

number of isomers represented by the structure becomes unduly large, so that it becomes scarcely possible for the synthetic chemist to obtain a product identical with the one in question.

Two outstanding problems in terpene chemistry remain to be solved, the mechanism of the formation of terpenes in plants and the part they play in plant metabolism. It is simple on paper to derive any terpene from geraniol or linalol but there seems to be little justification

for such a procedure. In many theories the assumption is made that the more complex terpenes are built up from the simpler. It is more probable however that the simpler terpenes originate with the degradation of the poly-terpenes and resin acids, similar to starch being the progenitor of the simpler saccharides. Our knowledge of the chemistry of these is still too limited however for the elaboration of any definite scheme.

Physiology of the Individual in the Tropics.*

THE address of Bt. Col. R. N. Chopra can conveniently be divided into two parts: the first part deals with the general principles involved in the phenomenon of adaptation; and the second part deals with the physiological adaptive reactions produced in the individual under tropical climate.

"The objective of human physiology is the study of 'normal' individual." But the term normality is a relative condition, as the human individual is influenced by the environment which is in itself a variable factor and which is continuously changing in different parts of the globe. Hence there is a necessity to find out the normality of the individual in relation to his environment. Importance of this aspect of study drew the attention of scientists from time to time even from prehistoric days until the advent of the science of bacteriology in the latter part of the nineteenth century, when it lost its significance.

Man reacts to forces of nature, which tend to disturb the physiologic equilibrium, by "continuous adjustment of internal relation to external relations". He adapts himself "to live best under varied environmental conditions". The physiological equilibrium is of a dynamic and oscillatory nature and is the resultant of the reactions of the body to various internal and external stimuli. The adjustment is brought about by development of compensatory mechanisms so as to mobilise the reserve forces in the individual. Depending on the degree of such adjustments, the power of adaption can be made to be set at a high level by previous "training".

Chemical, hormonal and nervous mechanisms, being the means of adaptation to environment, operate singly or conjointly. With the development of reason the nervous adaptive reactions become more 'complex, conscious and volitional'.

Of the environmental conditions in the tropical plains, the temperature, humidity and sunlight are the important climatic factors. They produce reactions on the various systems of the body, and the resultant effect may be the summation of these reactions.

The exact way in which the beneficial biological effects are produced by the sunlight is not clear. High humidity has not much direct effect but when associated with high temperature adversely affects the individual by preventing heat-loss through evaporation. High external temperature does not seem to have an effect on body temperature.

The temperature of the living body is maintained constant by balancing the production and loss of heat. Neither the relatively high

humidity of the atmosphere nor the concentration of sweat glands in the skin play an important part in heat loss. The composition of sweat, by lowering its salt concentration becomes altered as a measure of adaptation, when there is an excess of its excretion to lose body heat. The other adaptive measure concerned in regulating heat-loss is the development of a deep pigment in the skin.

The effect of tropical climate on gastro-intestinal tract is to produce an atonic condition with the resulting stasis and constipation. Possibly, this is due to reflex vaso-constriction in the viscera with increased vasodilatation in the skin. That the gastric acidity is much diminished due to temperature in tropical vegetarians is practically disproved. The bacterial flora of the intestine becomes changed due to high external temperature on the one hand and the rich carbohydrate diet on the other.

A change in depth but not in rate of respiration occurs as an adaptation, during acclimatisation in tropics. The rate and depth of respirations of a native of tropical plain do not differ from those of a person of temperate climate.

Changes in blood pressure and pulse-rate are relatively insignificant. Blood volume increases as a compensatory measure to restore the diminished blood supply to viscera. The only significant change in the hematological standards is a slight decrease in white blood corpuscle count, particularly a decrease in polymorphs and a noticeable increase in eosinophiles. Marrow stimulation is suggested by a shift of Arneeth count to the left. Plasma concentration is greater, water being held in corpuscles. Proteins and lipoids decrease and calcium increases in plasma.

The reported psychological changes in tropical climates are probably due to causes other than climate. The absence of any definite evidence indicating changes in the nervous system does not preclude the possibility of subtle changes in the nervous system of the young.

The metabolism, energy level and resistance to infection are lowered and the cause is attributed to the hypo-activity of Thyroid-Adrenal apparatus. Sex-glands are said to be less active in tropics.

Associated with the metabolic function is the problems of diet in tropics. The greater part of available food is of vegetable source. The diet of the natives of the tropics is one containing plenty of carbohydrates, relatively small quantity of proteins of vegetable origin and of low biological value and practically no fatty acid which is of great value in growth and nutrition. Though this type of diet got up probably from custom, seems to be well adapted for tropical climate. But there is a necessity

* Summary of the Presidential Address of Bt. Col. R. N. Chopra, Physiology Section, Indian Science Congress, Calcutta, 1938.

to find out the proper amount of protein of biological value that is to be added to this diet.

The high temperature and humidity of tropical climate seems to lower the resistance of the gastro-intestinal tract and nasopharynx to bacterial infections. Possibly the sudden change that is more responsible than the climate itself.

