III. THE SYSTEMATIC NOMENCLATURE OF HETEROCYCLIC COMPOUNDS INCLUDING POLYCYCLIC STRUCTURES.

By J. J. Sudborough.

Very few attempts appear to have been made to develop a systematic scheme of nomenclature adapted to all types of heterocyclic compounds. Recently[1] a systematic nomenclature suitable for practically all types of polycyclic systems containing rings of carbon atoms has been worked out, and in this paper an attempt is made to adapt the same system to heterocyclic compounds including different types of bridged compounds.

Ingold,[2] in one of his papers on 'The Additive Formation of Four-Membered Rings', has made a few suggestions with reference to the nomenclature of heterocyclic compounds. The system suggested was developed with the idea of providing distinctive names for numerous four membered cyclic compounds synthesised by the author.

The following rules are given :—

1. In fully hydrogenated rings the divalent groups CH_2, O, S, and NH are termed methylene, oxa, thia and imine respectively.

2. In the non-fully hydrogenated rings the tervalent groups CH and N are termed methine and azine respectively.

3. The atoms constituting the ring are numbered in rotation in such a manner that so far as possible oxygen atoms receive lower numbers than nitrogen and nitrogen atoms lower numbers than carbon.

Based on this system the compounds I–VIII receive the names given below the formulae.

I. $\begin{matrix} CH_2{\cdot}O \\ \dot{C}H_2{\cdot}\dot{C}H_2 \end{matrix}$ Oxatrimethylene

II. $\begin{matrix} CH_2{\cdot}NH \\ \dot{C}H_2{\cdot}\dot{N}H \end{matrix}$ Dimethylene-1:2-diimine

III. $\begin{matrix} CH_2{\cdot}NH \\ \dot{N}H{\cdot}\dot{C}H_2 \end{matrix}$ Dimethylene-1:3-diimine

IV. $\begin{matrix} CH_2{\cdot}O \\ \dot{C}H_2{\cdot}\dot{N}H \end{matrix}$ Dimethylene-1:2-oxaimine

V. $\begin{matrix} CH_2{\cdot}O \\ \dot{N}H{\cdot}\dot{N}H \end{matrix}$ Methylene-1:2:3-oxadi-imine

VI. $\begin{matrix} NH{\cdot}O \\ \dot{O}{\cdot}\dot{N}H \end{matrix}$ 1:3-Dioxadi-imine

VII. $\begin{matrix} CH{:}N \\ \dot{N}{:}\dot{C}H \end{matrix}$ Dimethine-1:3-diazine

VIII. $\begin{matrix} N—S \\ \ddot{C}H{\cdot}\dot{N}H \end{matrix}$ Methine-1:2:4-thiaimineazine

[1] This Journal, 1924, **7**, 145, and 166.

[2] *J. Chem. Soc.*, 1924, **125**, 88.

The system provides comparatively simple systematic names for the completely saturated or completely unsaturated monocyclic compounds containing more than four members, e.g. tetrahydrothiophene, pyrrolidine, piperidine, uretidine, piperazine, morpholine, furane, thiophene, pyrrole, pyridine, pyridazine, pyrazine, triazole, tetrazole, pyrazole, thiazole, etc.

With partially unsaturated compounds the names become more cumbersome, as it becomes necessary not only to give the number of methine and methylene groups but also to indicate their positions in the ring.

Pyrazoline, IX, is 4:5-dimethylene-3-methine-1:2-imineazine.

Pyrazolone, X, is 4:5-dimethylene-3-methine-1:2-imineazine-5-one.

Pyrone, XI, is 1-oxa-4-methenone-tetramethine.

IX. $NH\begin{cases} N=CH \\ CH_2\cdot\dot{C}H_2 \end{cases}$ X. $NH\begin{cases} N=CH \\ CO\cdot\dot{C}H_2 \end{cases}$ XI. $O\begin{cases} CH:CH \\ CH:CH \end{cases}CO$

The method to be adopted in naming heteropolycyclic compounds is not indicated and names for groups containing quadrivalent oxygen or sulphur, or quinquevalent nitrogen are not given.

SUGGESTED NOMENCLATURE APPLICABLE TO ALL TYPES OF HETEROCYCLIC COMPOUNDS.

A. Monocyclic Compounds.

Just as in the isocyclic series the prefix *cyclo* is used for all saturated hydrocarbons and their derivatives and the characteristic name indicates the total number of carbon atoms constituting the ring; it is now suggested that for saturated heterocyclic structures containing a single ring the prefix *heterocyclo* be adopted and the characteristic name indicate the total number of atoms constituting the ring. Then between the prefix and the characteristic name the atoms other than carbon are given, and, when necessary, their positions in the ring by means of numbers.

