st. A definite depression originating in the southern Bay of Bengal moved east towards Trincomalee and then instead of crossing the Island (as is usual during this time of the year) it travelled northwestwards parallel to the northeastern coast of the Island. Rainfalls of over five inches occurred in the north.

1923: December 12th—20th. During this period, there was clear evidence of general depressional activity off the northeastern coast of Ceylon; particularly between the 14th and the 17th, there was evident marked deterioration of weather. However, a small 'low' seemed to have traversed the Island on the 15th to reach the Gulf of Mannar, whence it moved out as a cyclone. In Ceylon the 24-hour periods 14th-15th and 16th-17th stand out as rainy spells. Thus, over five inches were recorded during either period at Buttala, Bibile, Deltota, Kurundu Oya, Alutnuwara and Hope Estate.

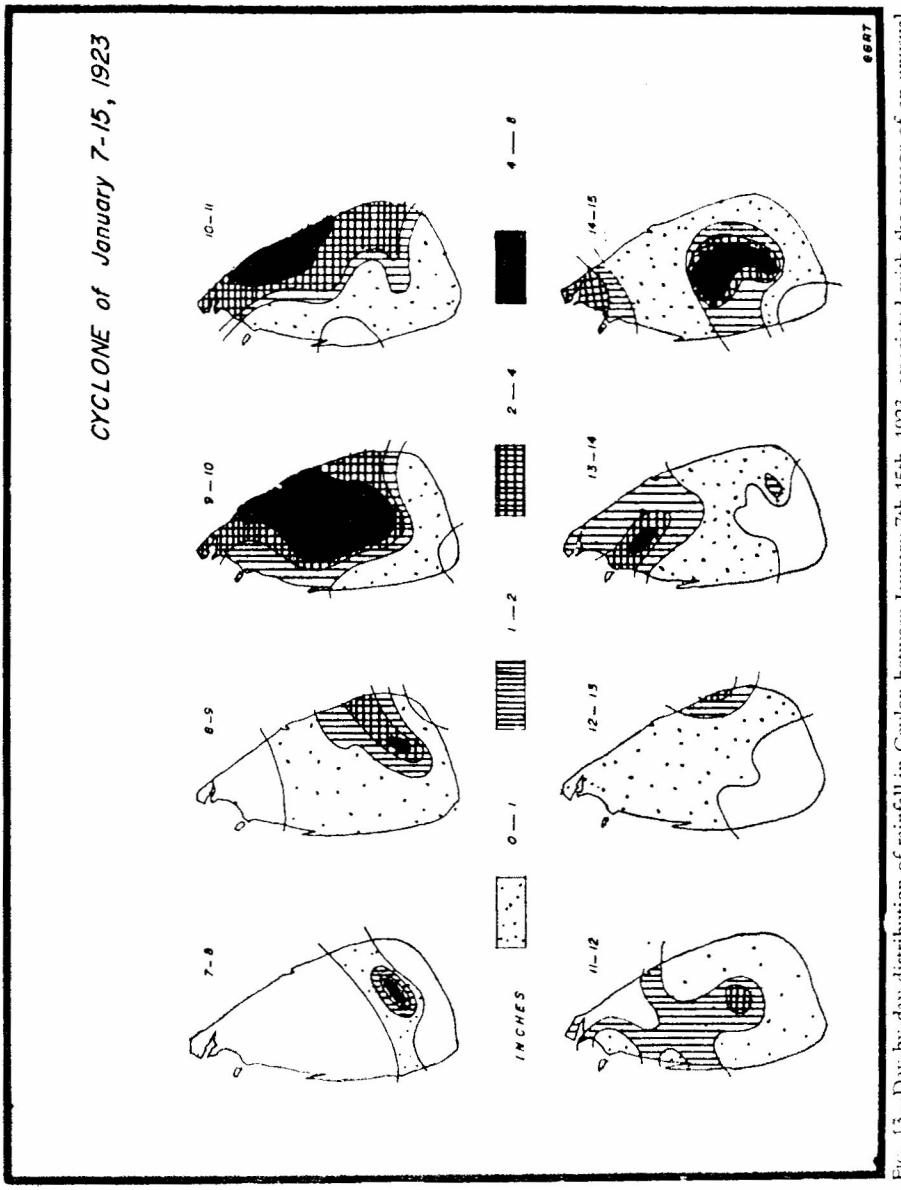

FIG. 13—Day-by-day distribution of rainfall in Ceylon between January 7th-15th, 1923, associated with the passage of an unusual 'storm' south of the island.

1925: January 9th—12th. A depression passed close to the Island, the centre traversing just south of Ceylon and was responsible for moderate rainfall between the 10th and the 12th, everywhere except in the Eastern province. It was this depression that was responsible for the unusually wet January.

1925: March 8th—15th. This depression chose to traverse an unusual track, namely, appearing over Galle on the 12th, it moved north and then east-north-east and on the 14th was located in the north of Ceylon. The rainfall during this period can certainly be related to the passage of the depression, because the normal convectional rainfall pattern was disturbed. This depression, by originating just west of the southern coast and by travelling due east, in fact was contrary to the nature of normal depressional tracks over Ceylon. (Fig. 14).

