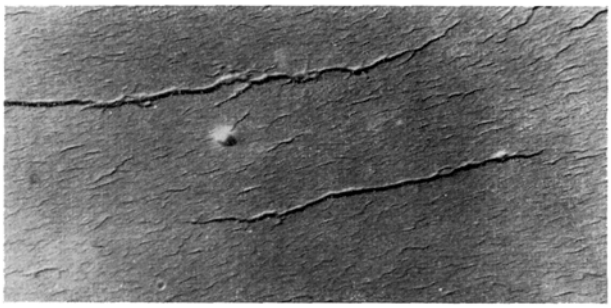
same treatment of the Zimm plot as for a different mucoprotein preparation previously studied[3] (according to the papers of SADRON and BENOIT[4], and BENOIT[5]), it is possible to conclude that a polydisperse system of coils is the best model for the molecular shape of MC in salt solution.



Electron micrograph of MC ($1 \cdot 10^{-5}$ g/ml in distilled water). Magnification: 30000 ×. Shadowing with gold-manganine at 20°.

An investigation with the electron microscope of extremely dilute aqueous solutions of MC showed the presence of fibrous structures (Figure). These fibres are thought to be formed by side aggregation of smaller units, possibly of mucoprotein and chondroitin sulphate molecules. They seem to confirm: (*a*) the previously postulated end-to-end arrangement of polysaccharide and polypeptides in the mucoprotein molecules[6], and (*b*) the suggested possibility of linkages between acid groupings of chondroitin sulphate or mucoprotein molecules and basic groupings of other mucoprotein molecules when the ionic strength of the medium is very low and consequently the ionization is high[7].

A more detailed account of this work will be published in due course elsewhere.

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Riassunto

Sono riferiti i risultati di uno studio chimico-fisico sul condroitinsolfato e sulla mucoproteina della cartilagine. È brevemente discusso il significato di questi risultati in relazione ad una struttura precedentemente proposta per la mucoproteina.

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The Structures of Ambrosin and Damsin[1]

Two crystalline compounds, named ambrosin and damsin, have recently been isolated from *Ambrosia maritima* L., fam. Compositae, by ABU-SHADY and SOINE[2]. The same authors carried out a thorough study of the oxidation and reduction of the two natural products and the following conclusions were made at that time. Ambrosin and damsin contain the same carbon skeleton and are tricyclic. The formation of an unidentified azulene on dehydrogenation of 'reduced ambrosin' suggested the presence of a substituted bicyclo-(5, 3, 0)-decane skeleton in these two natural substances. Finally the authors suspected a structural relation between ambrosin and helenalin.

Recent work on helenalin has shown that this sesquiterpene lactone is represented by I[3]. We have now used the information gained from the study of both helenalin (I) and tenulin[4] (III) to deduce possible structures for ambrosin and damsin.

The azulene obtained previously[2] was characterized by a trinitrobenzene-adduct, m.p. 125–130°, and in our opinion represents the derivative of chamazulene (IV), m.p. 132°[5]. This finding suggests that ambrosin and damsin belong to the guaianolides, a group of sesquiterpenes which are known to occur frequently in plants of the Compositae family.

The ultraviolet absorption spectrum of ambrosin (λ_{max} 217 mμ, ε 13465) cannot be reconciled with the presence of a cyclopentenone chromophore alone, because such systems are characterized by low extinctions. (Dihydrohelenalin V has λ_{max} 227 mμ, ε 7250 and tenulin III has λ_{max} 226 mμ, ε 7000.) The light absorption must therefore be due to two isolated chromophores and like in helenalin (I) (λ_{max} 220 mμ, ε 12200), the terminal methylene group in ambrosin must be conjugated with the γ-lactone ring. The second chromophore should therefore absorb like dihydrohelenalin (V) and we can conclude that ambrosin is in fact an α- or β-substituted cyclopentenone. The ready formation of bromoambrosin and particularly its light absorption (λ_{max} 248 mμ, ε 7025) strongly suggests that it is a α-bromo-β-alkyl cyclopentenone[6] and ambrosin, therefore, is a β-alkylcyclopentenone. The evidence discussed thus far can be summarized in the partial symbols IX and X.

There is no conclusive evidence at hand which would allow a distinction between the two alternatives IX and X. However, tenulin (III), helenalin (I) and geigerin[7], all isolated from Compositae, have been shown to be C_9-ketones rather than C_8-ketones and we would like to suggest, on biogenetic grounds, that ambrosin and damsin contain part structure IX.

