the less, revision levelling in the present century shows a persistent rise from Dhulia (lat. 20·9°, long. 74·7°) to Cawnpore (which also shows a small rise from Benares); and this, so far as it goes, confirms the Bengal results, which in turn are closely in sympathy with the underloading of which they are a natural consequence.

Before the earthquake occurred, the relevant facts accordingly were (*a*) that there was a large area of serious underloading, flanked by areas of overloading; (*b*) that in the part of this region where spirit levelled heights had been determined in sufficient detail at sufficient time intervals, the results indicated that the land has been rising steadily where the underload occurs, the rate of rise increasing as the centre of that region is approached.

A slow but continuous yielding of the crust has been in progress. When a material is stressed beyond its elastic limit, it yields in a non-elastic way and eventually fractures. In the present case, the earthquake gives evidence of fracture having occurred; and the floods which have followed the earthquake indicate the resulting rising of some portions of the area.

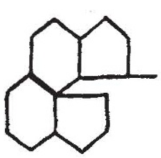
In the case of such a large area, fracture is not likely to extend throughout the entire region of stress, but it occurs at the position where the relation of stress to strength is most severe, and leads to a modification of the general stress distribution. There is no question of one earthquake of the magnitude of that which has recently occurred entirely relieving the stress differences. To do that an uplift amounting to thousands of feet would be necessary. I have little doubt that spirit levelling will show that there has been some sudden rising of the land. Were this of the order of tens of feet, it would immediately be made apparent by a wholesale change in the courses of the local rivers; and indeed, a recent report in the Press states that one of the most impressive features of the disaster has been such changes in river courses.

As stated earlier, the area from Meerut to Darjeeling is one of excessive underloading. A smaller amount of underload exists over a much larger area—a strip skirting the Himalaya from the Punjab to Bengal of width varying from 150 miles to twice that amount. We have so far discussed the eastern portion which provides the area of most acute underloading; but there is another region, roughly centred on Lahore (31·6°, 74·3°) where underloading of very considerable amount—about 2,000 ft. of rock-equivalent—exists. This region is not completely defined, as in the north-west it passes out of the area for which the necessary geodetic observations have been made. It is just in this neighbourhood that the last serious Indian earthquake—Kangra (32°, 77°)—occurred in 1905. Eight years previously, in 1897, there was the Shillong earthquake, with epicentre at 26°, 91°. Unfortunately, this is outside the area of full geodetic survey, and spirit levelling was not commenced in that region until 1900, so as yet we have no knowledge of what anomalies of loading exist there or of the secular changes of ground height.

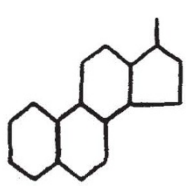
Recent Developments of Sterol Chemistry in Relation to Biological Problems

By JOHN PRYDE

ONCE again there has been demonstrated in striking fashion the impetus which organic chemistry gains from biology, and how a field of organic research, formerly of purely academic interest, enters on a fresh phase of development in virtue of a new correlation with biological problems. The field in question is that of the sterols and the polycyclic aromatic hydrocarbons.

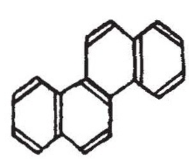


I

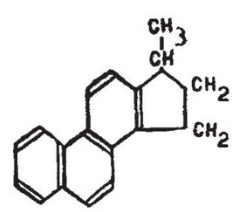


II

It is well known that the fundamental researches of Wieland, Windaus, Mauthner, Borsche, Diels and others on the sterols and bile acids received a new interest on the isolation of calciferol (vitamin D) from the products of irradiation of ergosterol, $C_{28}H_{44}O$, with which the vitamin is isomeric, and that our conceptions of the structure of these, and of other members of the cholane series to which they belong, have been re-oriented by the new formulæ advanced by Rosenheim and King[1]. The structures below show the old (I) and the now accepted representation (II) of the cholane nucleus. The new, and at the time somewhat revolutionary, formulæ conferred a great stimulus on the investi-



III

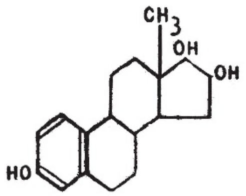


IV

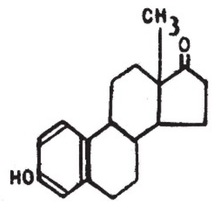
gation of the whole series of compounds. They are based upon evidence which cannot be detailed here, but some of the more salient of the recent observations can be summarised.

Thus, on drastic dehydrogenation with palladium-charcoal or zinc, cholesterol and cholic acid yield the fully aromatic hydrocarbon chrysene (III)[2], whilst less drastic dehydrogenation of these compounds and of ergosterol using selenium yields an interesting hydrocarbon of the composition $C_{18}H_{16}$, first obtained by Diels and his associates[3]. For this latter the constitution IV was suggested by Rosenheim and King[4]. Kon[5] has very recently proved the correctness of this suggestion by a synthesis yielding the desired 3-methyl*cyclo*pentenophenanthrene. It is therefore clear that the formation of chrysene in the more drastic process is due to ring enlargement associated with the migration of a methyl group, and the revised cholane formula of Rosenheim and King becomes firmly established upon fact.