The following names are suggested for the non-carbon constituents of the ring.

$\rangle O$ oxa; $\rangle O\begin{cases} H \\ Cl \end{cases}$ oxonium chloride.

$\rangle S$ thia; $\rangle S=O$ thia-oxide; $\rangle\!\!=\!\!S\text{-}Cl$ sulphonium chloride;

$\rangle SO_2$ sulphone.

$\rangle NH$ imine ; $\rangle NR_2I$ ammonium iodide ; $\rangle N(H)=O$ imine-oxide.

$\rangle AsH$ arsine.

Thus *cyclo*-octane indicates a monocyclic saturated structure containing eight carbon atoms in the ring; *heterocyclo*-oxahexane indicates a saturated heterocyclic compound containing a total of six atoms in the ring, one of which is oxygen and the remaining five carbon ; and *heterocyclo*-oxaiminepentane a saturated compound with a ring of five atoms, viz. one oxygen, one nitrogen and three carbon.

Unsaturation is indicated in the same manner as in isocyclic compounds, viz., by Δ-ene, Δ-diene, etc. There is, however, an important difference in the two cases, as in the isocyclic group the double linking is always between carbon and carbon, i.e., it is an olefine linking, whereas in the heterocyclic group it may be between carbon and carbon, carbon and nitrogen, nitrogen and nitrogen or with oxonium compounds between carbon and oxygen. The same system is used in all cases and the numbers given after the Δ indicate the positions of the double linkings and will thus show the elements they unite.

The numbering of the constituent atoms of the ring is practically identical with that suggested by Ingold. The numbering always begins with a non-carbon element and the order of priority is oxa, oxonium, thia, thia-oxide, sulphone, sulphonium, imine, imine oxide, ammonium, arsine.

Substituents in the ring are indicated in exactly the same manner as in the isocyclic compounds and are given as low numbers as possible.

Based on this system the following are the names for compounds I to XI.

I. *Heterocyclo*-oxatetrane..
II. *Heterocyclo*-1:2-diiminetetrane.
III. *Heterocyclo*-1:3-diiminetetrane.
IV. *Heterocyclo*-1:2-oxaiminetetrane.
V. *Heterocyclo*-1:2:3-oxadiiminetetrane.
VI. *Heterocyclo*-1:3-dioxadiminetetrane.

VII. *Heterocyclo*-1:3-diminetetra-$\Delta^{1:3}$-diene.

VIII. *Heterocyclo*-1:2:4-thiadiimine-tetra-Δ^{2}-ene.

IX. *Heterocyclo*-1:2-diminepenta-Δ^{2}-ene.

X. *Heterocyclo*-1:2-diminepenta-Δ^{2}-ene-5-one.

XI. *Heterocyclo*-1-oxa-hexa-$\Delta^{2:5}$-diene-4-one.

The following are the systematic names for a number of common heterocyclic compounds. The Roman numerals refer to the formulae on plates XII and XIII.

