CHAPTER -II

SECTION-A: A SHORT REVIEW ON "DIHYDROXY TRITERPENE ACIDS".

The acids belonging to the category "Dihydroxy triterpene acids" that have been isolated from natural sources, synthesis and assigned definite structures up to April of 1980 are classified in Table A and will not be further discussed.

Table -A

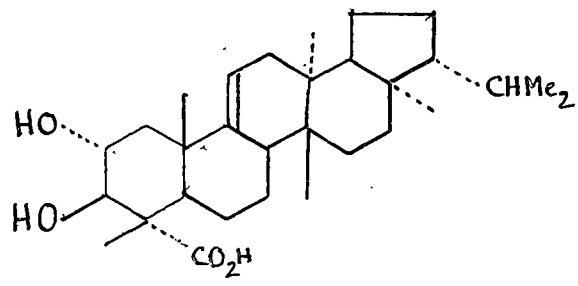
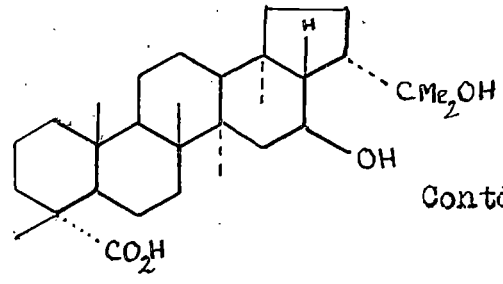
Sl. No.	Name, Molecular formula, m.p. °C and $[\alpha]_D$	Structure	Reference
1.	Retigeric acid A $C_{30}H_{48}O_4$ m.p. 296-99° $[\alpha]_D$ 26.5°		4
2.	Leucotylic acid. $C_{30}H_{50}O_4$ m.p. 260°C $[\alpha]_D$ 330°		5

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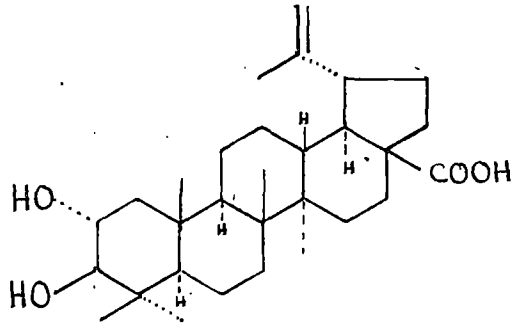
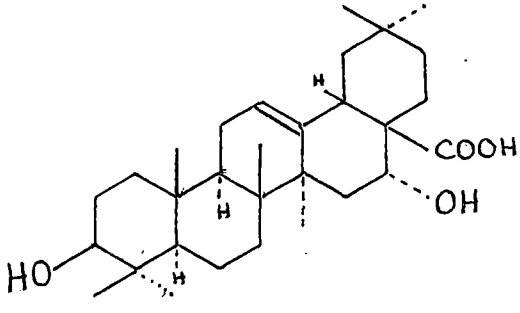
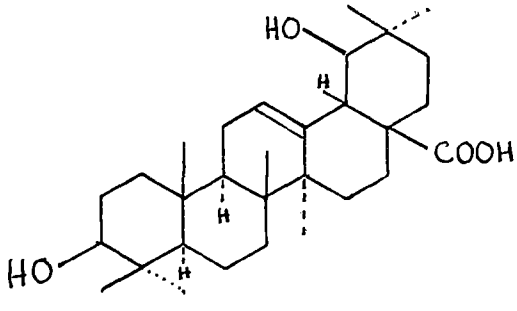
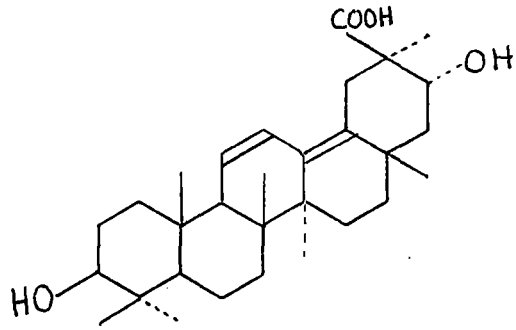
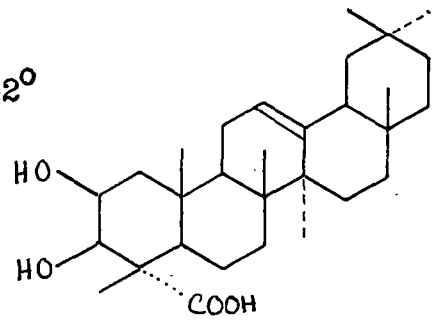
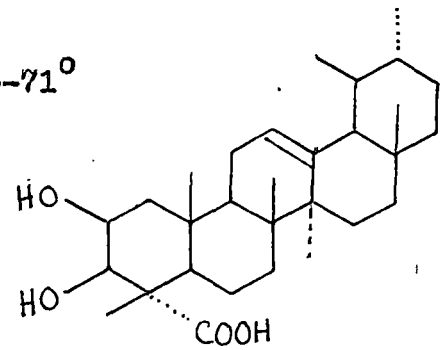
Table - A (Contd..)

Sl. No.	Name, Molecular formula, m.p. °C and $[\alpha]_D$	Structure	Reference
3.	Alphitolic acid $C_{30}H_{48}O_4$, $[\alpha]_D$ 14.1° Me-ester m.p. 234-37°		6
4.	Cochalic acid $C_{30}H_{48}O_4$ m.p. 303-6° $[\alpha]_D$ 58°		7
5.	Spinosic acid $C_{30}H_{48}O_4$ Me-ester m.p. 206-8° $[\alpha]_D$ Me-ester 70.0°		8

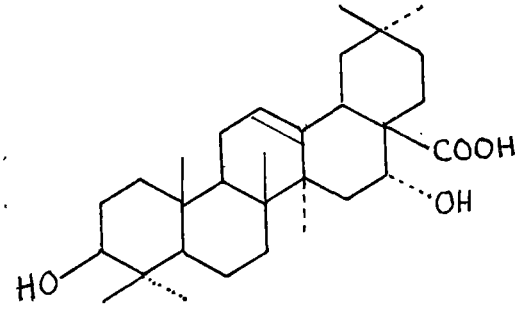
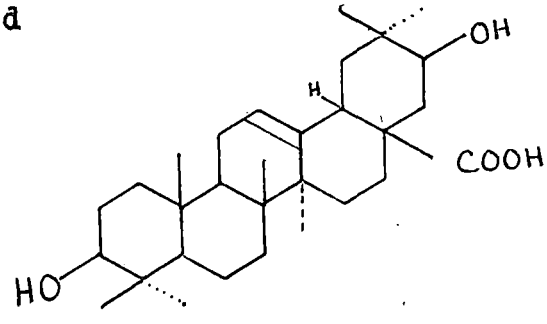
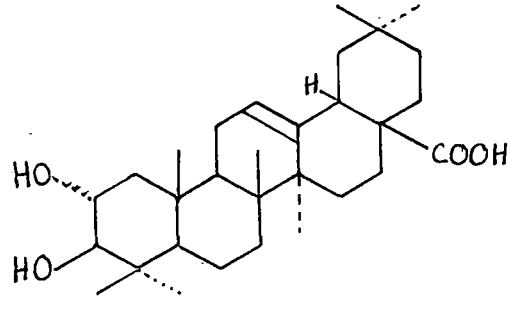
Contd..

Table -A (Contd..)

