The Monsoons and their Influence on the Ceylon Weather

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Wind Circulation over Ceylon

THE general movement of the air over Ceylon is determined chiefly by the general temperature and pressure conditions in the larger area of the meteorological region of which the Island forms a part. This general movement is somewhat modified by the local temperature and pressure conditions and by the geography of the Island. The general conditions determine the two great movements—the southwest and northeast monsoons.

Circulation in the Tropics and Subtropics

The surface of the earth is not heated uniformly by radiation received from the sun. The intensity of heat received by any particular region will depend on the position of the region relative to the sun. (The amount of heat absorbed will also depend on the condition of the atmosphere and the nature of the ground surface). Naturally, that region which is vertically below the sun will receive maximum heat energy from it because the incidence of solar radiation will be normal to the surface of the earth in the locality. Thus, during any particular month or season of the year, there will be a belt round the earth's surface (practically parallel to the geographical equator) where the temperature is higher than in the areas to its north or south. This belt is generally known as the thermal equator. The thermal equator moves northwards or southwards along with the relative movement of the sun.

Due to the differential heating between the thermal equator and the areas immediately north and south of it, the air at the surface of the thermal equator becomes less dense and, consequently, ascends. This air is immediately replaced at the surface by air from the regions immediately north and south of it. The ascending current reaches a height of several thousand feet above the surface, the actual height depending on the nature of the surface. When this ascending current reaches the upper limit it breaks up into two streams, one moving in the northern hemisphere and towards the north pole and the other moving in the southern hemisphere and towards the south pole. These streams are influenced by the deflective effect of the earth's rotation. This influence causes an air current in the northern hemisphere to be deflected towards its right while a current in the southern hemisphere is made to turn towards its left. The air stream in the northern hemisphere will, therefore, assume a southwesterly direction while the other will have a northwesterly direction. Each of these streams will be gradually cooled because it is moving towards colder regions. Hence the air becomes more and more dense until, at about 30° latitude, it begins to descend. This causes a heaping up of air and gives rise to a region of general high pressure. Air will quickly move out of this high pressure area on account of the tendency of nature to equalize. The major portion of this air travels towards

the thermal equator and completes the closed link of the general circulation of the region. The other portion of this air continues its journey towards the pole. The returning current will have a northeasterly direction (due to the deflective effect) in the northern hemisphere and a southeasterly direction in the other hemisphere. These return currents are known as the **trade winds** while the upper air streams are called the **anti-trades.** (See Fig. I.).

Air Masses and their Boundaries

From the preceding discussion it is clear that there are two distinct air masses (each with an eitirely different history) within the region of this circulation. One is the northeast trade of the northern hemisphere and the other is the southeast trade of the southern hemisphere.

Consider, for instance, a season when the thermal equator is situated in the northern hemisphere. When the south-

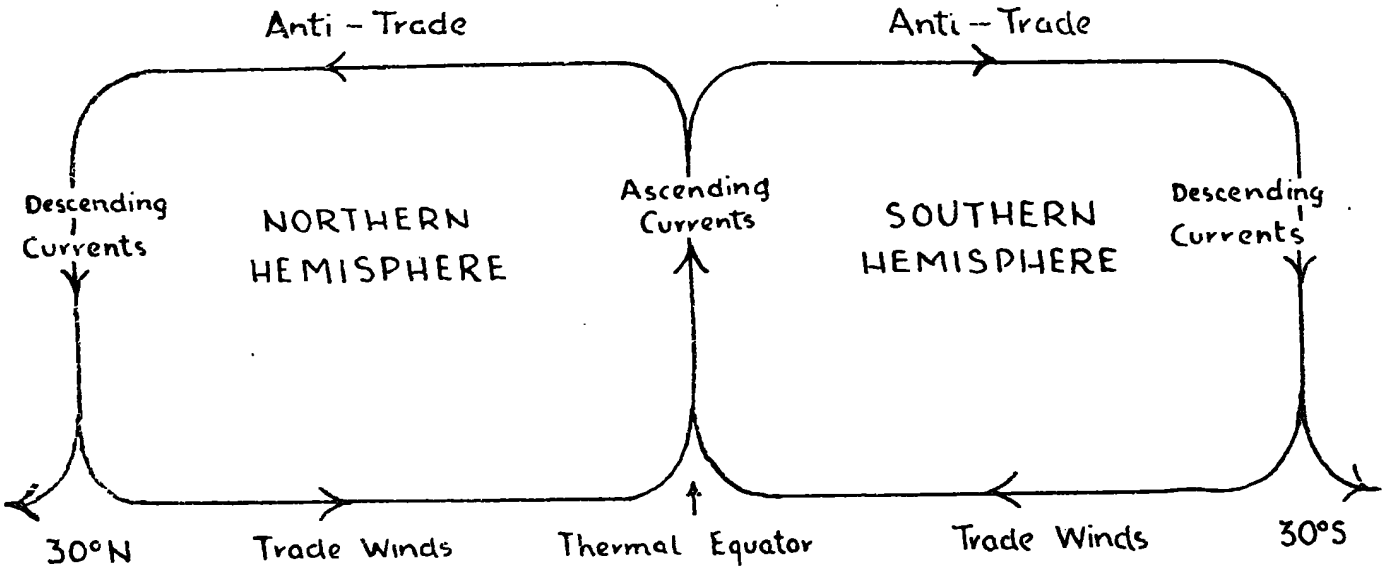

FIG. I.—A vertical section showing the general circulation of the winds in the tropics and sub-tropics.

