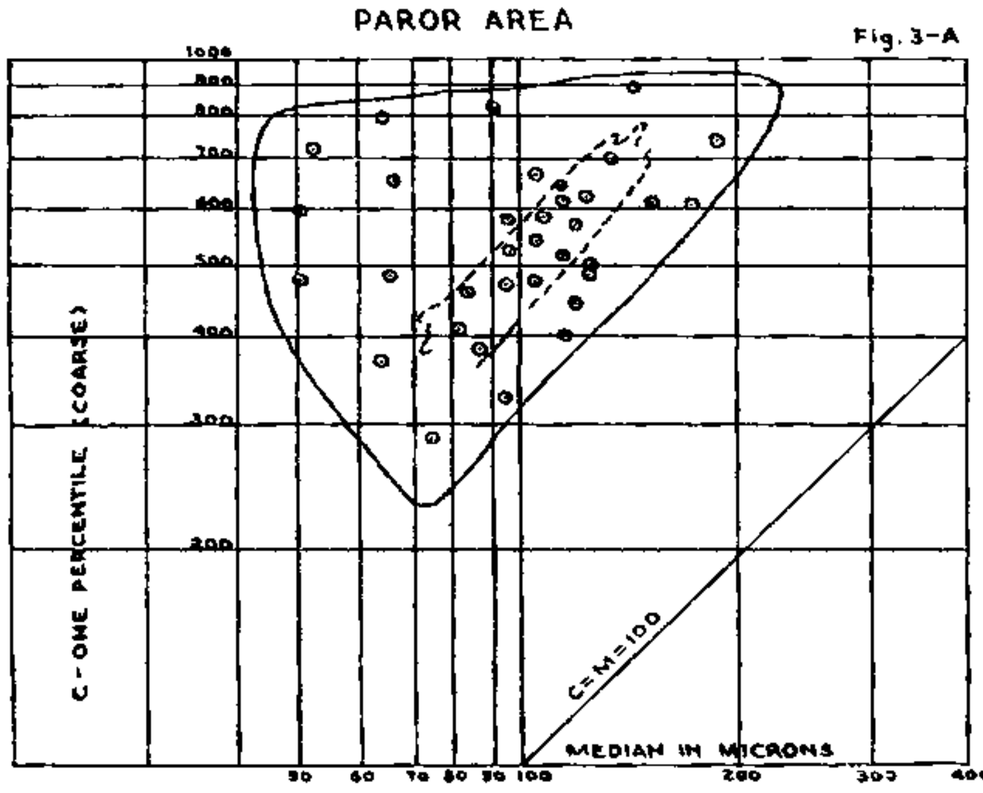
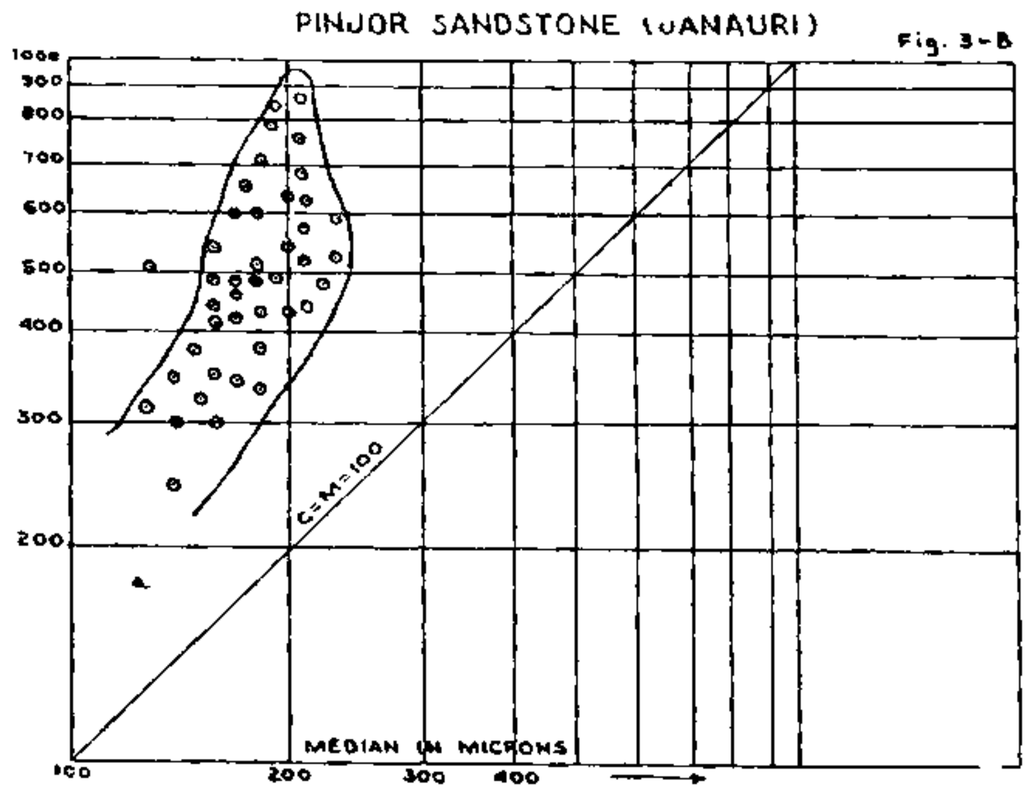
the Upper Siwalik sandstones (Pinjor-sandstones) from Janauri area [Fig. 3 (B)]. These patterns represent river-bed deposits similar to the Nibrar river sands (studied by Passega) and confirm the fluviatile origin of Middle and Upper Siwalik sediments. However, pattern in Fig. 3 (A) which represents Upper Siwalik pebbly sands in Paror area shows a completely erratic sample point distribution. This may be attributed to the fact that in this part of the Punjab the Upper Siwaliks are formed as "inter-Siwalik valley-infillings" under completely continental conditions.[3] A few samples from the basal part of Upper Siwaliks with a stable subrounded tourmaline assemblage show a linear CM relationship and probably represent reworked sediments.