Sl. No.	Name, molecular formula m.p. °C/ $[\alpha]_D$	Structure	Reference
6.	Macedonic acid $C_{30}H_{46}O_4$ m.p. 340-43°		9
7.	Commic acid C $C_{30}H_{48}O_4$ Me-Ester m.p. 239-42° $[\alpha]_D$ 84°		10
8.	Commic acid D $C_{30}H_{48}O_4$ Me-Ester m.p. 268-71° $[\alpha]_D$ 76°		11

Contd..

Table -A (Contd..)

Sl. No.	Name, molecular formula m.p. °C/ $[\alpha]_D$	Structure	Reference
9.	Echinocystic acid $C_{30}H_{48}O_4$ m.p. 305-12° $[\alpha]_D$ 40.6°		12
10.	Machaerinic acid $C_{30}H_{48}O_4$ m.p. 232-4° $[\alpha]_D$ 76°		13[a,b]
11.	Crategolic acid $C_{30}H_{48}O_4$ m.p. 263-65° $[\alpha]_D$		14

Contd..

Table-A (Contd..)

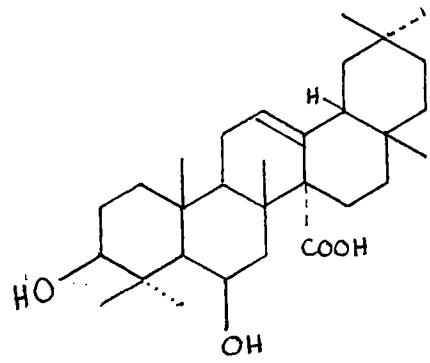
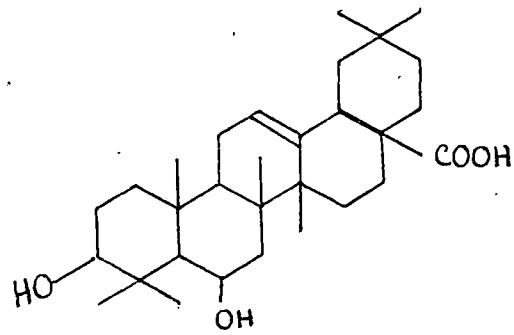
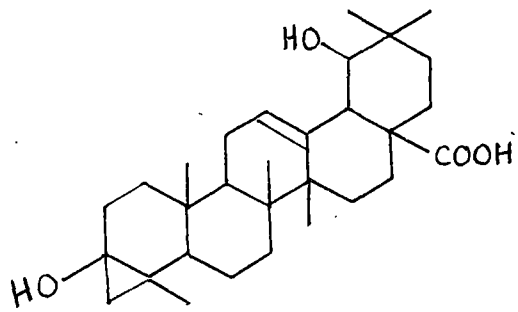
Sl. No.	Name, molecular formula, m.p. °C/ $[\alpha]_D$	Structure	Reference
12.	Astilbic acid $C_{30}H_{48}O_4$		15
13.	Sumaresinolic acid $C_{30}H_{48}O_4$ m.p. 298-9° $[\alpha]_D$ 102.2°		16
14.	Siaresinolic acid $C_{30}H_{46}O_4$ m.p. 274-5° $[\alpha]_D$ 98.5°		17a,b,c

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Table -A (Contd..)

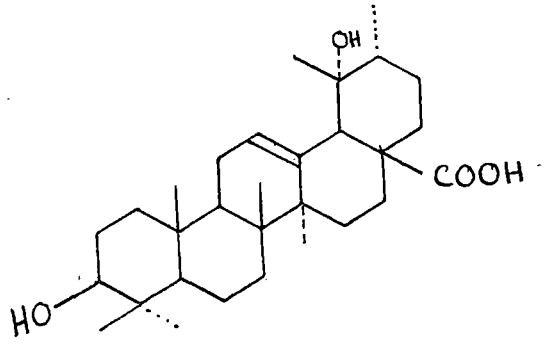
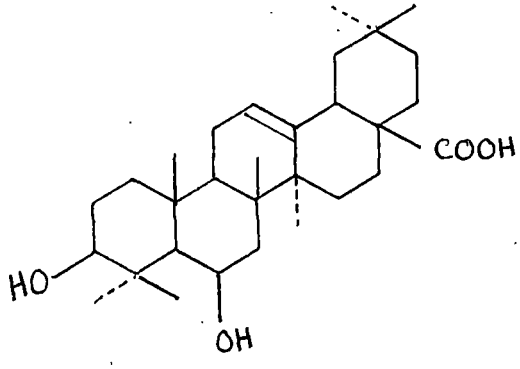
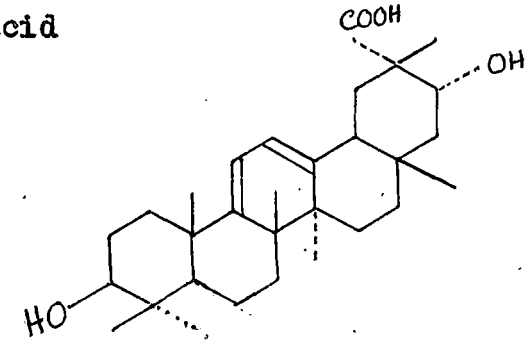
Sl. No.	Name, molecular formula, m.p. °C/ $[\alpha]_D$	Structure	Reference
15.	Polomic acid $C_{30}H_{48}O_4$ m.p. 272-5° $[\alpha]_D \pm 0°$		18
16.	Rubusic acid $C_{30}H_{48}O_4$ m.p. 265-70° $[\alpha]_D$ 55°		19
17.	Isomacedonic acid $C_{30}H_{46}O_4$		20

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Table - A (Contd..)