XII. Glycine anhydride is *Heterocyclo*-1-imine-trian-2-one.

XIII. Pyrrolidine is *Heterocyclo*-iminepentane.

XIV. Urazole is *Heterocyclo*-1:2:4-triiminepentan-3:5-dione.

XV. Valerolactone is *Heterocyclo*-1-oxahexan-2-one.

XVI. Valerolactam is *Heterocyclo*-1-iminehexan-2-one.

XVII. Glutaric anhydride is *Heterocyclo*-1-oxahexan-2:6-dione.

XVIII. Glycol oxalate is *Heterocyclo*-1:4-dioxahexan-2:3-dione.

XIX. Morpholine is *Heterocyclo*-1:4-oxaimine-hexane.

XX. Piperazine is *Heterocyclo*-1:4-diiminehexane.

XXI. Pyridazine is *Heterocyclo*-1:2-diimine-hexa-$\Delta^{1:3:5}$-triene.

XXII. Pyrimidine is *Heterocyclo*-1:3-diimine-hexa-$\Delta^{1:3:5}$-triene.

XXIII. Pyrazine is *Heterocyclo*-1:4-diimine-hexa-$\Delta^{1:3:5}$-triene.

XXIV. *s*-Triazole is *Heterocyclo*-1:2:4-triiminepenta-$\Delta^{2:5}$-diene.

XXV. Tetrazole is *Heterocyclo*-1:2:3:4-tetraiminepenta-$\Delta^{1:4}$-diene.

XXVI. Pyrone hydrochloride is *Heterocyclo*-1-oxoniumhexa-$\Delta^{2:5}$-diene-4-one-1-chloride.

XXVII. Betain is *Heterocyclo*-1-oxa-2-trimethylammonium-tetran-4-one.

XXVIII. Dimethyl-piperidonium iodide is *Heterocyclo*-dimethyl-ammoniumhexan iodide.

XXIX. Ethyl cyanurate is 2:4:6-triethoxy-*heterocyclo*-1:3:5-triminehexa-$\Delta^{1:3:5}$-triene.

XXX. Ethyl isocyanurate is 1:3:5-triethyl-*heterocyclo*-1:3:5-triimenehexa-2:4:6-trione.

XXXI. Diphenylguanazine is 1:4-diphenyl-3:6-diamino-*heterocyclo*- 1:2:4:5-tetraimine-hexa-$\Delta^{2:5}$-diene.

B. Bridged heterocylic compounds.

These may be conveniently divided into :—

1. Bridged compounds in which the non-carbon atoms are in the bridge and not in the basal ring.

2. Bridged compounds in which the non-carbon atoms are in the basal ring.

1. An isocyclic ring with nitrogen, sulphur or oxygen in the bridge.

In these cases the nomenclature is exactly analogous to that described in Part I for bridged isocyclic rings.

The largest ring possible is selected as the basal ring and the carbon atoms in this are numbered clockwise in such a manner that carbon atom No. 1 is the starting point of a bridge and if only one bridge is present the carbon atom at which the bridge terminates receives the lowest number possible. If the two rings formed by the bridge are of equal size then the numbering is such that substituents receive as low numbers as possible. When several bridges are present the numbering is so selected that the carbon atoms from which the different bridges start receive as low numbers as possible.[1]

The atoms constituting the bridge are numbered in direct continuation of the numbers of the basal ring and when several atoms are present beginning with the one nearest to carbon atom No. 1.

The following are examples of this type of bridged compounds:—

	Usual name.	*Systematic name.*
XXXII.	Oxidation product of Sabinene[2]	1B-oxa-1:7:4,-1-methyl-4-*iso*propyl-*cyclo*hexan-2:3-diol.
XXXIII.	Cineol	1B-8:8-dimethyl-oxamethene-1:7:8:4,-1-methyl*cyclo*hexane.
XXXIV.	Ascaridol[3]	1B-dioxa-1:7:8:4,-1-methyl-4-*iso* propyl*cyclo*hexa-Δ^2-ene.
XXXV.	Tropine	1B-methylimine-1:8:4,-*cyclo*heptan-6-ol.
XXXVI.	Tropinone	1B-methylimine-1:8:4,-*cyclo*heptan-6-one.

[1] See pp. 158-161.
[2] Henderson and Robinson, *J. Chem. Soc.*, 1923, 123, 1851.
[3] A constituent of the oil from *Chenopodium ambrosioides*.

XXXVII.	Ecgonine	1B-methylimine-1:8:4,-*cyclo*heptan-6-ol-5-carboxylic acid.
XXXVIII.	Cocaine	Methyl 1B-methylimine-1:8:4,-6-benzo-oxy*cyclo*heptan-5-carboxylate.
XXXIX.	No name given[1]	3B-2:2:11, 3:8, oxa-1:15:4,-4-vinyl-14-methoxy*cyclo*tetradeca-$\Delta^{9:12:14}$-triene-5-ol.
XL.	Lactam of *p*-amino-hexahydrobenzoic acid [2]	1B-iminemethenone1:7:8:4,-*cyclo*-hexane.

2. *Non-carbon elements in the basal ring; one or more bridges, either direct linkings or bridges containing carbon or any other element.*

The basal ring selected is the largest possible. If two such rings are possible one isocyclic and the other heterocyclic the former is chosen, or, in other words, where possible the non-carbon elements are put in the bridge rather than in the basal ring. An example of this is seen in ascaridole. In no case, however, is a smaller ring selected in order to bring the oxygen or nitrogen atom into the bridge and not into the ring.