1925: November 5th—9th. This was a small depression following the normal east-west track, the rain-belt migrating from the northeastern track (6th-7th) to a western track (7th-8th) as seen in Figure 14. Rainfall during the 24 hour period 7th-8th reached over ten inches at a number of stations (Carney Estate: 10.65 inches; Ohiya: 10.81 inches; Raiygam Estate: 13.34 inches; Kitulgala Estate: 11.20 inches (Fig. 15).

1926: November 6th—8th. A rather mild depression that did not cause any appreciable weather deterioration over the Island, paradoxically enough was later identified on the 14th as a cyclone in the Gulf of Aden.

1926: November 20th—30th. This was the characteristic depression of the month, with the ' centre ' definitely being experienced on the 21st over Ceylon. There was heavy rainfall in Ceylon on the 20th-21st. Towards the end of the month the depression deepened in the Bay and was mainly northeast of Ceylon, causing remarkable dry weather all over the Island. This may be explained in respect of the depressional air streams reaching Ceylon, not from over the Bay but from the Indian sub-continent.

1928: July 5th—8th. This was an exceptional case of a mild depression interacting with the SW monsoon to produce intensely, localized rainfall. The main effect were falls of over ten inches on the 7th along a narrow zone on the western coast extending from Heneratgoda northwards to Puttalam (Fig. 16). It is noteworthy that on the 5th when the de-

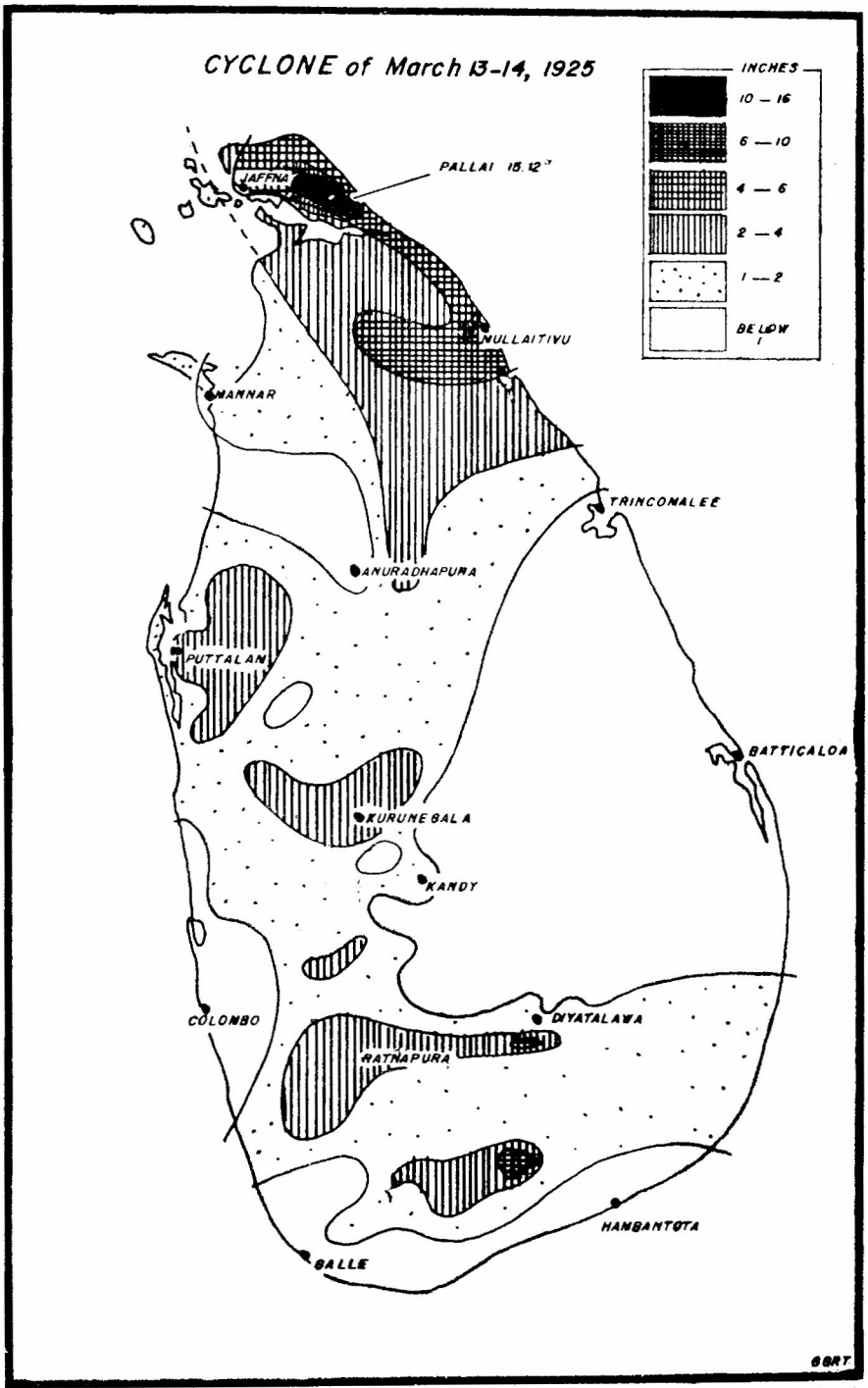

FIG. 14—The incidence of rainfall during the 24-hour period March 13th-14th, 1925, associated with a depression (cyclone) that traversed the island from south to north during the period March 8th-15th.