east trades move beyond the geographical equator, their direction alters on account of the change in the deflective effect of the earth's rotation, and the winds appear as a southwesterly current. These deflected trade winds are known as **monsoon winds.** Due to the difference in direction of the air movements on the two sides of this junction the wind streams converge and the air is forced to ascend. Pressure decreases with increase of height in the atmosphere. Hence the ascent of air is associated with lowering of pressure and, therefore, expansion. This expansion causes cooling (adiabatically) of the air provided no heat is communicated to the ascending air. If ascent and cooling continue the air may reach its dew point and any further cooling will cause water droplets or clouds to form. With continued ascent the droplets will keep on growing and increasing in weight until they become too heavy to be held within the cloud. They will then descend in the form of rain. This shows that, under suitable conditions, convergence of wind streams leads to the formation of cloud and rain.

Figure II is a horizontal section of the wind streams. The deflected trades or monsoon winds are generally known as the **equatorial westerlies.** From the diagram it is clear that the equatorial westerlies converge with the northeast trades along their boundary. This, too, usually produces cloud and precipitation. The two boundaries or zones of convergence are usually known as the northern and southern convergence zones.

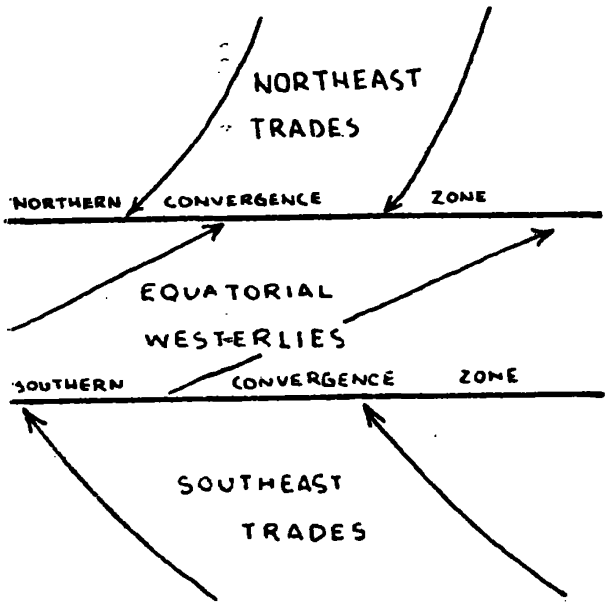

FIG. II.—A horizontal section showing the air streams and their boundaries, with the S. E. Trades bending near the geographical equator.

When the thermal equator is in the southern hemisphere, the geographical equator is the junction between the northeast trades and the equatorial westerlies while (approximately) the thermal equator forms the boundary between the southeast trades and the equatorial westerlies.

One or the other of these two zones moves north or south with the relative movement of the sun with a lag of about two months. The other remains practically stationary near the geographical equator. The moving zone is always found in the summer hemisphere and is usually referred to as the Inter-tropical Front.

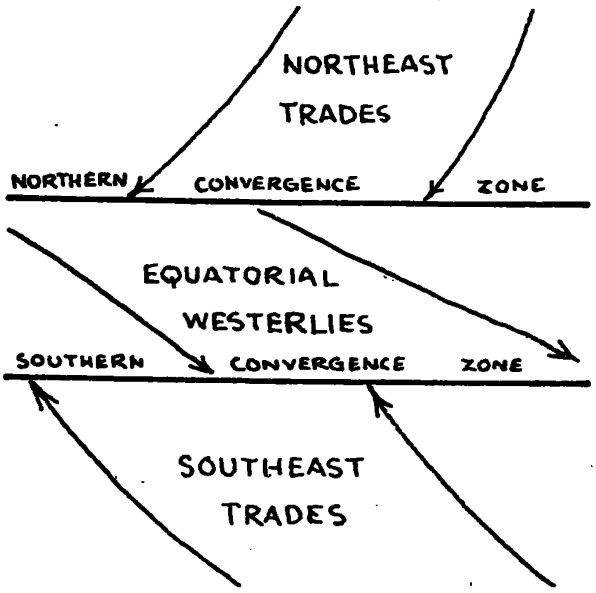

FIG. III.—The bending of the N. E. Trades near the geographica equator.