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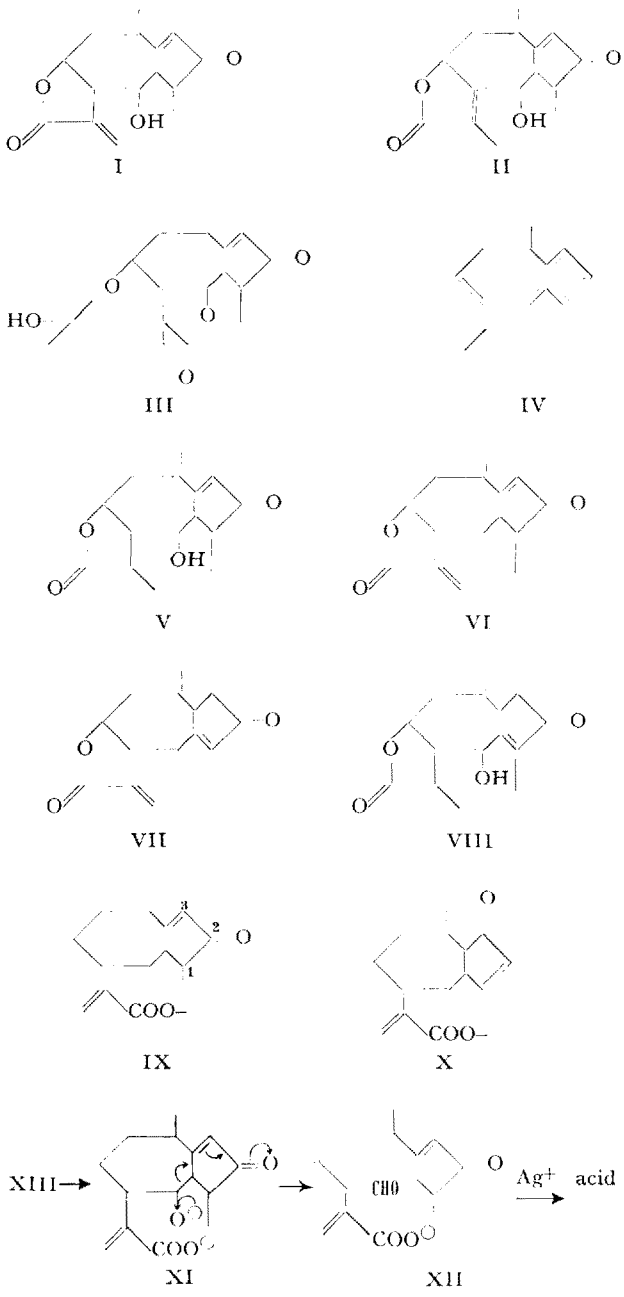
To develop the structures further we now have to differentiate between the two isomers VI and XIII. A distinction was possible as follows. According to ABU-SHADY and SOINE[2] ambrosin, like dihydrohelenalin (V), gives a positive Tollens test. The functionality undergoing oxidation cannot be derived from the α,β-unsaturated ketone *per se* (no β hydrogen) nor can it be a vinylogous α-hydroxyketone because helenolid (VI)[8], neohelenolid (VII)[9] and dihydroneohelenalin (VIII)[9] all give *negative* Tollens tests. The simplest explanation of these findings is that ambrosin, on treatment with base undergoes, at least partly, a retroaldol cleavage (XI→XII), which is followed by oxidation of the aldehyde (XII) with silver ion. Ambrosin should therefore be XIII.

We now discuss the behavior of ambrosin and damsin on reduction. It has been shown previously[10] that natural helenalin contains both I and isohelenalin (II) and that the isomers are not separable by crystallization. Helenalin (I) on catalytic hydrogenation yields dihydrohelenalin (V) which, however, is reduced rapidly to tetrahydrohelenalin. Isohelenalin (II), on the other hand, yields *only* dihydroisohelenalin and the tetrasubstituted double bond is not reducible by the conventional catalytic methods. The results of ABU-SHADY and SOINE can be rationalized easily if we assume that their 'ambrosin' is actually a mixture of approximately 50% of XIII, for which we retain the name ambrosin and 50% of XIV, which we wish to call isoambrosin. This proposal is supported by the following experimental observations[2]: (a) The mixture of XIII and XIV described as ambrosin absorbs 1·41 mole equivalents of hydrogen yielding XV and XVI. (b) The infrared spectrum has bands at 1770 cm^{-1} (γ-lactone); 1718, 1594, 815 cm^{-1} (alkylcyclopentenone); 1675 cm^{-1} (tetrasubstituted double bond of γ-lactone); 1650, 910 cm^{-1} (conjugated $CH_2=CR_2$). (c) The high extinction in the ultraviolet spectrum (ε 13465) observed is in agreement with our suggestion because the cisoid helenalin (I) has ε 12200 whereby the transoid isohelenalin (II) has ε 20000. (d) On ozonization the mixture yielded 35% of the theoretical amount (50%) of formaldehyde. (e) 'Ambrosin', like helenalin (I)[11], forms a monopiperonylidene derivative which is probably XX.