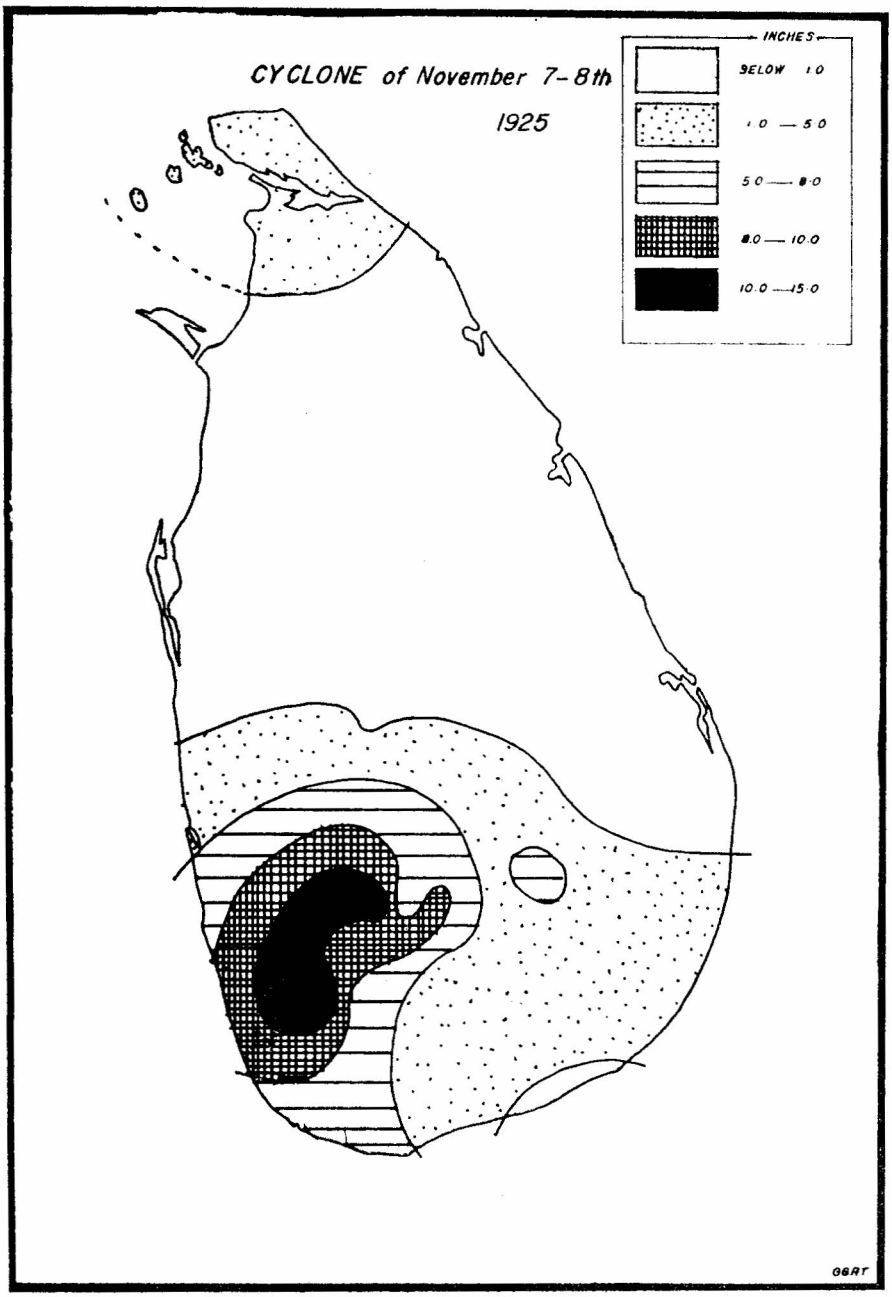

FIG. 15—Rainfall distribution over Ceylon during the 24-hour period November 7th-8th, 1925, associated with weak depressional activity between the 5th and the 9th.

pression was yet south of Ceylon, rainfall occurred along a strip (Hambantota to Diyatalawa) that is usually dry in July. It is noteworthy that the rainfall belt of the 7th was confined to a narrow zone, hardly 10 miles wide and stations on either side recorded less than half of that recorded within this strip.

1929: November 29th—30th. This depression passed northeast of the Island and was responsible for dry weather during these two days.

1930: May 5th—10th. The weather over the Island from the end of April to the 5th of May, was certainly the conventional type. On the 5th, synoptic charts indicated pressure fall which was confirmed by the evening charts. On the 6th morning, the pressure at Trincomalee was 4.9 mb. lower than the previous morning. Heavy rainfell on the 5th-6th period of 24 hours, with as many as 150 rain-guage stations reporting over five inches and many of them even double figures. This rainfall intensity was continued during the 6th and the pressure continued to drop. The centre of the cyclone was located east and just north of Batticaloa in the Bay on the 6th and by the 7th, it had definitely moved over to the Jaffna environs. Heavy rain continued and by the 8th, there was only a diminution of rain but no cessation. The cyclone had moved over the Palk Strait into the Indian mainland by the 8th, though the weather over the Island still continued to be affected, particularly in the southwestern quarter (Fig. 16), even as late as the 14th.