Secondly, the recent isolation and investigation

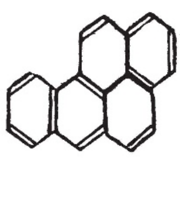


V

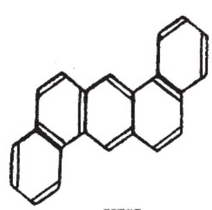


VI

of the female sex (œstrous-producing) hormone, mainly due to the efforts of Doisy in the United States, Marrian in Great Britain, and Butenandt in Germany, show that the hormone occurs in two forms—œstriol (V) and œstrone (VI), to adopt the nomenclature recently advanced in NATURE by workers in this field[6]. Evidence is available which amply establishes the close relationship of the œstrane and cholane series, which may be inferred from the isolation of the same 1 : 2-dimethylphenanthrene from œstriol and from ætiobilianic acid of the cholane series[7]. Mention may also be made of the isolation from œstrone, after dehydrogenation in the presence of zinc, of a hydro-



VII

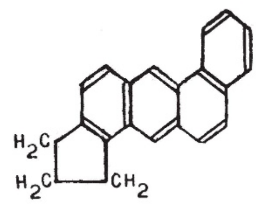


VIII

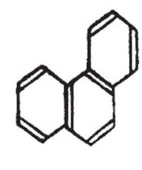
carbon of the same C_{18} series as that obtained from the cholane compounds. To this hydrocarbon Butenandt has ascribed the composition $C_{18}H_{14}$, but in all probability the compound is impure chrysene $C_{18}H_{12}$.

Thirdly, it has been known for many years that the tars and pitches resulting from the pyrogenic decomposition of coal and other organic products frequently possess carcinogenic properties. Much patient work in Great Britain, with which the names of Kennaway and Cook and their collaborators are associated, has culminated in the isolation[8] from a soft coal-tar pitch of a pure actively carcinogenic hydrocarbon, namely, 1 : 2-benzpyrene (VII). This, together with certain other but somewhat less active carcinogenic hydrocarbons [for example, 1 : 2 : 5 : 6-dibenzanthracene (VIII) and 5 : 6-*cyclo*penteno-1 : 2-benzanthracene (IX)][9] has been synthesised and the peculiar biological properties of these compounds have been amply proved.

It will therefore be realised that calciferol, œstrous-producing hormones, and carcinogenic hydrocarbons, all correlated with some phase of growth, all have the phenanthrene nucleus (X) in common. Lastly, the group of the cardiac-stimulating glucosides—strophanthin, digitoxin—yields aglucones in which the phenanthrene nucleus again



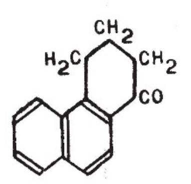
IX



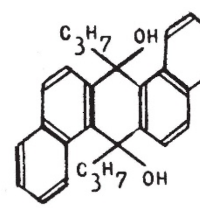
X

occurs[10]. It may also be significant that some of the most powerful alkaloids, such as morphine, codeine, etc., of the opium group, the corydalis alkaloids and colchicine (meadow saffron) contain a phenanthrene nucleus. To this nucleus are added various cyclic and straight-chain substituents which confer on each group its characteristic biological activity.

That these groups of compounds, of such apparently diversified physiological activities, should exhibit such fundamental constitutional similarities is sufficiently striking, but the story does not end here and indeed it would be bold to attempt to predict where it will end.



XI



XII

Mention has already been made in these columns[11] of the œstrogenic action of certain synthetic hydrocarbons and their derivatives—either themselves carcinogenic or closely related to carcinogenic compounds—and of the similar activity of some of the sterols and calciferol. Amongst the former are 1-keto-1 : 2 : 3 : 4-tetrahydrophenanthrene (XI) and 1 : 2 : 5 : 6-dibenz-9 : 10-di-*n*-propylanthraquinol (XII). In reference to the activity of the latter compound, it is of interest to note that a series of diols derived from 1 : 2 : 5 : 6-dibenzanthracene was investigated[12]. Of these the dimethyl, di-*n*-amyl, and di-*n*-hexyl compounds are inactive, whilst the intermediate diethyl, di-*n*-propyl and di-*n*-butyl compounds are all highly active, the propyl derivative showing the maximum activity. The compounds mentioned above are the most active of those so far investigated; then follow in order of activity neo-ergosterol, 5 : 6-cyclopenteno-1 : 2-benzanthracene, 1 : 2-benzpyrene, calciferol and ergosterol. That behaviour characteristic of a specific hormone should be shared by other compounds of related structure, some possessed of physiological activities of their own, provides a remarkable extension of our conceptions of biological specificity. It suggests future developments of great interest in the chemistry and biology of the sterols and the polycyclic hydrocarbons.