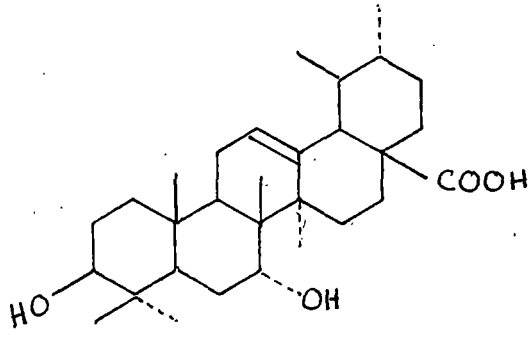
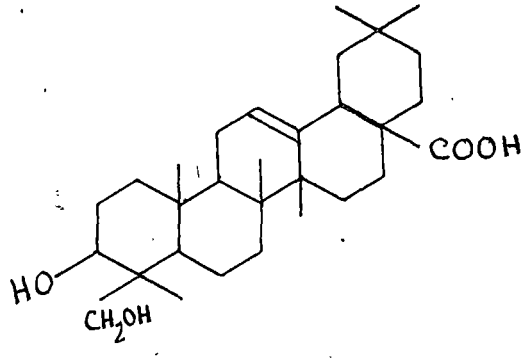
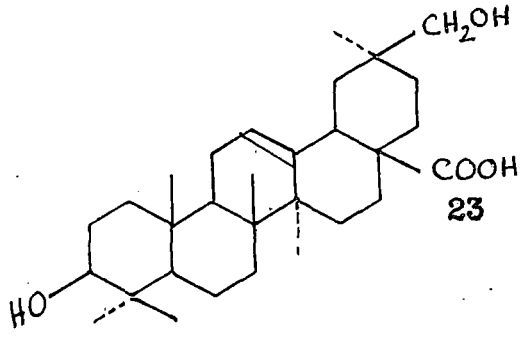
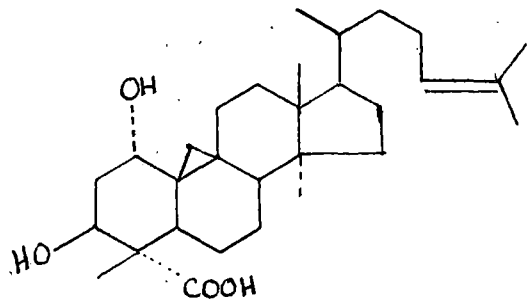
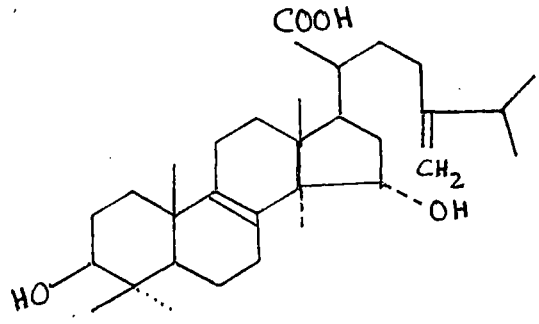
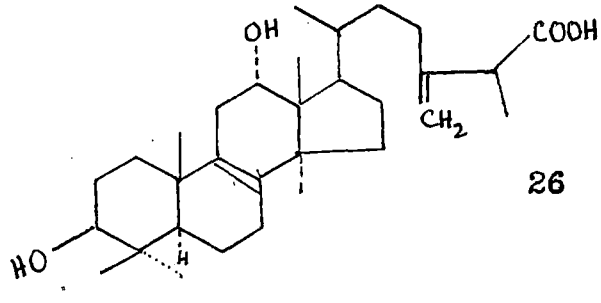
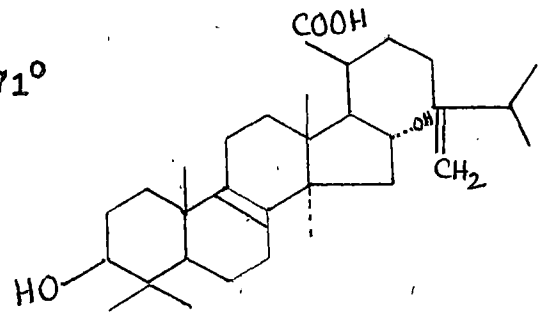
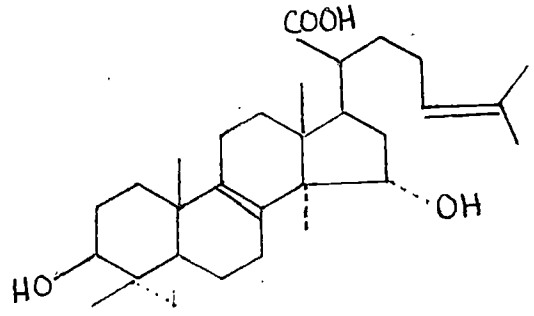
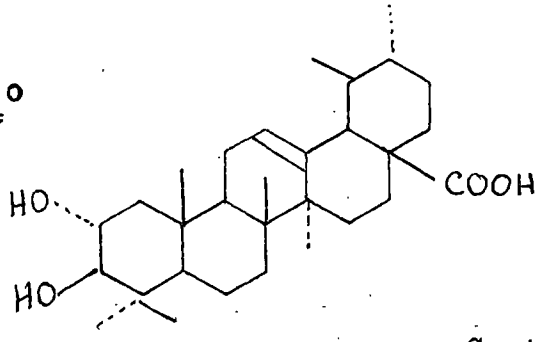
Sl. No.	Name, molecular formula, m.p. °C/ $[\alpha]_D$	Structure	Reference
18.	Rubitic acid $C_{30}H_{48}O_4$ m.p. 252-54° $[\alpha]_D$ 65°		21[a,b]
19.	Hederagenin $C_{30}H_{48}O_4$ m.p. 332-4° $[\alpha]_D$ 80°		22
20.	Queretaroic acid $C_{30}H_{48}O_4$ methyl ester m.p. 223-24° $[\alpha]_D$ 67°		23

Table - A (Contd..)

Sl. No.	Name, molecular formula, m.p. °C/ $[\alpha]_D$	Structure	Reference
21.	Mollic acid m.p. 248-50° $[\alpha]_D$ 38°		24
22.	Sulphurenic acid $C_{31}H_{50}O_4$ m.p. 252-4° $[\alpha]_D$ 42°		25
23.	Polyporenic acid A $C_{31}H_{50}O_4$ Me-ester m.p. 148° $[\alpha]_D$ 84°		26

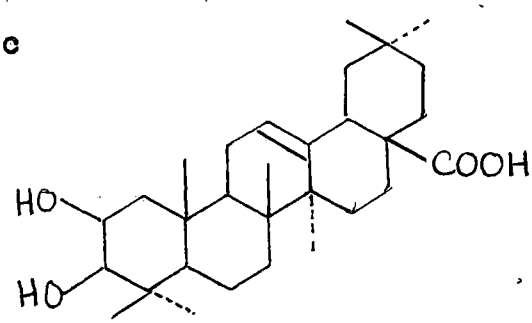
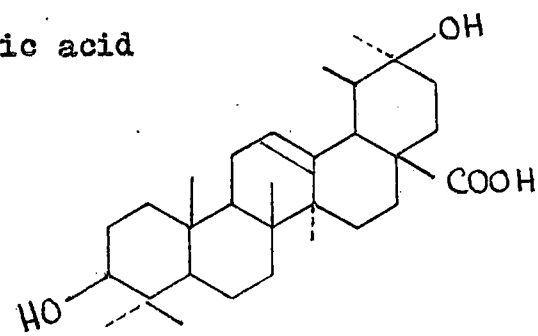
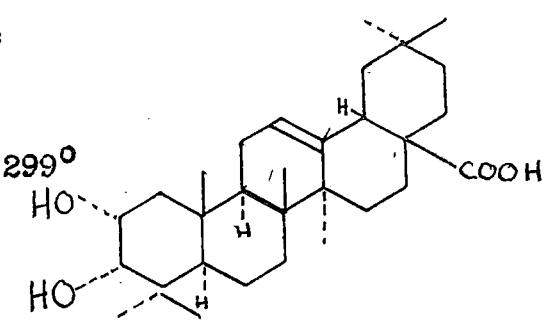
Contd..

Table -A (Contd..)

Sl. No.	Name, molecular formula m.p. °C/ $[\alpha]_D$	Structure	Reference
24.	Polyprenic acid B $C_{31}H_{50}O_4$ Me-ester m.p. 168-71° $[\alpha]_D$ 28°		27
25.	15α, hydroxy tramtenolic acid $C_{30}H_{48}O_4$ m.p. 255° $[\alpha]_D$ 45°		28
26.	2α, hydroxy ursolic acid $C_{30}H_{48}O_4$ Me-ester m.p. 212-14° $[\alpha]_D$ 54.5°		29