1930: October 20th—28th. On the 20th rainfall over the island was typically convectional and it was on the 21st morning that a pressure-drop was discerned; though most stations reported only slight wind, Jaffna recorded NW winds of Beaufort scale 6. On the 22nd morning, pressure had dropped further and heavy rain continued to fall in the north, many stations recording 24-hour falls of over eight inches. The cyclone then moved northwards and by the 24th had reached the Indian coast near Nagapatam but it was not until the 28th that the Island was generally free of the influence of this cyclone. Floods resulted in the southwest and in the north.

1930: November 26th—30th. A small yet severe 'storm,' similar in many respects to the cyclones of May and October of this year. This 'storm' was first felt on the 27th with the pressure-drop, though the centre was reported to have been ascertained to be nearly 300 miles

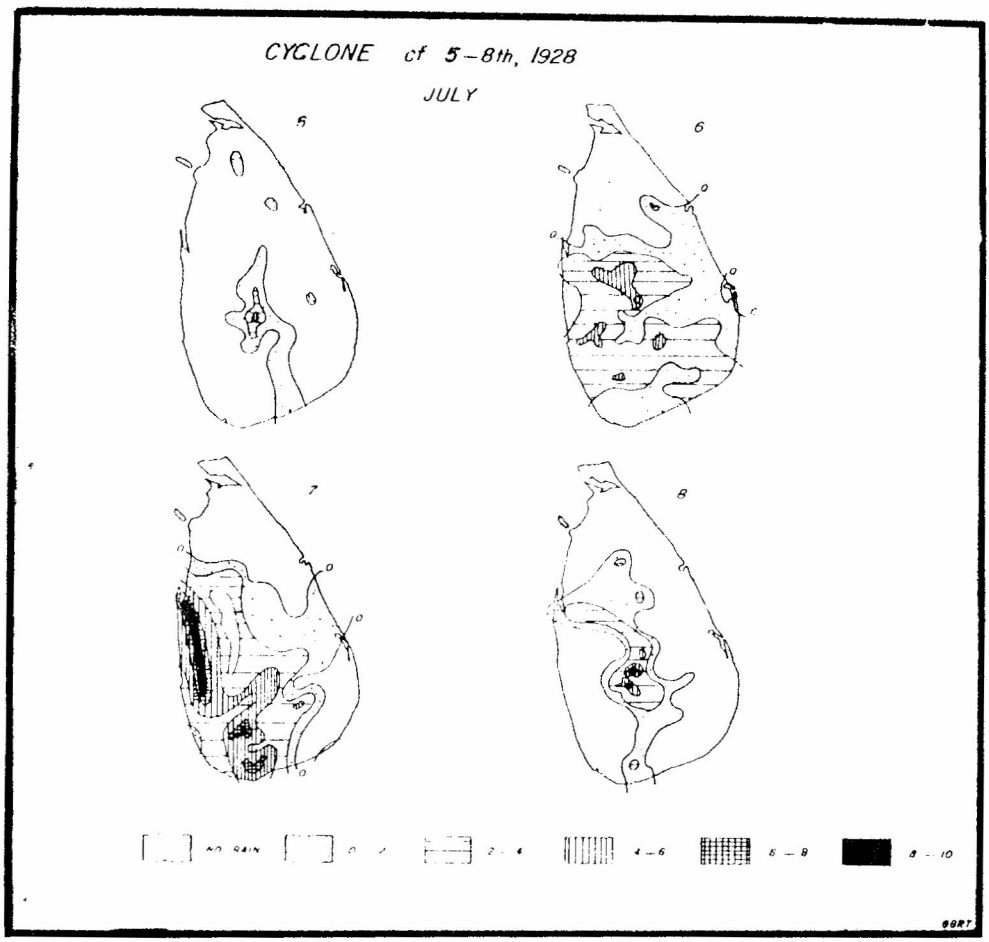

FIG. 16—Rainfall distribution during the period July 5th-8th, 1928, related to an unusual depression (cyclone) interacting with the SW monsoonal circulation over the island.

east of Trincomalee on the 26th. Since the 'storm' kept to a northerly course than its October predecessor, the floods were not repeated. The weather did not deteriorate so much as is normally true of such storms but great damage was caused at Trincomalee, Mullaitivu and the northeastern coast of the Island by heavy swells from the sea. While the rainfall was not so intense, yet gale force winds were experienced (Beaufort scale of 10 to 11 were reported by the ss *Mulbera* north of Ceylon, (200 miles northeast of Jaffna). By the 29th the storm had reached the Indian coast and its effects were not felt in Ceylon after the 30th.

1931: October 20th—25th. During this period, two depressions approached the Island near enough to slightly influence the weather on the 20th-21st and the 24th-25th, the 24-hour period falls being heavier during the later phase.

1931: December 7th—10th. This depression formed on the 7th to the southeast of the Island and crossed over to the Arabian Sea on the 9th. Heavy rain fell during this period 7th-10th, rainfalls of over five inches being experienced during the 24-hour period (8th-9th) along a belt, extending from Dambulla southwards along the eastern flanks of the Highland.