1 *J. Soc. Chem. Ind.*, **51**, 464, 954 ; 1932.
2 Diels and Gädke, *Ber.*, **60**, (B), 140 ; 1927.
3 *Annalen*, **459**, 1, 1927 ; **478**, 129 ; 1930.
4 *J. Soc. Chem. Ind.*, **52**, 299 ; 1933.
5 *ibid.*, **950**.
6 NATURE, **132**, 205, Aug. 5, 1933.
7 Butenandt, *J. Soc. Chem. Ind.*, **52**, 268, 287 ; 1933.
8 Cook, Hewett and Hieger, *J. Chem. Soc.*, 395 ; 1933.
9 *Proc. Roy. Soc.*, B, **111**, 455, 485 ; 1932.
10 Jacobs and Fleck, *J. Biol. Chem.*, **97**, 57 ; 1932.
11 NATURE, **132**, 1933.
12 Discussed at a meeting of the Royal Society on Nov. 16, 1933.

Obituary

PROF. ERWIN BAUR

BY the sudden death of Prof. Erwin Baur at the early age of fifty-eight years the science of genetics, and particularly plant breeding, has lost one of its foremost exponents. Having gone to Berlin to give an address at Harnack House on December 2 in commemoration of Correns, whose death was recorded only a year ago, he was suddenly struck down with angina pectoris and died within a few hours.

Baur was born in 1875 at Ichenheim in Baden, the son of an apothecary. He studied medicine in several German universities and was for one year assistant in the Botanical Institute at Kiel, receiving the degree of doctor of medicine in 1900. He served as ship's doctor on a voyage to Brazil, followed by a year of service in the navy. He was afterwards assistant physician in the psychiatric clinic of the University of Keil and physician to an institute in Baden for the insane. In 1903 he returned to botany and received the Ph.D. at Freiburg under Oltmanns, his thesis being on the development of the apothecia in lichens. Apparently his first botanical paper was on the sex organs of the lichen *Collema* (*Ber. deut. bot. Gesells.*, **16**, 1899), the figures from which have frequently been reproduced in textbooks. Baur now migrated to Berlin as assistant in botany, where he became full professor and director of the Botanical Institute of the Königliche Landwirtschaftliche Hochschule in 1911.

The rest of Baur's life was not only actively devoted to research in plant genetics and its applications (except for the last two years of the War, when he was transferred to Potsdam with his staff), but also in this period he founded and directed successively a new Institut für Vererbungslehre in Berlin-Dahlem in 1922 and a still larger Kaiser Wilhelm Institut für Züchtungsforschung at Müncheberg, some distance from Berlin, in 1929.

Erwin Baur was a man of tremendous energy and vigour, but overwork brought his life to an all too early end. His well-known genetical investigations of *Antirrhinum* were begun about 1904, and already in 1910 he was growing some 30,000 antirrhinums a year. He also made the early studies of infectious chlorosis in Malvaceæ, *Ligustrum*, *Fraxinus* and other plants, and his investigations of graft hybrids and chimæras in *Pelargonium* and other plants were notable. His "Einführung in die experimentelle Vererbungslehre", first published in 1911, has passed through eleven editions, and fulfilled somewhat the same functions in Germany that Bateson's well-known "Mendel's Principles of Heredity" did in England.

In a series of classical researches, Baur first investigated the large number of colour factors and other mutational differences in the garden snapdragons. Later his interest in the evolutionary aspects of the genus developed. He collected and studied the wild species of *Antirrhinum* from Spain and other Mediterranean countries, finding throughout the genus that the specific differences behaved as Mendelian characters in crosses. At the Müncheberg Laboratory the same genus was extensively used by Baur, Stubbe and other colleagues in the production of an extraordinary series of mutations in flower and leaf form by the use of X-rays, ultra-violet light, temperature shocks and a wide range of chemical substances. These substances were forced into the leaves through the stomata by centrifuging seedlings which were inverted in tubes containing the solutions. The plants were then set out and allowed to flower. Baur's great knowledge of the wild forms of *Antirrhinum*, their distribution and genetics, will unfortunately be lost, as it had not been put in a form for publication.

Baur's interests lay not only in the wider aspects of genetics but also in their application. This was exemplified in the Masters Lectures of the Royal Horticultural Society, which he gave in 1931. His general evolutionary outlook was that of Darwinian natural selection based on mutational variations, but the aims of the Müncheberg Institution were immediately economic. Baur set about to produce a wheat suitable for light soils in Germany in place of rye, by crossing and selection on a huge scale. By the testing of one and a half million lupins, plants were found in both the yellow and the blue species which were devoid of alkaloid and could be propagated as a forage field-crop. By similar large-scale selection a variety of *Melilotus alba* was obtained free from cumarin, and a tobacco