With regard to immunological reactions under tropical conditions, more work is to be done.

In the concluding remarks of the address, attention is drawn to the salient features of the address and to the fields in which further work is to be carried to supplement the scanty information available on those topics.

Zoology and its Advancement in India.

ZOOLOGY and its advancement in India was chosen by Prof. G. Matthai as the subject of the Presidential Address before the Section of Zoology, as the Indian Science Congress celebrated its Silver Jubilee at the 1938 Session in Calcutta. The address dealt with the progress of Zoology since the foundation of the Indian Science Congress in 1914, more particularly since 1921.

Oceanographical investigation of the Indian Ocean was conducted, since the first meeting of the Indian Science Congress, mainly by R.I.M.S. 'Investigator' (till 1926) and the John Murray Expedition (1933-34), under the direction of Lt.-Col. Seymour Sewell, F.R.S. Previously the 'Sea-lark' Expedition, under the leadership of Prof. J. Stanley Gardiner, F.R.S., had surveyed the western Indian Ocean south of the Maldives, more particularly the Islands of the Chagos Archipelago and the Mascarene region (during 1905-06 and 1908-09). The work of the 'Sea-lark' Expedition was mainly on problems relating to coral reefs and atolls and their biology, and was a continuation of a previous study of the Maldives and Laccadives. The R.I.M.S. 'Investigator' concentrated its work in the Andaman Sea and the Bay of Bengal. The recent work of the John Murray Expedition was in the region of the Arabian Sea, not covered by the 'Sea-lark' Expedition. The study of the Deep-sea Biology of this region was assisted by physical, chemical, hydrographic and topographic investigations. The Survey of India collaborated with the John Murray Expedition in the cruise down the Maldives for making pendulum observations with a view to determining the nature of the foundations on which the Maldives and Laccadives are situated.

The work of the R.I.M.S. 'Investigator' has extended our knowledge in regard to variation in the air temperature over the open waters of the Indian seas, in the wind force, in the amount of rainfall and in the relationship between the temperature of the sea surface and that of the air. There is always a vertical circulation of the layers of water caused largely by differences in temperature and salinity. A reversal of seasons is noticeable in the Indian seas at a depth of about 100 fathoms, comparable to the phenomenon that takes place in the temperate seas.

The 'Murray Ridge' discovered by the John Murray Expedition appears to be ultimately connected with the Carlsberg Ridge. The latter ridge divides the western region of the Indian Ocean into north-eastern and south-western halves. 'King Fuad Bank' is probably a submerged atoll with a distinct rim about 40 feet high and a level floor 130 fathoms deep.

Regarding the reefs of the Western Indian Ocean, Prof. J. Stanley Gardiner, F.R.S., recently pointed out that the Mascarene region differs from the Chagos Archipelago in regard to conditions of reef-growth, changes adverse to reef-growth taking place at a much faster rate than

in the latter. The regression of coral reefs in the Mascarene region does not appear to be due to any biological reason such as sedentary organisms that cause destruction by boring into the reefs, since the activity of such organisms is decreased at the depths at which reefs of this region are situated, nor by sediment which cannot settle on the seaward sides of reefs and banks nor by precipitation of calcium carbonate (for such precipitation is not visible on coral polyps on the seaward sides), nor by currents whose action is less on the sides facing the sea, nor by temperature which at 50 fathoms is not lower than 61°·9 F., nor by any decrease in the amount of plankton that serve as food material to coral polyps, for it is not liable to much quantitative variation in the Indian Ocean, nor does the chemical composition of the surface water in the Indian seas show any appreciable difference. The comparative poverty of the deep sea fauna in the Chagos and Mascarene regions is perhaps due to the hardness of the sea floor and to the fact that the quantity of plankton which serve as food material to the larger organisms is less than in the Indian seas than in the temperate regions. In spite of the 'shallow and few-conditions' of life on the reef of these regions, it is interesting to observe that the animals do not exhibit any special structural features that may be regarded as adaptations to the peculiar environmental conditions.

The Madreporarian corals collected by Prof. J. Stanley Gardiner, F.R.S., in his several expeditions to the Indian Ocean, particularly of the Astræid corals, provided material for a comparative study, of the morphological organisation of their hard and soft parts, with a view to determining, if possible, the limits of species and genera, most previous taxonomic studies on corals having been based on characters taken solely from the hard parts that are liable to considerable variation. The same material, along with others, formed the basis for a study of colony formation in Astræid corals.

The Zoological Survey of India has been engaged mainly in faunistic investigation, more especially of the brackish water of the Chilka Lake and its island (Barkuda), the estuarine fauna of Goa, the fauna of the Muttah River, of the Inle Lake, the Indian fresh-water Molluscs and their Trematode parasites, the aquatic and terrestrial fauna of the Punjab Salt Range, the cave fauna of the Siju Cave in Assam. Particular attention has been paid to the study of the fishes of mill streams in various parts of India and their structural and other adaptations to this peculiar environment. Fisheries research, especially on *Trochus*, was conducted in the Andamans.

The address ends with a brief account of the research work carried out in the various Zoology Departments in India,