1931: December 22nd—26th. This depression also formed to the southeast of Ceylon but crossed the Island in the north during the 22nd-23rd, as a cyclone with gale force winds and accompanied by heavy 24-hour falls of over ten inches (Jaffna: 11.12 inches; Jaffna Farm School: 14.20 inches and Talaimannar: 12.97 inches). The northern half of the Island, beyond a line joining Trincomalee and Mannar was strongly affected.

1932: November 8th—10th. A mild depression northeast of the Island but did affect the weather in the north. On the 9th-10th heavy rainfall occurred at Mullaitivu (10.90 inches) and Kayts (8.07 inches).

1932: November 19th—25th. The seasonal low developed into a cyclone, which had a very marked influence upon the Island's weather. Practically the whole peninsula received heavy rain both on the 23rd-24th (E. Pass: 11.00 inches; Point Pedro: 11.50 inches; Pallai and Kankesanturai, each with 11.30 inches; and Vadamarachchi 20.00 inches (Fig. 17).

and on the 24th-25th (Chavakachcheri: 12.81 inches and Kankesanturai: 11.28 inches). On the 24th, the cyclone was centred about 10°N 82°E and by the 26th had crossed the Indian peninsula into the Arabian Sea.

1933: October 13th—23rd. A cyclone in the Bay of Bengal moved close to the Island to strongly influence the retreating SW monsoonal streamlines ; a temporary re-establishment of monsoonal conditions was effected and squally rainfall was observed, until the cyclone passed out of the Bay.

1933: November 15th—18th. This depression in the Bay of Bengal was in effect responsible for extreme dry weather in the Island, from the 15th to the 18th. As in similar circumstances on earlier occasions, the dry weather was due to continental air streaming into the Island from the Indian mainland.

1933: December 12th—16th. On the 12th, the barometric tendency suggested the potential development of a depression in the Bay of Bengal. This did take effect and until the 16th, the weather of the northern and northeastern areas was affected by strong winds and heavy rainfall.

1934: January 23rd—25th. The depression, located east of Ceylon moved westwards and not northwestwards as is usual and on the 24th-25th, its centre passed over south Ceylon. Though no gale winds were experienced yet heavy rainfall occurred in south Ceylon.

1934: November 4th—8th. This depression in the Bay of Bengal, was responsible for 24-hour rainfalls of over ten inches on the 5th and the 7th, along the western coast of Ceylon, being particularly confined to between Kalutara and Chilaw. Kottawa (near Colombo) received nearly 33 inches during this period.

1934: November 14th—15th and 26th—27th. Heavy rainfall during these two periods in the north, were due to depressions in the Bay.

1935: October 17th—20th. This depression from the Bay, travelled northeast of Ceylon and crossing the Madras coast on the 18th, entered the Arabian Sea on the 20th. Weather conditions became unsettled over the island on the 17th and squally weather prevailed until the 19th.