Similarly we would like to suggest that 'damsin' is a 1:1 mixture of XVII and dihydroisoambrosin (XVI). The following evidence[2] seems to support this proposal. (a) Catalytic reduction of the compound described as 'damsin' is complete after the uptake of 0·47 mole equivalents of hydrogen. (b) The dihydroisoambrosin (XVI) present in the mixture remains unchanged while damsin itself (XVII) is reduced to tetrahydroambrosin (XV). (c) The infrared spectrum of the mixture of XVI and XVII has bands at 1754–1766 cm^{-1} (broad) (γ-lactone and cyclopentanone); 1677 cm^{-1} (tetrasubstituted double bond of γ-lactone); 1650, 910 cm^{-1} (conjugated $CH_2=CR_2$). (d) Damsin gives a negative Tollens test. (e) Ozonization of the mixture of isomers gave 33% of the theoretical amount (50%) of formaldehyde. We may further conclude that 'dihydroambrosin' is actually dihydroisoambrosin (XVI) and its infrared spectrum with bands at 1750 cm^{-1} (broad) (γ-lactone and cyclopentanone); 1672 cm^{-1} (strong) (tetrasubstituted double bond of γ-lactone) is in agreement with this formulation. The



'dihydroambrosinol' described previously[2] must thus be XVIII and the dicarboxylic acid obtained by nitric acid oxidation of XVI can now be formulated as XIX. The infrared spectra of these compounds are in good agreement with the postulated structures. These arguments further suggest expression XV for tetrahydroambrosin (1764 cm^{-1}: γ-lactone; 1745 cm^{-1}: cyclopentanone) the common reduction product of XIII and XVII. It is of interest to mention that the wavelength of infrared absorption of the carbonyl band of γ-lactones is not materially affected by conjugation with the cisoid methylene group. This fact had been noted before with

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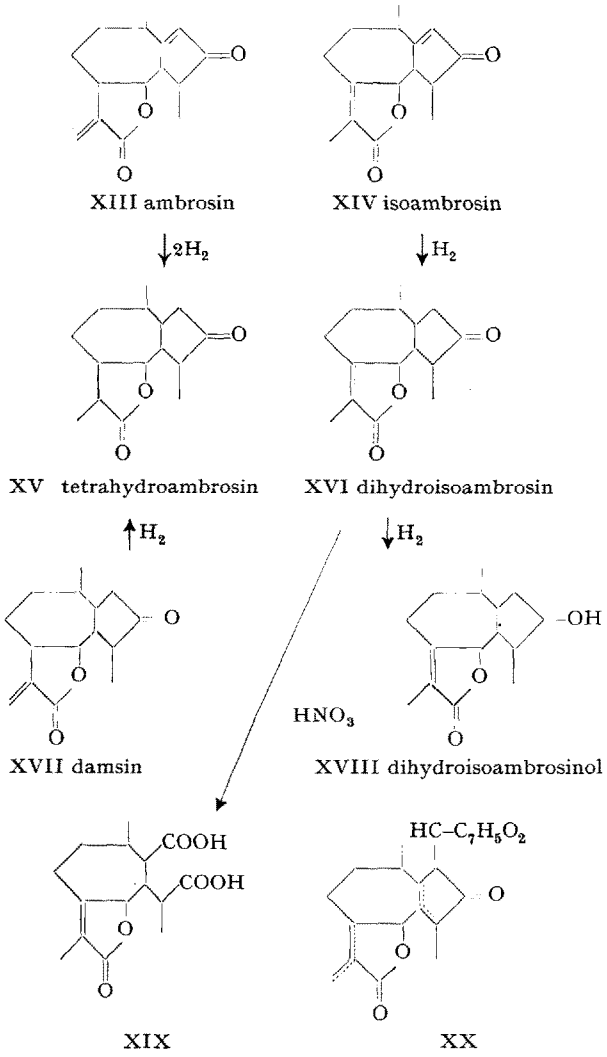
helenalin (I)[11], pyrethrosin[12] and with five-ring *ketones* from garryine and veatchine[13].



