is unnecessary to discuss in detail the numerous experiments in the cultivation of economic plants which have been and are still being conducted in the garden since its beginning. A few of the products tried may simply be mentioned. Chief among these are flax, hemp, rhea or ramie, tobacco, henbane, vanilla, coffee, India-rubber, Japanese mulberry, cardamoms, tapioca and cacoa. As regards horticulture, it may suffice to say that a large proportion of the kinds of exotic plants now found in private gardens in India have been introduced into the country through the agency of this Garden, and that the improved methods of cultivation were to a great extent initiated here.

The Garden containing about 13,000 species under cultivation, offers enormous opportunity for the study of the tropical flora. These are arranged regionally over the whole area which are divided into 25 working divisions.

The Garden with the Herbarium and Library offers valuable materials for study of Indian plants in detail and tropical flora in general both in its dried and living state.

Thus in the long history of the Garden its usefulness has been for the benefit of India as a whole—not merely for Bengal. The scientific results obtained and the monumental publications of the *Annals* of the Royal Botanic Garden, Calcutta, are of world-wide interest. The collections of the herbarium are incomparably the most valuable scientific collections of their kind in Asia and one of the most valuable in the world. The Herbarium with the library is fittingly situated in the Garden. The collections of the Herbarium dates from Roxburgh's time. The approximate number of sheets in the Herbarium is estimated to be about two and a half million. These are arranged according to Bentham and Hooker's *Genera Plantarum*. All the precious collections of India, Burma and a fair number of plants of those of Asia outside India, Europe and Australia, also a few of Africa and America are housed in the Herbarium. The provincial floras are stocked in almirahs situated in the northern wing. The southern wing is mainly occupied by the Library. The Library contains nearly 2,500 volumes and some of the oldest botanical periodicals, the full set of the irreplaceable Roxburgh's *Icones*. The present Herbarium building is damp-proof and fire-proof and was erected specially for the purpose by the late Sir George King in 1883 for housing securely the irreplaceable collections.

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# The Chemistry of Sesquiterpene Ketones.*

ALTHOUGH the terpenes have been extensively studied during the last fifty years it is only within the last decade that the sesquiterpenes and their derivatives received the attention of chemists. With the exception of doremone described by Semmler in 1917, no sesquiterpene ketones were known to occur in volatile oils till 1932 and their isolation opened up an interesting field of research. Eremophilones from the wood oil of *Eremophila mitchelli* were the first series of sesquiterpene ketones to be isolated[1] and were found to belong to the eudalin group. Eremophilone forms an epoxide with alkaline $H_2O_2$ and gives a hydroxymethylene derivative thus showing the presence of the grouping $-CH_2-CO-CH:CH$. An isopropenyl side chain was indicated in eremophilone and in hydroxydihydro-eremophilone and an isopropylidene in hydroxy-eremophilone. The naphthalene hydrocarbon obtained by treating eremophilone with Grignard's reagent and selenium was found to be not 1 : 3-dimethyl-7-*iso*propyl-naphthalene as per eudalene structures thus throwing a doubt on the presence of the angular methyl group. The new structures adopted are allied to the ionones and resin acids and are under investigation. Shortly afterwards in 1934, St. Pfau and Plattner[2] described two ketones α-atlantone and β-atlantone occurring in Atlas-cedar wood oil. Their presence in the oil had been overlooked previously since α-atlantone is hydrolysed readily by alkali. The formula assigned to these are based on degradation of atlantones to α-acetyl-dipentene and 4-methyl-$\Delta^3$-tetrahydro-acetophenone. The presence of a small quantity of γ-atlantone was also concluded by formation of 9-acetyl-terpinolene with potash.

Closely related to these two ketones but of an aromatic type are the sesquiterpene ketones turmerone and *ar*-turmerone present in admixture in the oil obtained from the tubers of *Curcuma longa* which have been worked out with great ingenuity by Rupe, Clar, St. Pfau and Plattner.[3] Recently, B. Sanjiva Rao has isolated from the oil present in the tubers of *Cyperus rotundus*, a sesquiterpene ketone α-cyperone which like eremophilone is a derivative of eudalene. It is stereoisomeric with β-cyperone, the two ketones differing from each other in the disposition of the angular methyl and isopropenyl groups and related to each other as menthone and isomenthone. Cyperones have recently been synthesised at Oxford by Prof. Robinson and at Bangor. The very elegant method, so very characteristic of Oxford laboratories, in recent years gave an optically active α-cyperone.[4] Although the synthetic cyperones differed somewhat from the natural products, there appeared to be little doubt that the products had identical structure. The importance of the synthesis lies in the fact that it definitely establishes for the first time the presence of the angular methyl group in cyperones and in compounds of the eudalene type. This is of significance in connection with the eremophilones already referred to.

Though the analytical chemist's methods and weapons have reached a stage of perfection that it cannot be said with the same force, as was said some years ago, that a proof of a particular structure lay in its synthesis in the laboratory. There is no doubt however synthesis plays its own part in some doubtful cases as the above. With compounds of increasing complexity, the

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* Synopsis of an address delivered by Professor J. L. Simonsen, D.Sc, F.R.S., at the Indian Institute of Science on 13th January 1938.

[1] Bradfield, Penfold and Simonsen, *J.C.S.*, 1933, 2744.

[2] *Helv. Chim. Acta.*, 1934, 17, 129.

[3] *Ibid.*, 1934, 17, 372.

[4] Adamson, McQuillin, Robert Robinson and J. L. Simonsen, *J.C.S.*, 1937, 1576.

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 polyterpenes 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.

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# 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 adptation can be made to be set at a high level by previous "training".

Chemical, hormonic 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 hæmatological 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 Arneth 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

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