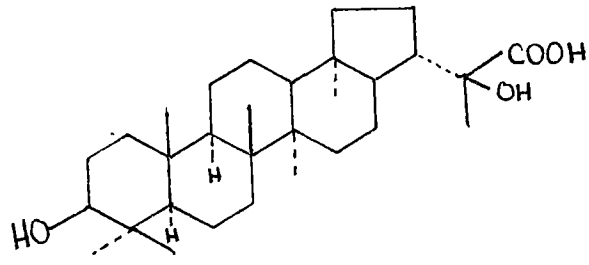
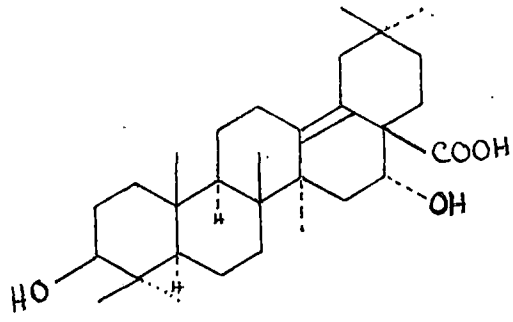
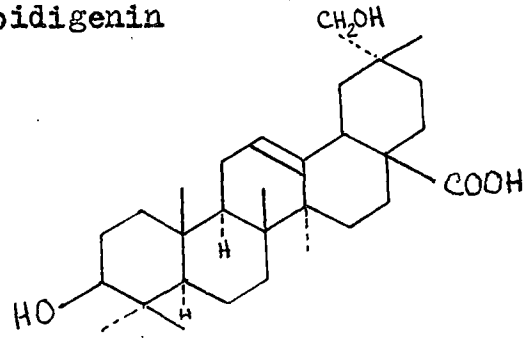
Contd..

Table - A (Contd..)

Sl. No.	Name, molecular formula m.p. °C/ $[\alpha]_D$	Structure	Reference
27.	2β, 3β-dihydroxy olean-12-en-28- eic acid m.p. 258-61°		30
28.	20β-hydroxy ursolic acid $C_{30}H_{48}O_4$ m.p. 220-5° $[\alpha]_D$ 56.7°		31,32
29.	2α,3α, dihydroxy olean-12-en-28-oic acid Me-ester m.p. 296-299° $[\alpha]_D$ 58°		33

Contd..

Table - A (Contd..)

Sl. No.	Name, molecular formula m.p. °C/ $[\alpha]_D$	Structure	Reference
30.	Pyxinic acid $C_{30}H_{50}O_4$ m.p. 254°C $[\alpha]_D$ 62°		34
31.	Albigenic acid $C_{30}H_{48}O_4$ m.p. 247°C $[\alpha]_D$ -13°		35
32.	Mesembry anthemoidigenin $C_{30}H_{48}O_4$ m.p. 306°C $[\alpha]_D$ 71°		36

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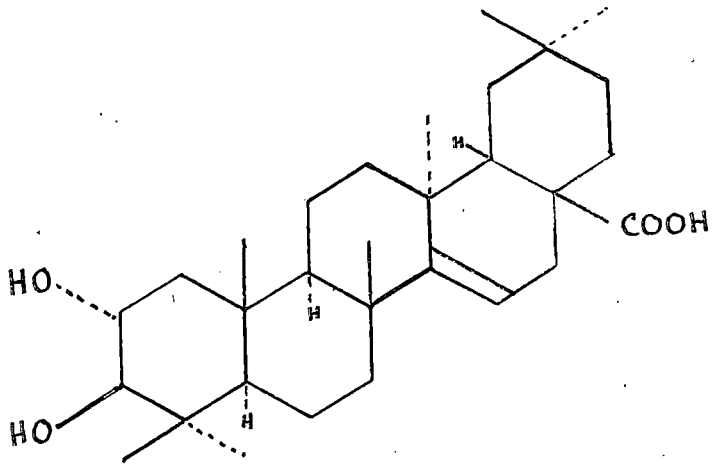
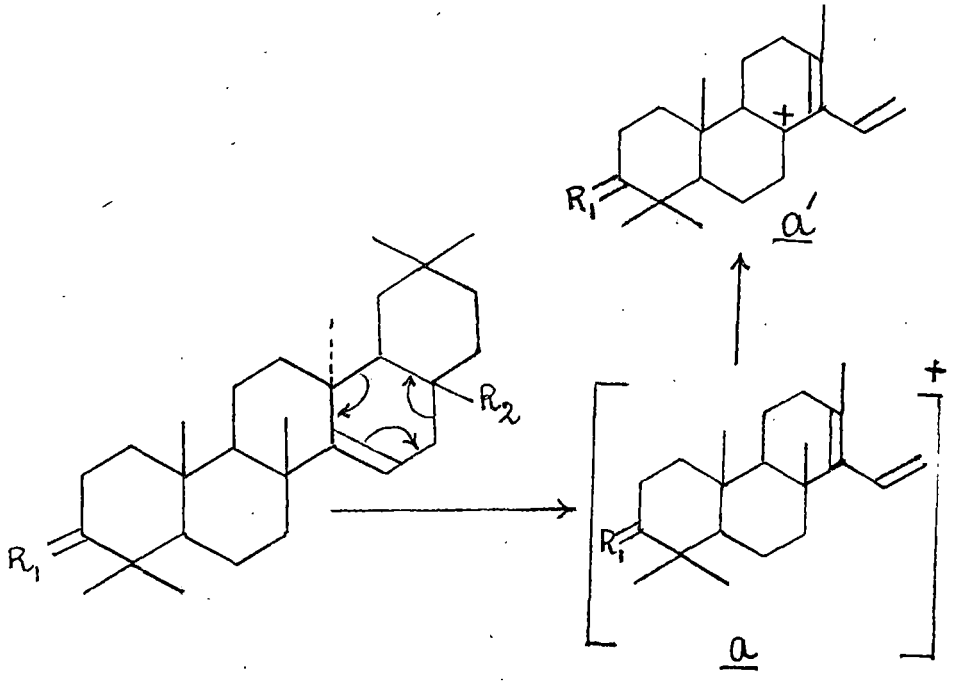
A new dihydroxy triterpenic acid SEBIFERENIC ACID 1 $C_{30}H_{48}O_4$ (Me-ester m.p. 253-54°) has recently been isolated by the present author from the acidic fraction of the bark and stem of Sapium sebiferum Roxb., The details regarding its chemistry is reported in the next Chapter (Chapter III)



1

Section B: A review on the mass spectra of Δ^{14}-taraxerene

Mass spectra of Δ^{14}-taraxerene: The spectra of three compounds of this class, namely, taraxerone 2, taraxerol 3 and myricadiol diacetate 4 have been measured by Djerassi and co-workers[37], thus offering the necessary labels for assigning structure to the major fragments.



