to isostatic adjustment. Work at Minicoy leads to the interesting conclusion that the Laccadive islands are tectonically different from the Maldive islands.

Two detachments were employed on tracing sections of the geoid by means of stations at close intervals by observing both components of the deviation of the plumb line. One worked from Assam–Burma frontier through Bengal to Bihar. In 1934–35 it is expected to push this up to Agra and to observe in Sindh and Baluchistan. It is expected that by 1935–36 the whole section from Persia to Indo-China would be completed. The second detachment observed latitude only between Cape Comorin and Hyderabad (Deccan). The observations of the Siamese Survey have been made use of along with those of the Indian and the geoid calculated. The radius of curvature of the east-to-west section 2,500 miles long is 700 feet greater than that of the international spheroid, while the curvature of a 2,000 miles north-to-south section 1,500 feet less than that of the international spheroid. It is suggested that the geoid of South Siam is 100 feet higher than any geoid that fits in with those two arcs and that therefore South Siam shows some departure from isostatic equilibrium. This might lead to some earthquake in the near future.

In Chapter VIII on research notes, conversion maps are given showing the heights of the International Spheroid over the Everest Spheroid used by the Geodetic Survey, as well as over that of its spheroid II used since 1928. The short Chapter VI gives the value of longitude observed at Dehra Dun for the International project arranged by the Burma International de l' heure at Paris, working with four different instruments. Standardisation measurements are given in Chapter VII. Tide predictions from observations at 14 ports are given and the accuracy discussed.

B. DASANNACHARYA.

The Geology of Ceylon.*

THE island of Ceylon constitutes largely a continuation of the main geological formations of Southern India. Like the adjacent mainland it consists of large masses of ancient crystalline schists and narrow fringes of some of the later sediments deposited along the coastal strips.

Mr. J. S. Coates has recently published an account of the geology of the island, based on the results of his traverses over the greater part of the country, supplemented by numerous scattered observations which he had been able to make while engaged as Government Mineralogist. According to him nine-tenths of the island is occupied by the Archean crystalline schists with only a few narrow belts of sediments along the coast. The sequence of rock formations as given by the author is as noted below :—

Post Tertiary,
Miocene,
Jurassic,
Archean.

The *Jurassic* rocks are described as forming an insignificant series occupying a small area of less than a square mile in extent. They are found exposed near Tabbawa, at a distance of about 80 miles N.N.F. of Colombo, and form a series comprising of conglomerate, grits and sandstones, shales and nodular limestones attaining an estimated thickness of about 2,000 feet. The sandstones and shales are unfossiliferous, but impressions of a number of plant relics have been found in a clay bed. Amongst them, many of the identified species seem to be of lower Oolite and Upper Liassic horizons and correspond to the plant fossils recorded from the Madras Coast.

The *Miocene* rocks form the entire peninsula of Jaffna and they are also seen as narrow fringes in the north-west coast, extending to a width of about 10 to 12 miles inland. This formation consists mainly of fossiliferous limestone succeeded by a series of sandy argillaceous beds and mottled sandstones. The fossils from the Jaffna limestone include several identifiable species of molluses and foraminifers. The palæontological evidence leads to the conclusion that this series of rocks of the north-west Ceylon are identical with similar rocks at Quilon in Travancore, and are of an older age than those of Karikal on the Coromandel Coast of India.

Pleistocene and Recent.—These post-tertiary formations consist of various types of coastal deposits, including sandstones, coral

* "The Geology of Ceylon," J. S. Coates. *Ceylon Journal of Science*, 1935, **19**, Sec. B, Part 2.

deposits and blown sand, a detailed account of which is given by the author.

Archean.—The Archean formations of Ceylon like those of the Peninsular India show a great variety of groups which are described under the following names:—

(*a*) *Bintenne gneiss.*—This name is given to a series of complex banded granitic gneisses covering an extent of about 5,000 square miles of the island in its south-eastern part. The biotite gneisses of this complex are noted to show very variable strikes, but they seem to dip consistently, especially in the eastern Bintenne area, everywhere conformably under the "Khondalite" rocks, forming possibly the floor on which the great masses of the latter group were laid down. The gneisses of this group form a composite series without any perceptible clear lines of junctions to enable one to separately classify and map the individual components. The Bintenne gneiss recalls certain features characteristic of similar gneisses of other Archean terrains, but it differs from the Bengal gneiss of India in having no intercalated beds of limestone or dolomite and also in containing very few accessory minerals.

(*b*) *Khondalite series.*—An extensive series of schistose and gneissic rocks comprising quartzite or granular quartz rock as its principal member, fissile quartz schists, finely banded quartz-felspar gneisses with or without biotite and garnet, impure crystalline limestones and a variety of garnet sillimanite schist, form among themselves a distinct group separable from the other gneisses of the island. They are confined almost to the central part of the island, covering an area of about 5,000 square miles.

They have a general resemblance in appearance and character to the great masses of the garnet-sillimanite-graphite schists or the "Khondalites" of the Kalahandi State in the north-east part of the Peninsular India. In Ceylon, varieties corresponding to the typical "Khondalites" of Dr. Walker, are rather rare, and many of the types differ from them generally in containing felspar and in not having graphite. The associated crystalline limestones or marbles, especially the darker varieties, contain abundant silicates like olivine, dark pyroxene, tremolite and pale phlogopite. Clinohumite is also found at certain places as a conspicuous constituent of these limestones. Pyrite, graphite, magnetite and spinel are some of the non-silicate minerals usually present.