UPPER SIWALIKS

(C.M. DIAGRAM)





Siwalik sediments, therefore, are the products of deposition under varying conditions, even though the fluviatile nature of Middle and Upper Siwaliks is suggested by this study.

1. Passega, R., *Bull. Amer. Assoc. Petr. Geol.*, 1957, **41** (9), 1952.
2. Raju, A. T. R. and Dehadrai, P. V., *Ind. Sci. Cong.*, 1962, Pt. 3, p. 210.
3. — and —, *Quart. Jour. Geol. Min. Met. Soc. of India*, 1961 (Under publication).

APPLICATION OF CHEMICAL ANALYSIS TO SOME CASES OF SYNONYMITY IN BOTANICAL NOMENCLATURE

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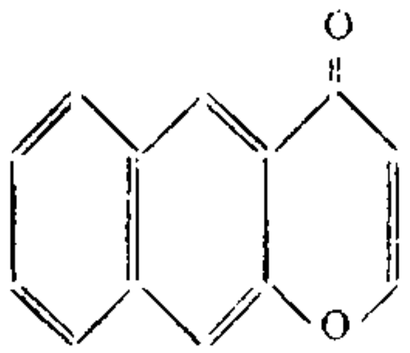
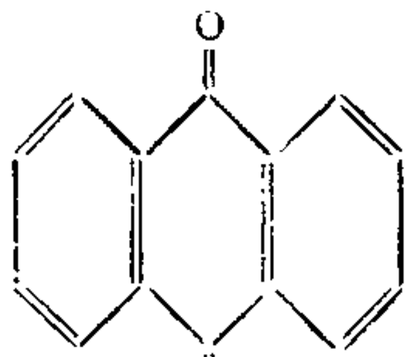
ON account of inherent difficulties, detailed chemical study of plants as an aid to plant classification has not made much headway. It may be said in general that where such study has been made it has corroborated the findings of the systematic botanists as far as individuality of botanical species is concerned. But instances have recently come to light where the chemical study has rightly indicated the need for a revision of the opinion of botanists. A few fresh instances of this nature are mentioned below :

Although Linnaeus recognised the two species of *Cassia* (N.O. Leguminosæ) named as *Cassia tora* Linn. and *Cassia obtusifolia* Linn. as distinct, there has recently been a tendency to consider the two names as synonymous. Chemical information is now available regarding the seeds of both the species. *Cassia tora* seed has been found to contain, among others, rubrofusarin and norrubrofusarin[1] which are derivatives of naphtho-γ-pyrone[2] (I) (previously considered erroneously to be xanthone derivatives).[3] On the other hand *Cassia obtusifolia* seed has been found to contain a number of anthraquinone (II) compounds, viz., chrysophenol, physcion, obtusifolin, obtusin, chrysoobtusin and aurantio-obtusin.[4] The difference between two groups of chemical compounds is unmistakable and there seems to be ample justification for considering the two species as distinct, as indeed Linnaeus originally did. In a paper entitled "A revision of the genus *Cassia* (*Cæsalp.*) as occurring in Malaysia" published

in *Webbia*. 1955, 11, 197-292, De Witt (H.C.D.) accepts *Cassia tora* Linn. as distinct from *Cassia obtusifolia* Linn.,* thus agreeing with the chemical finding.