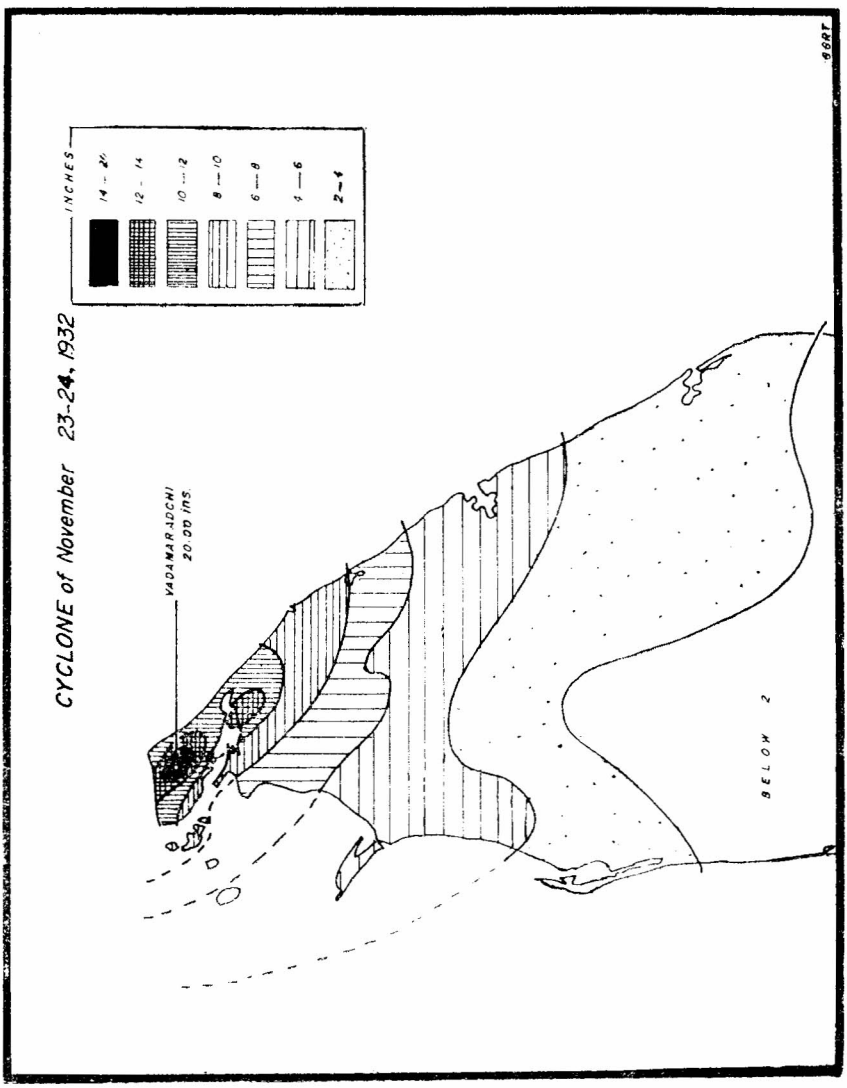

FIG. 17—Heavy rainfall over Ceylon on November 23rd-24th, 1932, associated with a strong cyclone that crossed the northern part of the island.

1935: November 11th—15th. Unsettled conditions in the southern Bay of Bengal, resulted in the formation of a depression on the 9th which intensified into a cyclone by the 11th. On the 14th, this cyclone passed close to the island causing high winds and heavy rainfall in the north. By the 15th its influence on the island's weather was over.

1936: September 28th—30th. A depression in the Bay, helped in accentuating SW monsoonal conditions during this period.

1936: October 25th—30th. This period was marked by the unsettled weather conditions over Ceylon, in consequence of a depression forming in the Bay on the 25th. Widespread moderate rain and heavy falls in the southwest, prevailed until the 28th when the depression crossed into the Indian peninsula. A new, localized low north of Ceylon, caused heavy rain in the Highland and in adjacent areas.

1936: December 29th—31st. A deep depression of small magnitude from the Bay, crossed the island rapidly on the 29th accompanied by heavy rain in the north and east. The influence of this depression was felt on the 30th and 31st, in the form of moderate rain.

1937: April 15th—18th. A short-lived depressional influence on the weather of the island prevailed during this period ; rain mainly in the north.

1937: September 28th—October 3rd. A depression in the Bay approached the island in the northeast and influenced the weather to cause fairly heavy rain in the southwest.

1937: November 11th—13th. During this period, a depression which formed to the east of the island in the Bay, caused fairly heavy rainfall.

1938: March 20th—21st. During this period, a mild depression observed off the east coast of Ceylon, travelled northwards to eventually fill-up off the south Indian Coromandel coast on the 22nd. Widespread moderate rainfall occurred in Ceylon on the 21st.

1939: January 8th—11th. A depression forming in the southern Bay of Bengal on the 8th, crossed the island on the 11th, causing widespread rain between the 9th and the 11th.

1939: April 11th—13th. A depression identified on the 12th east of Ceylon, intensified into a cyclone and moved northwestwards to cross the Indian coast near Cuddalore on the 13th evening. Widespread heavy rain was experienced over the island between the 11th and 12th.

1939: November 14th—18th. This depression was first evident on the 14th morning and by the 15th, it had intensified into a cyclone which travelled along the coast northwesterly to reach Nagapatam on the 16th morning. Soon after, it filled-up. Very heavy widespread rain was recorded in the island on the 14th and 15th (over ten inches on the 15th at Delft, Jaffna, Kankesanturai, Paranthan and Chavakachcheri with 21.17inches).

1940: November 1st—11th. Depressional incidence during this period caused fairly widespread rain in the island.

1941: October 4th—8th. This depression, which formed in the south-west Bay of Bengal, moved northwesterly to the Indian coast. Heavy rain was experienced on the 4th along the western sea-board.

1941: November 14th—18th. During this period, unsettled weather conditions with moderate rainfall was experienced, due to a depression northeast of the island.

1942: December 4th—18th. A low pressure centre persisted around the island during this period, causing generally unsettled weather conditions.

1943: May 11th—20th. On the 11th, the weather became unsettled due to a depression in the southwest Bay of Bengal and widespread rain occurred, with heavy falls being confined to the southwestern and northern parts. The depression gradually intensified into a cyclone and by the 18th, had reached the Indian coast. Nevertheless, it continued to influence the island's weather up to the 20th.

1943: October 6th—14th. During this, period two depressions in the Bay influenced the island's weather, so as to induce fairly widespread heavy rainfall.

1944: September 12th—17th. Heavy rainfall was recorded at many stations in Ceylon, in consequence of a depression making its presence east of Ceylon.

1944: November 29th. A weak depression in the Bay of Bengal, caused appreciable rainfall in the island.

1945: October 14th—18th. Unsettled conditions on the 14th in the Bay, resulted in the formation of a depression which, by the 16th had intensified into a cyclone 400 miles northeast of the island. After following the usual northwesterly track, it reached the Indian coast on the 18th. The two days 14th and the 15th, were noteworthy for the widespread heavy rainfall.

1945: December 5th—8th. Heavy widespread rain fell in the island, under the influence of a depression (about 300 miles east of Ceylon) which failed to intensify. The depression stagnated from the 5th to the 8th, when it filled-up (Kankesanturai: 10.27 inches and Pallai: 10.58 inches on the 5th; Talaimannar: 10.23 inches on the 6th).