(2) $R_1 = O$, $R_2 = CH_3$

(3) $R_1 = H$, (OH, β), $R_2 = CH_3$

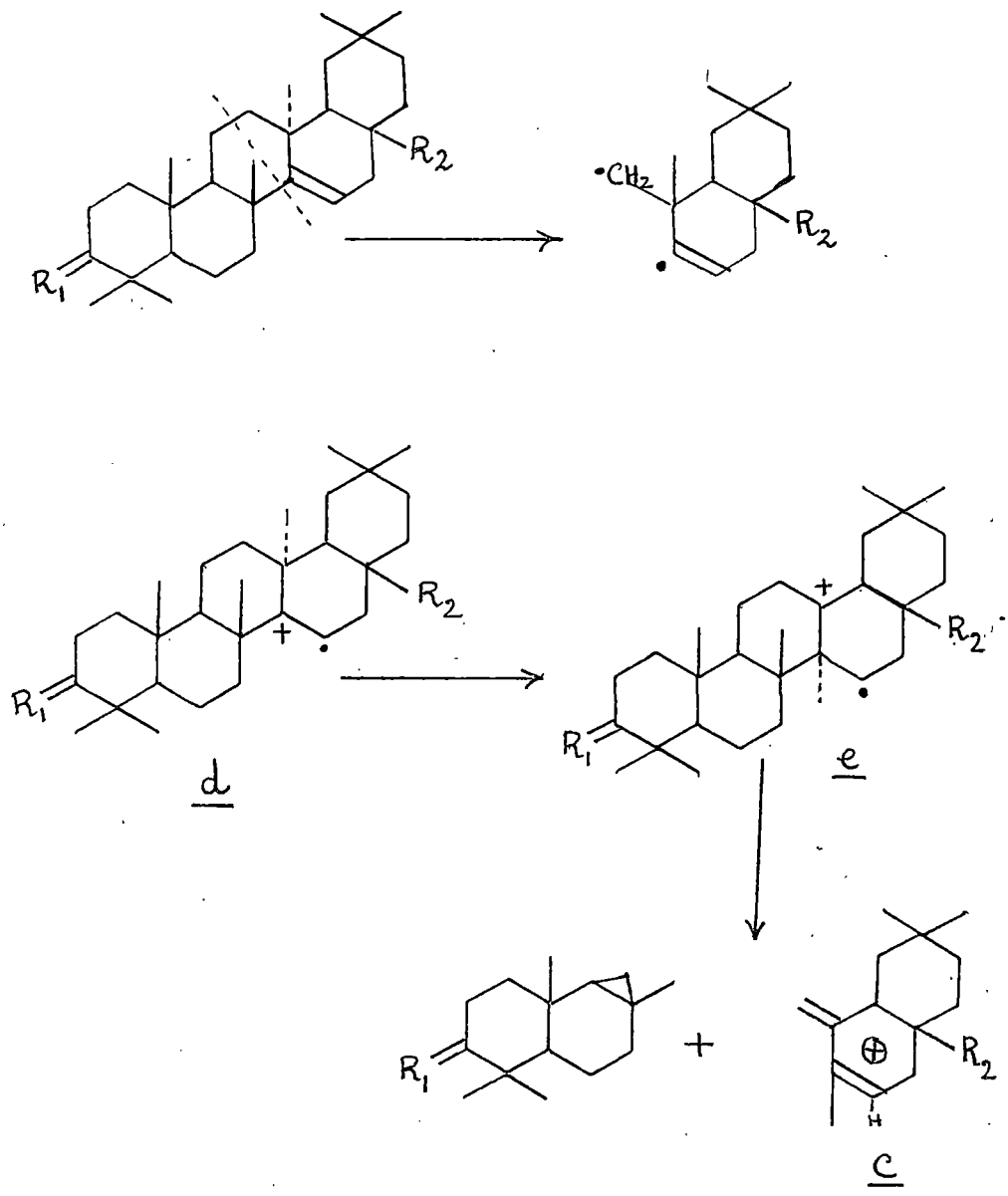
(4) $R_1 = H$, $(-OAc, \beta)$, $R_2 = CH_2OAc$

In these molecules a similar retro-Diels-Alder decomposition was observed as was the case with Δ^{12}-unsaturated derivatives except that collapse of ring D

rather than ring C occurred. This cleavage process was actually observed, the charge remaining with the diene portion, comprising the rings A, B and C. The resulting fragment a exhibits a mass of m/e 300 in the case 2, 302 for 3 and 344 for 4 depending upon C_3 -substituent. Ion a is accompanied by a satellite peak 15 mass units lower, which is formed by the loss of a methyl group, probably the allylically activated one at C-8 (a'). The spectrum of 3 exhibited additional peaks due to the loss of H_2O and (H_2O+CH_3) respectively from species a, while that of 4 showed (a-CH_3COOH) and (a'-CH_3COOH) ion peaks. In addition to species a and its further decomposition products, the spectra of (2) and (3) showed a very abundant fragment at m/e 204 (c). This cleavage product, therefore, cannot contain ring A but must be derived from ring D and E, which had been verified by the spectrum of 4, which showed a small peak at m/e 262 (c), but an abundant one at m/e 202 (c-CH_3COOH). Furthermore, fragment c losøes the substituent at C-17 giving rise to a fragment c -CH_3 for 2 and 3 and c -CH_2OAc for 4 (m/e 189 = c). The formation of the fragment c corresponded to the cleavage of 11-12 and 8-14 bonds as indicated by the wavy line (Chart I). But it is difficult to visualise the driving force of this fragmentation as this would involve rupture of a bond next to a double bond and cleavage of a bond

between two secondary carbon atoms, rather than next to the quaternary C-13 center. Furthermore, the resulting ion would not be a very favourable species, since it contains a primary carbonium ion and a radical on a double bond.

CHART - I



A more acceptable mechanism was also proposed by assuming that in the molecular ion the missing electron is preferentially removed from the carbon-carbon double bond (d), migration of the C-13 methyl group yielded the radical ion e. Fission of 11-12 and 8-14 bonds gave the stable diene c. However, no experimental proof was available and it was emphasised that many factors influenced the formation of a fragment ion, release of strain and stability of the final product being among the important ones.

Section C: A short review on the biogenesis of triterpenoids with special emphasis on Friedo oleananes:

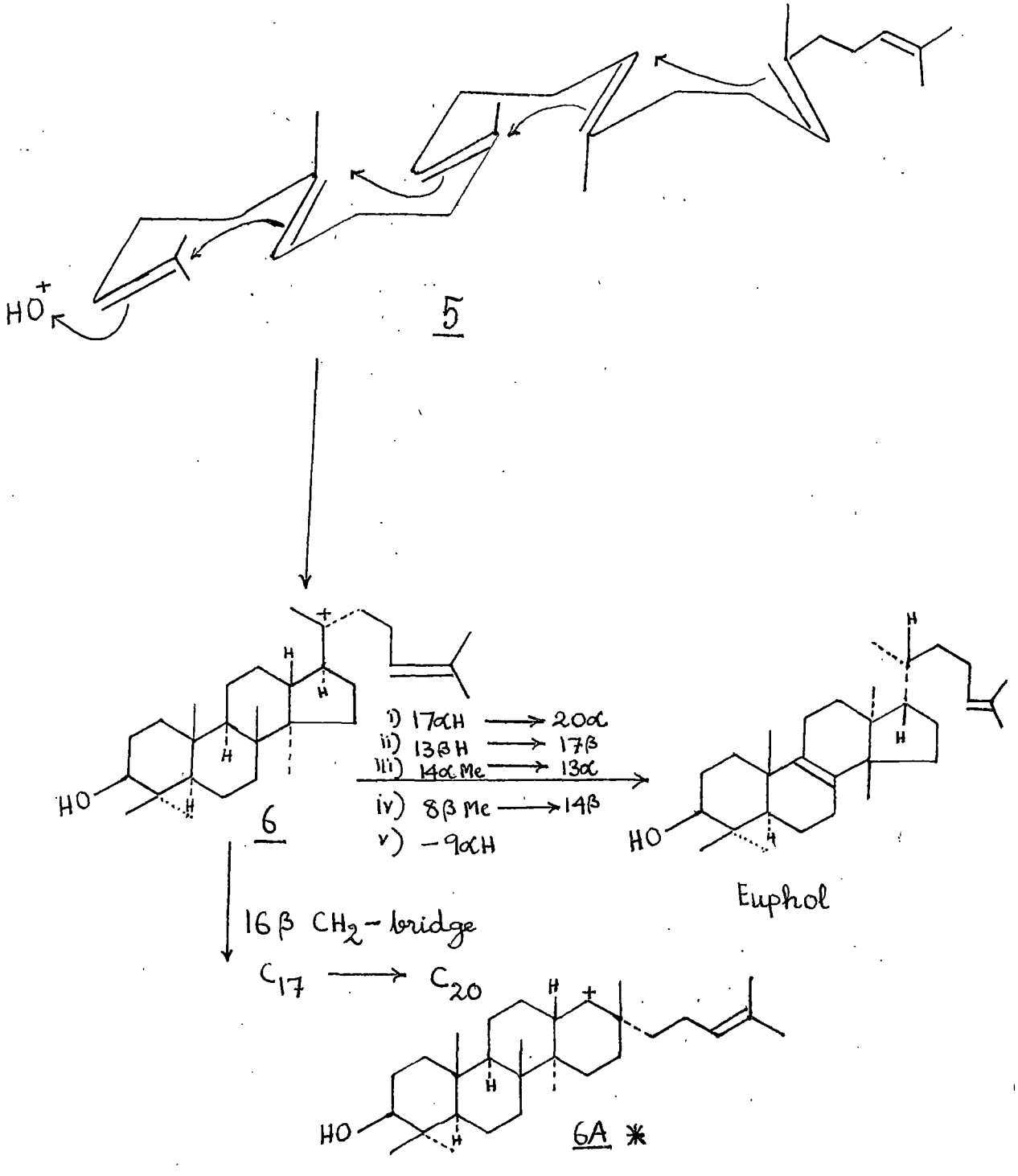
Pentacyclic triterpenoids were formerly classified into oleanane, ursane and lupane groups only. Later, a host of triterpenoids containing new skeletons began to be discovered, thus creating confusion in nomenclature and classification, until the backbone rearrangement[38,39] of these groups of triterpenoids was understood and all the new types discovered fitted into the general biogenetic pattern. Today the pentacyclic triterpenoids may be rationally classified as follows, keeping in view their biogenetic origin.