The series with its intercalated bands of Charnockite is estimated to have a total thickness of some 30,000 to 40,000 feet. The rocks of this group, like the Khondalites of Peninsular India, are believed to have originated from the metamorphism of a series of sediments consisting of limestones, shales, sandstones and arkoses.

(*c*) *Kadugannawa gneisses.*—Bounding the western edge of the "Khondalite Series" in the central part of the island, is another series of rocks which outcrop as a thick lens of about 30 miles in length north and south and 8 miles across the thickest part, gradually tapering away at both ends. The types forming this complex are dense, black, glittering hornblendic rocks with more or less biotite and felspars, and comprise of banded, massive and schistose varieties. Some of the narrow bands are stated to contain mainly of pyroxene, while calcite seems to be always present. Attention is drawn to the close resemblance of these Kadugannawa gneisses to the calc gneisses of Fermor. The descriptions of these types as given, seem to fit in also with the types described as secondary pyroxene rocks or Tarurites from the Mysore State. The gneisses are regarded as metamorphosed calcareous sediments of probably the same age as the Khondalite Series.

(*d*) *Charnockites.*—The series of granulitic hypersthene rocks, comparable to the well-known "Charnockites" of Southern India are found widely distributed in Ceylon. They reach their greatest development in the south-west quarter of the island where they seem to be continuous over an area of about 4,000 sq. miles. They are also found as numerous thick sills between the schists of the Khondalite Series. Isolated exposures are found in other gneissic areas as well. Acid, intermediate, basic and ultrabasic types all seem to be represented.

The Charnockites of Ceylon are stated to differ from the Indian Charnockites in certain respects, *viz.*, in the almost complete absence of microcline, the widespread distribution of calcite, the prevalence of micaceous types and in the intercalation of numerous bands of garnetiferous leptynites.

Wanni gneisses.—A distinct group of reddish, pink or buff coloured gneisses and granulites of intrusive appearance is found in the northern half of the island. The

different types of this series are all characterised by (1) the paucity of ferro-magnesian minerals, (2) the abundance of magnetite, and (3) the comparative abundance of monazite.

These seem to correspond petrologically to some of the newer granites or gneisses of Peninsular India which have been found intruding the Charnockites.

Pegmatites and basic dykes are also found and among the latter, dolerites, peridotites and pyroxene scapolite dykes have been noted.

Among the economic minerals found and worked in the island, graphite, various gem stones, mica, thorianite, monazite and zircon sands are the most important.

B. R. R.

Diet and Climate.*

DR. CHICK'S "Cantor Lectures" on "Diet and Climate" cover a wider field than their title indicates. While she deals at length with the specific question of ultra-violet light and sunshine in relation to vitamin D, calcium metabolism, rickets, osteomalacia, etc., she has included also sections on diet as influenced by locality, race, and custom. In the first lecture she points out that one of the first important clues as to the cause of rickets was found in the study of its seasonal incidence and geographical distribution. As long ago as 1890, Theodore Palm put forward the theory that rickets is a disease of sunless places. His theory, broadly speaking, was correct, but it was not until over 30 years later that the reason *why* rickets tends to be a disease of sunless places was discovered. The explanation, which is at once remarkable, unexpected, and completely satisfying, was provided during the years 1918–30 as a result of the labours of many investigators working independently at different aspects of the problem in their respective countries. No single worker can claim credit as the discoverer of the cause of rickets.

Dr. Chick comments on the existence of rickets, and especially osteomalacia, in Northern India and China. In these regions there is plenty of sunlight capable of transforming the eyesterol normally found in the skin into vitamin D, but there exist "social customs which hinder access to fresh air and sunshine for women and children". At the same time there tends to be a deficiency of mineral salts in the diet. "Vitamin D can only control and correct the metabolism of lime salts and phosphates if these are present in adequate quantities in the diet; sunshine can only provide vitamin D if the inhabitants take advantage of the supply thus provided."

Wilson has shown that rickets and osteomalacia occur in Kashmir even in villagers fully exposed to sunlight. Here, it seems, the chief factor in the causation of these diseases is mineral deficiency rather than lack of vitamin D. The administration of tri-calcium phosphate has proved more effective in treatment than cod liver oil. As a result of the lack of calcium salts and phosphates in the diet, vitamin D, derived from sunshine, is unable to fulfil its proper function.

The lecturer emphasises the association between a high intake of milk and its products and good physique. As McCollum has remarked, "Wherever dairy animals are abundant in proportion to the population and their products form a staple article of diet, fine physical development is seen without exception." In India, McCay was the first to suggest a relationship between the physical characteristics of the various peoples and their staple diet. His investigations have been confirmed and extended by McCarrison, and precisely parallel observations have been made by workers in other parts of the world—notably by Orr and Gilks in East Africa. In England it has been amply demonstrated that an improvement in national physique could be brought about by an increased consumption of "protective" foods, notably milk.

Dr. Chick concludes with some wise remarks about the need for common sense in applying in practice the scientific principles of nutrition:

"A great deal of exact knowledge is now available and ready to be applied, but dietetics is not an exact science, and the application of the science of nutrition to the art of dietetics needs to be made with common sense and with intelligent adaptation to the particular circumstances. For example, it is vital that the Madrassi peasant or the Malay coolie should be weaned from rice

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* The Cantor Lectures. "Diet and Climate" by Harriette Chick, C.B.E., D.Sc., *Journal of the Royal Society of Arts*, Sept. 13 and 20, 1935.