1946: October 31st—November 3rd. The presence of a depression in the southwest Bay, was responsible for heavy fain in the north (Jaffna: 8.50 inches and Kayts: 7.50 inches on the 1st of November).

1946: November 6th—16th. Depressional activity during this period accounted for widespread rain in the island.

1946: December 4th—8th. Two depressions from the southwest Bay of Bengal, influenced the weather of Ceylon. The second of these depressions, developed into a cyclone but was too far northeast to seriously affect the island's weather.

1947: October 19th—24th. Bad weather was first experienced in the island on the 20th, due to the influence of a trough of low. On the 21st, a depression was identified which, by the 22nd intensified into a cyclone. Moving north by the 24th, the island was outside its influence. Rainfall was widespread and heavy during the period 20th to 23rd, while squally weather was felt along the west coast.

1948: April 16th—18th. A low pressure centre off the western coast, caused unsettled conditions to result in widespread heavy rain on the 18th.

1949: October 21st—28th. A Bay of Bengal depression caused squally weather in the southwestern parts of the island during this period.

1949: December 6th—7th. Widespread rainy weather was experienced during these two days, due to the influence of a low pressure wave across the island.

1949: December 17th—26th. Unsettled weather on the 17th, bore evidence of a depression, which caused 24-hour period rainfall of 12.71 inches at Trincomalee and 11.05 inches at Andankulam.

1950: July 25th—28th. Depressional activity during this period was responsible for widespread moderately heavy rain.

1952: January 1st—9th and 22nd—24th. Two periods of depressional activity, were responsible for floods in the Batticaloa area. Between the 2nd and the 5th, heavy rain was recorded from Trincomalee southwards. During the 22nd to the 24th the depressional rain was less intense yet was fairly widespread.

1952: October 3rd—10th. A Bay of Bengal depression strongly influenced the island's weather during this period, with heavy rain on the 3rd. The southwestern slopes of the Highland received most of the rain and resulted in a minor flood of the Kelani Ganga.

1952: November 29th—December 1st. Floods were caused in the north, consequent upon the visitation of a severe cyclone with hurricane force winds and heavy rainfall. Great damage was caused in the Jaffna peninsula and adjoining areas.

1953: January 21st—23rd. A depression off the eastern coast of Ceylon, was responsible for rather heavy rain along the eastern littoral and the flanks of the eastern Highland.

1953: September 8th—10th. A mild depression in the southern Bay of Bengal, accentuated SW monsoonal activity causing heavy rainfall in the southwestern sector.

1953: November 3rd—9th. This depression, which reached the Indian mainland from the Bay, brought dry continental air to the island as did happen on earlier occasions. A period of marked dry weather ensued.

1954: July 24th—25th. A low pressure wave from the Bay of Bengal, caused unusual rainfall in the North Central Province and the neighbourhood.

1954: October 17th—21st. Precursory signs of a depression were noticed since the 17th (moderate rainy spell inaugurated) and it was definitely identified on the 20th. Stormy seas, high winds and heavy rain were characteristic throughout this period, mainly in the northern and western parts of the island. Local floods were recorded and the Nagalam rain-guage touched the minor flood-level on the 24th.

1954: December 6th—12th. During this period, a severe cyclone caused heavy rainfall and strong winds particularly on the 7th-8th, when most stations in the northern half of the island recorded over five inches, during the 24-hour period. Floods and extensive damage were experienced.

1954: December 16th—19th. The second of the December depressions was of a smaller magnitude than the earlier one and heavy rain during this period, was highly localised in the north-central parts. A low pressure area over the island, caused heavy rain between the 24th and the 26th.

1955: January 6th—9th. A low pressure wave traversed south of Ceylon, causing particularly on the 6th and 7th widespread rain, gloomy skies in general and heavy falls in the northeastern Highland and in southern Batticaloa District. Floods were recorded in the Uva Province and in the Gal Oya Development Board area. The wave strengthened into a depression when it reached the Maldives on the 9th.

1955: February 7th—9th and 12th—13th. A series of low pressure waves, moving westward from the Bay into south Ceylon, caused generally unsettled weather (as in 1944) and caused heavy rain and floods in an area (extending from the southern parts of the Batticaloa District) from the sea coast, right up to the hills and also stimulated thunder activity along the western coast. The severest of these, reached the island on the 7th-8th, when the Batticaloa area and the Gal Oya region received heavy rain (over five inches for the 24-hour period at 30 stations) causing floods. The second wave followed in the wake of the first and accentuated flood conditions in this area and for the first time the Gal Oya Reservoir overflowed.

1955: September 17th—28th. This period was marked by the incidence of a series of low pressure waves and a depression, resulting in rather wet weather. A low pressure wave on the 18th, caused heavy rainfall along the southwestern coast, while a second wave caused widespread rain over the island. On the 25th-26th, a depression in the Bay of Bengal influenced the island's weather in the form of rainy spells and gusty winds.

1955: October 16th—21st. An unusually located low pressure wave near the Malabar coast and a Bay of Bengal depression during this period, were responsible for the wet weather. The remarkable fact was that, only the southwestern low and hill-country and the southern parts of the North-West Province region experienced marked weather effects. There were at least 75 stations recording daily falls of over five inches and consequently low lying areas in the Western Province and the Kelani Ganga and Kalu Ganga were flooded.