(1) Lupeol type or Lupanes (2) Oleanane and Friedo-oleanane type (3) Ursane, modified ursane and Friedo-ursane type (4) Hopane and modified hopane type.

The alternative chair-chair-chair-boat unfoled conformation 5 of squalene prior to cyclisation as depicted in Chart-II leads to the carbonium intermediate (6) which is the progenitor of the majority of triterpenoids. The intermediate (6) can undergo a variety of 1:2-Wagner type shifts and rearrangements leading to the tetracyclic triterpenoids of euphol and tirucallol types on the one hand, and to the pentacyclic triterpenoids of

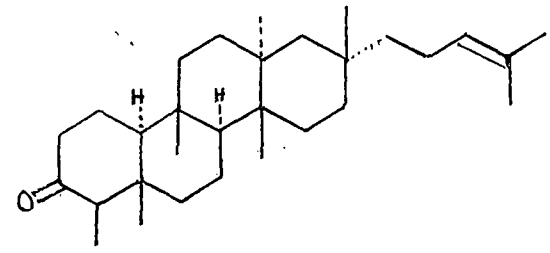
lupane class on the other. The vital cation (6) can rearrange to the ion (7) which is precursor of the friedo-oleanane and friedo-ursane groups of triterpenoids.

Chart-II



6A *

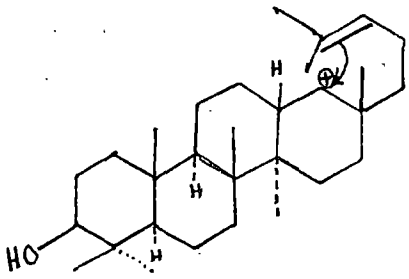
i) 13βH → 18β
ii) 14αMe → 13α
iii) 8βMe → 14β
iv) 9αH → 8α
v) 10βMe → 9β
vi) 5αH → 10α
vii) 4βMe → 5β
viii) − 3αH

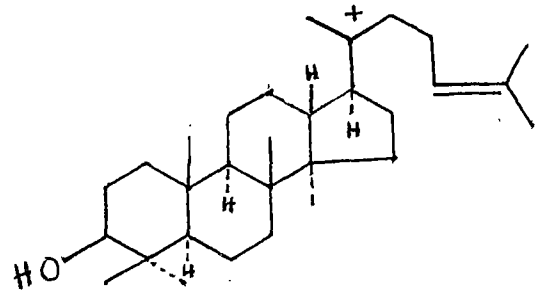


Shionone

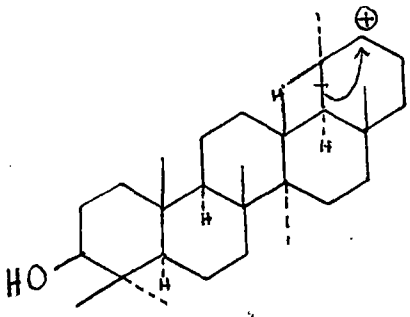
16β CH_2 - bridge

C_{17} → C_{18}

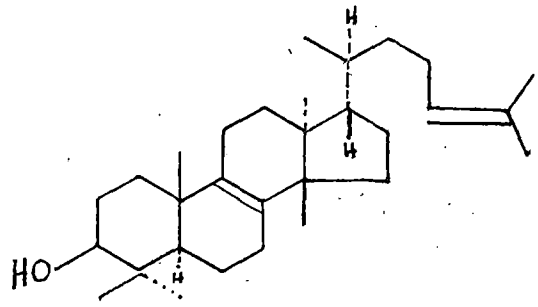




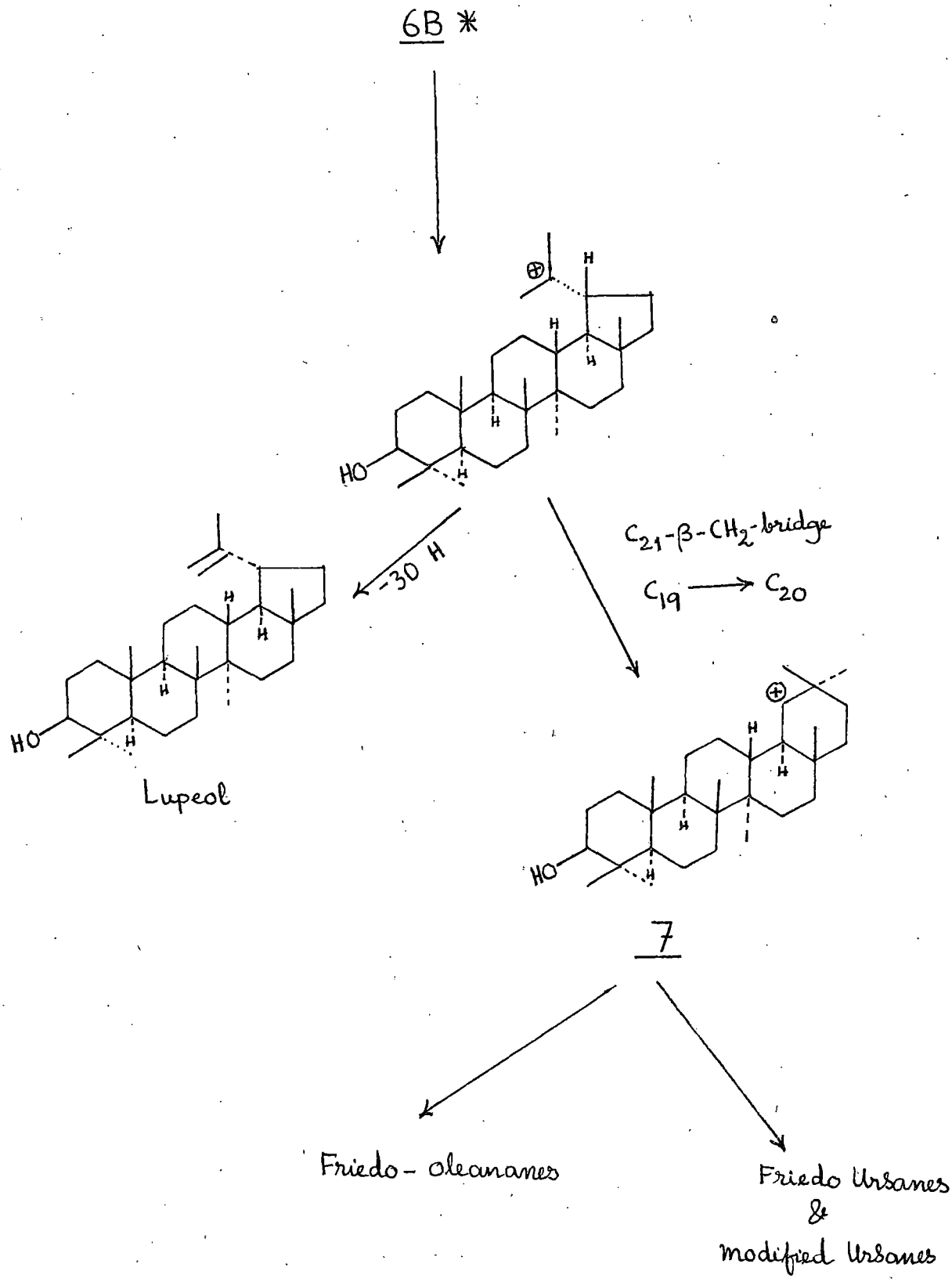
i) 17αH → 20α
ii) 13βH → 17β
iii) 14αMe → 13α
iv) 8βMe → 14β
v) − 9αH