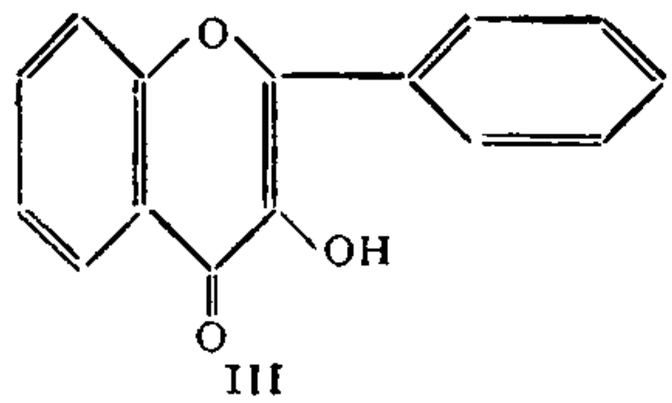
I



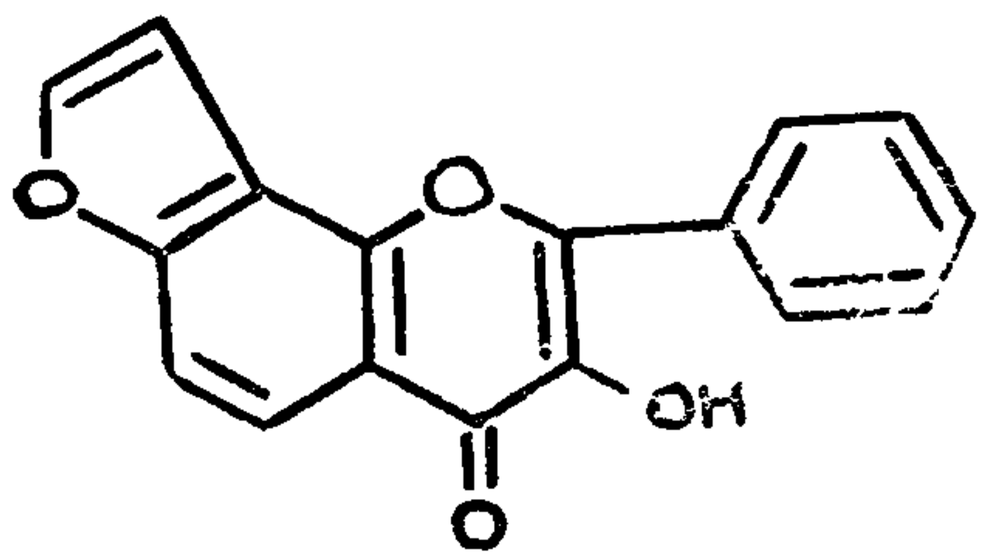
II

Another case is that of the two species *Pongamia glabra* Vent. and *Pongamia pinnata* (Linn.) Merr. (N.O. Leguminosæ). The former is found widely distributed in South India and the latter in Australia. Botanists have considered them as synonymous but their chemical features indicate unmistakable dive gence. Detailed studies of the chemical components of different parts of *Pongamia glabra*, the seeds, flowers, stem-bark and root-bark have been made; but in the case of *Pongamia pinnata* only the root-bark has been studied chemically. Hence in order to be valid the comparison has to be restricted to the composition of the root-bark of the two species. The root-bark of *P. glabra* has been found to contain two closely related flavonol (III) methyl ethers namely kanugin and desmethoxykanugin.[5-7] On the other hand *Pongamia pinnata* root-bark contains four furanoflavones.[8,9] Two of these karanjin and pongapin are angular furanoflavonol (IV *a*) derivatives and the other two, gamatin and pinnatin are linear furanoflavones (IV *b*). The difference in the chemical composition between the two roots seems to be quite definite. On this score the two names *Pongamia glabra* and *Pongamia pinnata* seem to refer to different species and they need not be taken to be synonymous.