The northern convergence zone crosses Ceylon through the lowest layers of the atmosphere during April on its northward journey and during October on its return. On the other hand, the southern zone has not been known to lie over Ceylon. Perhaps, it never reaches the Island.

When the northern convergence zone moves away to the north of Ceylon the Island comes under the influence of the equatorial westerlies or the southwest monsoon stream. Monsoon activity, however, is not experienced over the Island until the latter half of May because an air stream of sufficient depth is required for such activity. The onset of the monsoon is generally associated with heavy rain, particularly if the convergence zone is associated with a centre of low pressure.

This air stream has a very high moisture content owing to the fact that

it has reached the Island after a long journey over a warm sea. As a result this air stream is a potential rain-bearer and lifting of this air when it strikes a coastline or a range of hills causes the building up of large cumulus and cumulonimbus clouds and, in certain cases, the production of rain. Orographic features are, therefore, of great significance in the distribution of the monsoon rainfall. Precipitation over the Island is induced by the south and west coasts and the central hills, and the rainfall due to the southwest monsoon is practically confined to the southwest quarter of the Island and the western and southern slopes of the exposed hills. Most of the monsoon rain falls from isolated cumulonimbus clouds. The rainfall is neither continuous nor uniform because it depends on the strength of the wind stream. The wind strength varies considerably and appears as a series of pulses.

The average total rainfall during the monsoon season is highest in the Watawala area where the total generally exceeds 120 inches for the period of five months from May to September. The average totals decrease steadily towards the southwest coast. The average values along the coastal belt are less than 60 inches, being 40 to 60 inches between Ratmalana and Weligama, 20 to 40 inches from Dehiwala to Horakele and from Matara to Tangalla, and below 20 inches from Chilaw onwards along the west coast and beyond Tangalla along the south coast.

As mentioned earlier the northern convergence zone generally crosses the Island in October during its southward journey. In other words, the southwest monsoon withdraws from the Ceylon area at the end of September or during the early part of October. This retreat of the monsoon is usually accompanied by fairly general rain over most parts of the Island.

The northern convergence zone moves over successive regions of the Indian sub-continent, during its northward journey, after it passes Ceylon. This results in the southwest monsoon air stream reaching India only after the monsoon conditions are well established over the Island, the onset of the monsoon being experienced in the southern and central portions earlier than in the north. Southwest monsoon conditions are finally established over Pakistan and northern India during July. With the return of the convergence zone towards the equator this monsoon stream commences its withdrawal from the northern-most regions during the latter part of August. The retreat of this monsoon from the central and most of the southern areas of India takes place during September.

The Northeast Monsoon

Ceylon comes under the influence of the northern hemisphere trade winds when the northern convergence zone is to the south of the Island. This generally occurs from the beginning of December to the end of February. During this period the northeast monsoon prevails over the Island.

Orographic lifting of this air by the east coast and the northern and eastern slopes of the central hills gives rise to rain in the north and east, particularly along the windward slopes of the hills. The highest rainfall in this locality during the northeast monsoon is experienced in the Nitre Cave area where the average total for the three months is between 80 and 90 inches.

The Madulsima, Gammaduwa and Urugala areas come next with totals ranging from 50 to 70 inches for the period. Along the coast the greatest rainfall is experienced in the Valaichenai, Batticaloa, Kalmunai and Akkaraipattu areas with average totals of 30 to 35 inches. South of Akkaraipattu the season's rainfall decreases gradually towards Pottuvil and Panawa where the averages are between 25 and 30 inches. Beyond Panawa the decrease is more abrupt, the total rainfall in Yala being only about 15 inches. North of Valaichenai, too, there is a decrease in the northeast monsoon rain along the coast. The approximate average totals at Trincomalee, Mullaittivu and Point Pedro are 25, 20 and 15 inches, respectively.

It is obvious from what has been stated earlier that the northeast monsoon establishes itself over the northern and central regions of the Indian subcontinent long before it reaches Ceylon. It is also clear that the withdrawal of this monsoon from the Island commences earlier than from the subcontinent, the monsoon withdrawing from Pakistan and Northern India only after it has retreated from the southern and central areas.

Transition Periods

The periods, March-April and October-November, are neither in the southwest monsoon season nor in the northeast monsoon. During these months the northern convergence zone lies either across Ceylon or in its immediate vicinity and the air stream over the Island does not consist purely of one type—the northern trades or the equatorial westerlies.

Summary

Southwest monsoon conditions prevail over the Island from May to September and northeast monsoon conditions from December to February, the technical criterion being the position of the northern convergence zone. The rainfall of the southwest monsoon is practically confined to the southwest quarter of the Island, the heavier falls being concentrated along the southern and western slopes of the hills. Northeast monsoon rain is experienced chiefly in the north and east with the larger falls along the northern and eastern slopes of the central hills.