6B *



Tirucallol


6B *
-30 H
Lupeol
C_{21}-β-CH_2-bridge
$C_{19} \longrightarrow C_{20}$
7
Friedo-oleananes
Friedo Ursanes
&
modified Ursanes

As the new acid isolated belonged to Friedo-oleanane skeleton, biogenesis to Friedo-oleanes from the cation 7 has been discussed as shown in Chart-III.

This hypothetical carbonium ion intermediate (7) from squalene 5 postulated[38] in chart II for pentacyclic triterpenoid biogenesis can stabilise itself by any one of the sequence of rearrangements, followed by subsequent proton elimination, as depicted in Chart-III giving rise to oleanane and modified oleanane better known as friedo-oleanane skeletons, ultimately leading to friedlin 18. Germanicol[40,41] 8, δ-amyrin[40,41] 9, β-amyrin[40,41] 10, taraxerol[40-41] 11, multiflorenol[41,42] 12, walsurenol[43] 14 and glut-5-en-3β-ol[41,44]-17 are the statilised intermediates in this biogenetic sequence, that have been isolated from nature as also the ultimate product friedlin[45,41] 18. Other theoretically predicted intermediates, (15, 13 and 16) have not so far been encountered in nature, although isomultiflorenol[42] 13 and glut-5(10)-en-3β-ol[41,44]-16 are otherwise known compounds.

Chart-III

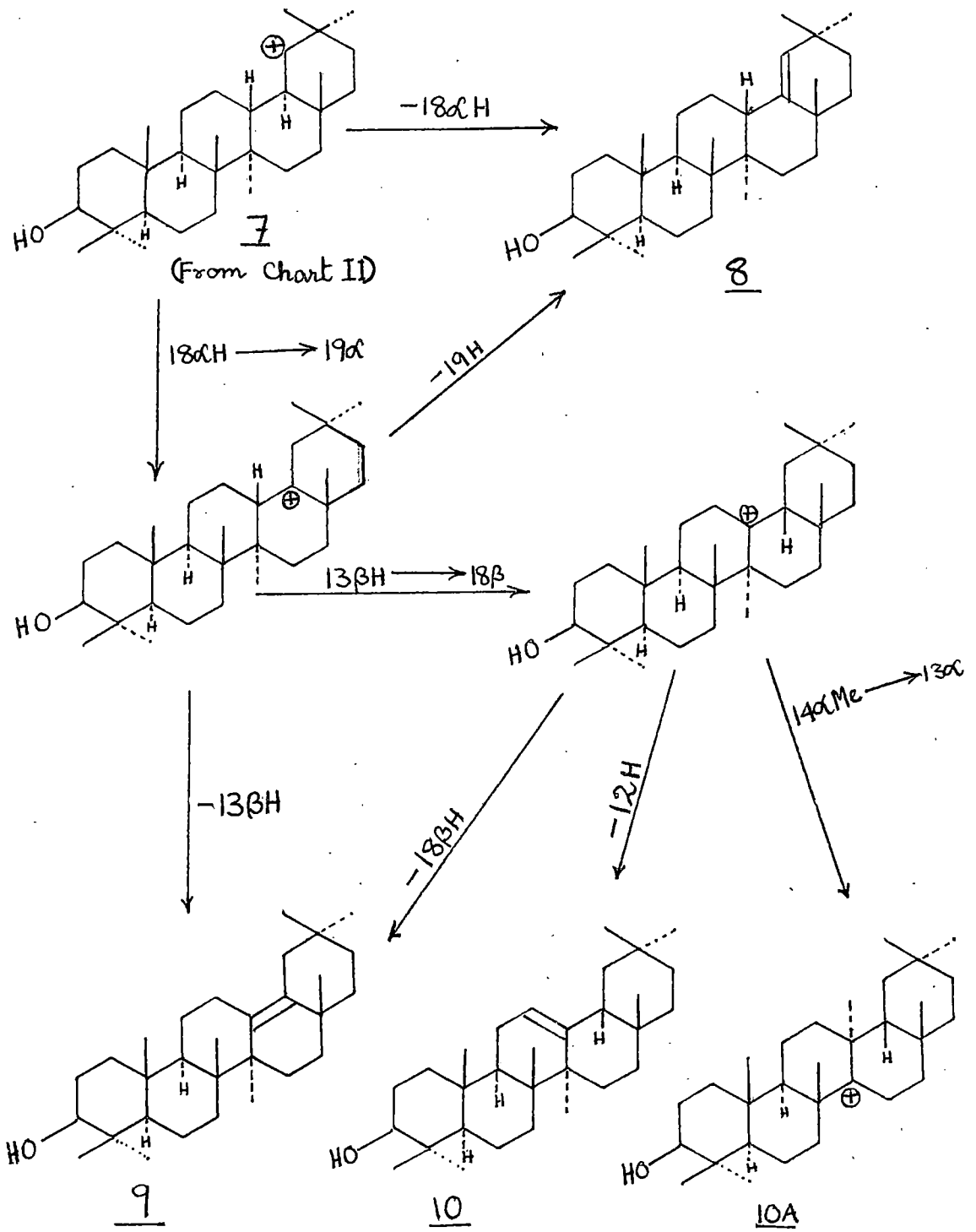

7
(From Chart II)
-18αH
8
18αH → 19α
-19H
13βH → 18β
-13βH
-18βH
-12H
14αMe → 13α
9
10
10A

Chart-III (Contd..)