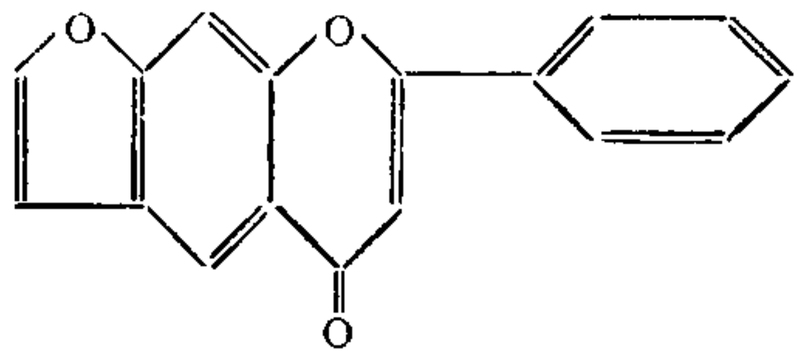
There seems to be a third case also which is interesting. *Daucas carota* Linn. var. *sativa* DC. (N.O. Umbelliferæ), the cultivated carrot of European origin, is now grown widely in different parts of the world. The root tubers invariably contain carotene (β) and carotenoids and the material-pigment relationship is aptly brought out by the names; they are made up of isoprene units (V). There is a carrot indigenous to India commonly used in making sweet preparations. It is intensely red or black in appearance and contains a deep red pigment most intense in the outer layers. It is remarkable in being rich in cyanidin diglucoside (C_{15} skeleton, VI) and in being completely devoid of carotene and carotenoid pigments.[10] The difference in the pigment components is very marked and the habitat also seems to be



III

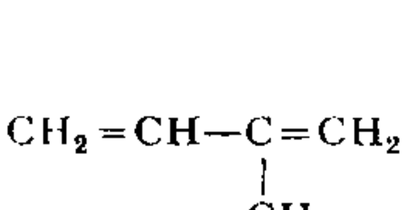


IV *a*

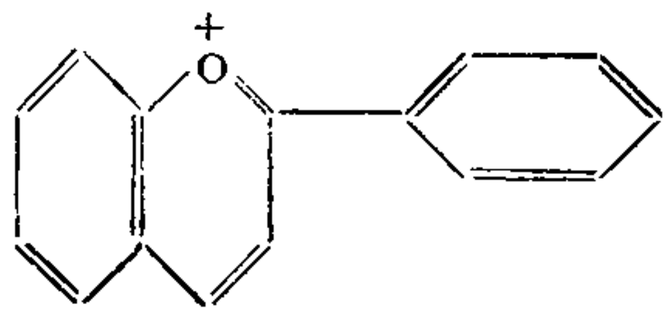


IV *b*

definitely demarked. It would appear that here again we are dealing with two distinct species and not the same species.



V



VI

* The author thanks Dr. H. Santapau, Chief Botanist Botanical Survey of India for this information.

1. Narayana, C. S. and Rangaswami, S., *Curr. Sci.*, 1956, **25**, 359.
2. Stout, G. H. and Jensen, L. H., *Acta Cryst.*, 1962, **15**, 451.
3. Ashley, J. N., Hobbs, B. C. and Raistrick, H., *Biochem. J.*, 1937, **31**, 287.
4. Takido, M., *Chem. Pharm. Bull.*, 1958, **6**, 398; 1960, **8**, 246.
5. Rangaswami, S., Rao, J. V. and Seshadri, T. R., *Proc. Ind. Acad Sci.*, 1942, **16 A**, 319.
6. Rajagopalan, S., Rangaswami, S., Rao, K. V. and Seshadri, T. R., *Ibid.*, 1946, **23 A**, 60.
7. Mittal, O. P. and Seshadri, T. R., *J. Chem. Soc.*, 1956, p. 2176.
8. Row, L. R., *Australian J. Sci. Res.*, 1952, **5 A**, 754.
9. Pavanaram, S. K. and Row, L. R., *Australian J. Chem.* 1956, **9**, 132.
10. Krishnamurti, V. and Seshadri, T. R., *J. Sci. and Ind. Res.* (India) (Under publication).