1955: November 1st—5th. A depression during this period caused moderately heavy rainfall over a wide area.

1955: November 28th—December 3rd. A severe cyclone to the north of Ceylon, was responsible for the bad weather and extensive damage to property and crops in the Jaffna Peninsula. Heavy rainfall was recorded at Murikandy, Pallai and Kankesanturai.

1955: December 24th—26th. A low pressure wave in the Arabian Sea during this period, led to weather deterioration with localized heavy rainfall.

1957: December 23rd—28th. A severe cyclone from the Bay of Bengal, reached the eastern coast on the 25th and continued to follow a track northwestwards across the island, causing very heavy rain in the northern half and in eastern Ceylon. Gale winds were also evident causing much damage and a good part of the island was literally inundated. The floods following the cyclone were considered to be one of the heaviest on record, because this year the irrigation tanks had already been filled by heavy NE monsoonal rain prior to the cyclonic incursion.[7]

7. A detailed analysis of this cyclone will appear in a subsequent paper.

Conclusions

The fairly detailed analyses of the more important cyclones and associated tropical 'disturbances' that have had repercussions upon the weather of the island, seem to bring out certain significant features. These may be briefly considered :—

1. Tropical cyclonic incidence either over the island or close to it, forms an integral part of Ceylon's climate. It does have repercussions upon the island's weather in respect of its own character or aids in accentuating weather produced by other agencies.

2. Tropical cyclones make incursions into the island's climatic environment in all months of the year, with the exception of June and August.

3. The period October to December (inclusive) forms the most potential cyclonic phase of the island's climate. Out of a total of 99 cyclones and depressions recorded in Ceylon between 1845 and 1958, October (18), November (33) and December (21) together, experienced over seventy percent.

4. The Southwest monsoon period (June-September), constitutes the least 'cyclonic' phase of the island's climate.

5. Cyclones recorded during the SW monsoon period serve mainly to accentuate monsoonal weather.

6. Occasionally cyclones occurring in late September and early to mid-October, can induce a 're-establishment' of the SW monsoon circulation, with associated weather along the western and southwestern sectors of the island.

7. Most of the cyclones are first observed in the southwest or southern Bay of Bengal and follow tracks westward across the island or move northwestwards, to strike the Indian coast and eventually 'dissipate' over the Arabian Sea or over the mainland.

8. Only a few cyclones and depressions have formed immediately west of the island (i.e. in the Arabian Sea) and were generally confined to April, May, July and very rarely in November.

9. Quite a number of depressions have stagnated east of the island, to produce generally unsettled weather over Ceylon and have been found to fill-up without intensifying into cyclones.

10. In a number of instances, low pressure waves and centres have failed to 'develop' further and are found to have dissipated quickly.

11. Some of the cyclones that traversed the island have been found to be China Sea typhoons, that were regenerated after they had crossed (in a senile stage) into the Bay of Bengal.

12. Most of the cyclones cross the island rapidly from east to west, though a few exceptions in March and July have traversed from south to north.

13. While all cyclones and depressions traversing the island or approaching close to it, cause marked deterioration of weather with heavy rainfall and gusty winds, a few of them reaching the Indian subcontinent were responsible for extremely dry weather over the island.

14. While in some cases marked local weather is confined to the track of the cyclones, in most cases the effects were more widespread with localized heavy rainfall zones.

15. A number of cyclones reaching the Indian mainland are found to dissipate soon after, though some of them do reach the Arabian Sea to be 'regenerated,' and even reach the Arabian coast. It is clearly evident, that over maritime surfaces the cyclone continues to be maintained, therefore suggestive of convectional significance.

16. In many circumstances, cyclones reach the island and produce heavy rain but little wind, while others are accompanied by gale force winds but moderate or little rain.

17. The absence of cyclonic activity in November and during the NE monsoon period of December to February, is clearly evident in the deficit rainfall values of these months.

18. The marked incidence of cyclonic activity in May, and October to December, seems to suggest that cyclogenesis may be attributed to

air mass contrasts, related to the inter-tropical convergence zone migration over the island's environs ; it is also suggestive that some frontal activity may be induced by the passage of the ITCZ. It is nevertheless significant that cyclonic activity is strongest, when the relatively colder NE trades persist over the island's atmospheric environment.

It is clear from the foregoing analyses, that tropical depressions and cyclones constitute integral features of the weather and climate of Ceylon. The evidence in respect of their period of incidence and in terms of association with other weather phenomena of the island, seem to suggest that 'cyclogenesis' may be induced under varying conditions of the atmosphere. No single theory so far postulated, may be claimed to provide a completely satisfactory explanation, in the context of all aspects of such phenomena. While in general, it may be accepted that depressional and cyclonic activity, either over the island's environs or in proximity to Ceylon, is associated with deterioration of weather, it has also been shown that reverse circumstances may also prevail. Another general feature fairly evident is that, strong monsoonal circulation inhibits depressional activity. Finally, it may be pointed out that recent investigations of the nature and character of the Upper Atmosphere over the tropics, have revealed some interesting hitherto-unknown features ; the latter may perhaps provide some of the answers wanting in the theories so far available.

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