Finally, the Kuhn-Roth C-methyl values of 'ambrosin', 'damsin', dihydroisoambrosin and tetrahydroambrosin are in good agreement with the values reported[11] for the corresponding helenalin derivatives.

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Zusammenfassung

Es wird gezeigt, dass die von ABU-SHADY und SOINE isolierten Sesquiterpenlaktone «Ambrosin» und «Damsin» vermutlich Gemische von isomeren Substanzen darstellen. Die Interpretation bereits bekannter Tatsachen über die beiden Naturstoffe und der Vergleich mit verwandten Produkten ermöglicht die Aufstellung provisorischer Strukturformeln.

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Voacamidin und Voacristin, zwei neue Alkaloide aus *Voacanga africana* Stapf

Aus der in Afrika heimischen Apocynacee *Voacanga africana* Stapf sind bis jetzt durch Chromatographie der Gesamtalkaloide an Al_2O_3 folgende Inhaltsstoffe isoliert worden: Voacangin[1], Voacamin[2] (= Voacanginin[3]), Voacaminin[4], Vobtusin[5] und Voacorin[6] (= Voacalin[7] ?). Die Alkaloide sind Derivate des Indols bzw. 5-Methoxyindols; mit Ausnahme des Voacangins enthalten sie zwei Indolkerne.

Wir haben aus *Voacanga africana* Stapf zwei weitere neue Alkaloide in reiner Form isoliert, für die wir die Namen Voacamidin und Voacristin vorschlagen.

Voacamidin wurde auf Grund seiner etwas stärkeren Basizität durch Anwendung des Verteilungsverfahrens nach CRAIG von Voacamin und auf Grund der Schwerlöslichkeit seiner halogenwasserstoffsauren Salze von Voacristin abgetrennt.

Die Base ist nach ihrem Verhalten bei der Craig-Verteilung sowie bei der Papierchromatographie einheitlich; ihre Kristallisationstendenz ist sehr gering. Sie kristallisierte jedoch aus Benzol in farblosen Nadeln; Smp. 128–130° (Zers.); $[\alpha]_D^{24} = -174{,}5°$ (Chloroform); Summenformel $C_{45}H_{56}O_6N_4$ (ber.: C 72,16; H 7,54; N 7,48; 3 $-OCH_3$ 9,26; $>NCH_3$ 1,49%; gef.: C 72,10; H 7,56; N 7,79; $-OCH_3$ 9,56; 9,56; 9,41; $>NCH_3$ 2,19; 1,49%).

Das UV.-Spektrum in Methanol hat charakteristische Maxima bei 227,5 mμ (log ε 4,74) und bei 292,5 mμ (log ε 4,32), die einer 5-Methoxyindol-Gruppierung entsprechen. Das in Chloroform gemessene IR.-Spektrum enthält Banden bei 2,79 (OH); 2,91 (NH), 5,85 (CO), 6,20 und 6,37 μ (C=C). Weitere starke Banden (fest in KBr gemessen) finden sich bei 13,56 μ und bei 14,8 μ (OH ?). Voacamidin ist demnach isomer mit Voacamin; seine spektralen Eigenschaften sind denen des Voacamins sehr ähnlich.

Hydrochlorid. Aus Aceton/Methanol farblose Nadeln; Smp. 265–267° (Zers.); $[\alpha]_D^{16,5} = -166{,}5°$ (Methanol); $C_{45}H_{58}O_6N_4Cl_2$ (ber.: C 65,76; H 7,11; N 6,82; Cl 8,63%; gef.: C 65,64; 65,43; H 6,97; 6,86; N 6,81; 7,13; Cl 8,94%).

Hydrobromid. Aus Aceton farblose Nadeln; Smp. 265 bis 266° (Zers.); $[\alpha]_D^{22} = -144°$ (Methanol); $C_{45}H_{58}O_6N_4Br_2 \cdot 1/2\ H_2O$ (ber.: C 58,76; H 6,47; N 6,09%; gef.: C 58,65; 58,75; H 6,38; 6,52; N 6,83; 6,75%).

Hydrojodid. Aus Aceton farblose Nadeln; Smp. 263 bis 264° (Zers.); $[\alpha]_D^{26} = -142°$ (Methanol). $C_{45}H_{58}O_6N_4J_2 \cdot 1/2\ H_2O$ (ber.: C 53,31; H 5,87; N 5,53%; gef.: C 53,15; 53,22; H 5,96; 5,88; N 5,39%).

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