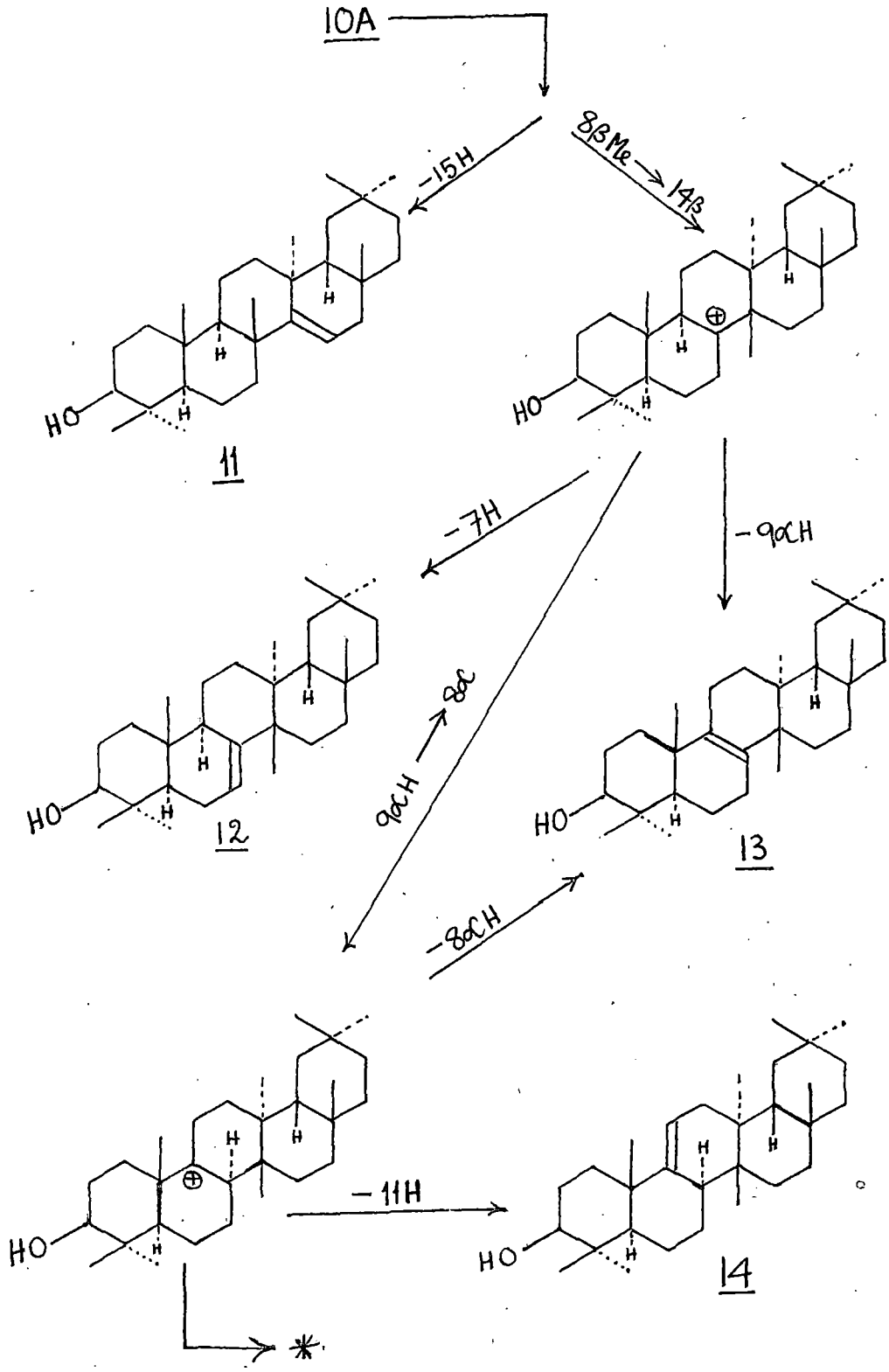


Chart-III (Contd..)

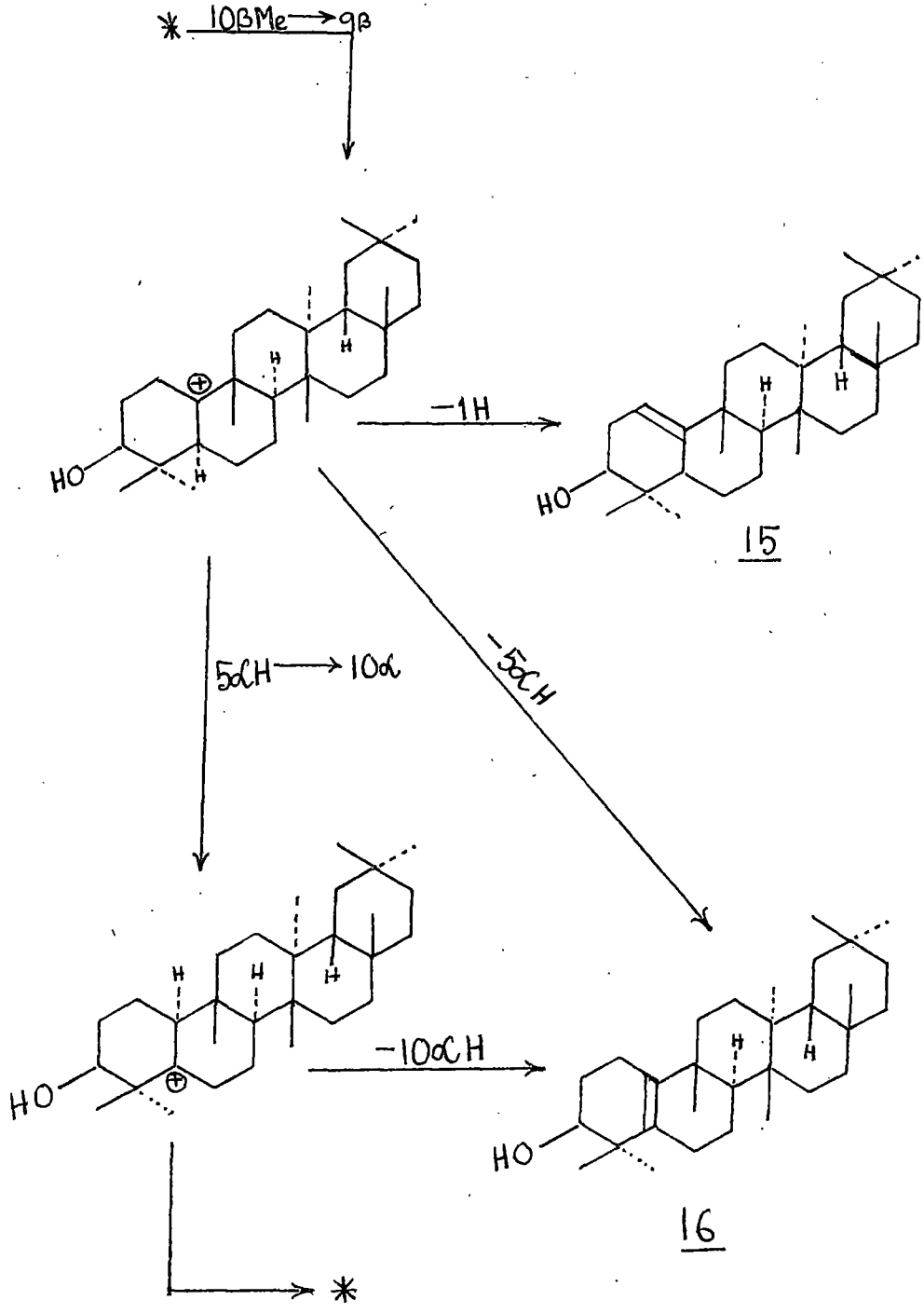


Chart-III (Contd..)