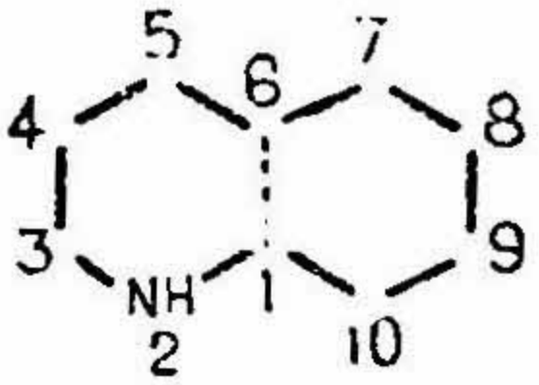
The numbering is clockwise and the starting point is always the tertiary or quaternary atom from which a bridge starts and not the oxygen or nitrogen atom as in the case of monocyclic systems (cf. p. 183). The rules for numbering are exactly similar to those adopted for bridged isocyclic systems and for compounds containing the oxygen or nitrogen in the bridge. The influence of the oxygen, sulphur or nitrogen atom is observed when the two rings formed by the bridge are equal in size, the numbering then proceeds round the ring containing the non-carbon element and starts as near to this element as possible.

Thus decahydroquinoline, XLI, is 1B-1:5,-*heterocyclo*-2-imine-decane and decahydro*iso*quinoline, XLII, is 1B-1:6,-*heterocyclo*-3-imine-decane.

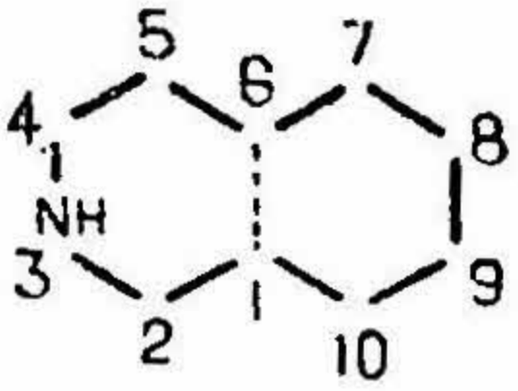
In other cases also the oxygen, nitrogen or carbon atom is given the lowest number compatible with the general rules, e.g., XLIII is 1B-1:5,-*heterocyclo*-7-iminenonane, and uric acid, No. LXII (p. 189) is

[1] Spyer aud Krauss, *Annalen*, 1923, **432**, 233.
[2] Houben and Pfau, *Ber.*, 1916, **49**, 2295.

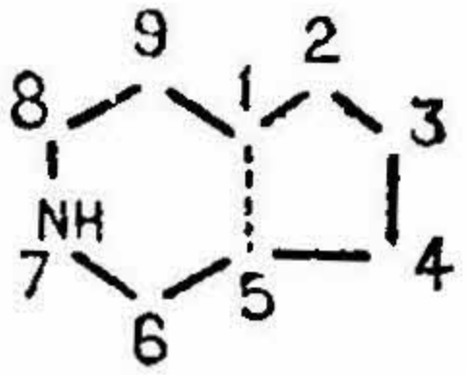
1B-1:1:5,-*heterocyclo*-2:4:6:8-tetraiminenona-3:7:9-trione and not 1B-1:1:5,-*heterocyclo*-2:4:7:9-tetraimine-nona-3:6:8-trione.



XLI.



XLII.



XLIII.

The bridges are named and numbered in the usual manner[1] and if elements, whether carbon or non-carbon, are present in the bridges the atoms of these elements are numbered immediately after the atoms in the ring.[2] Double linkings in a bridge or in the ring are indicated in the usual manner: in the former case by a repetition of the lower of the two numbers representing the two atoms between which the double linking functions, and in the latter case by Δ-ene with the lower of the two numbers. In the case of heterocyclic compounds these double linkings may be between carbon and carbon, carbon and nitrogen or nitrogen and nitrogen but are all treated in the same manner for purposes of naming.

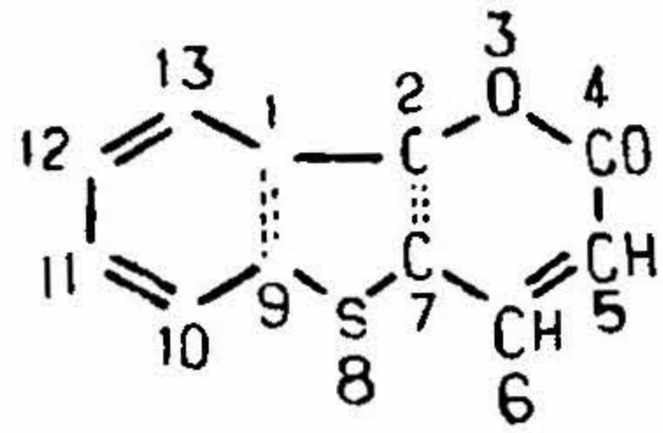
Thus tetrahydroquinoline is 1B-1:1:6,-*heterocyclo*-2-iminedeca-$\Delta^{-7:9}$-diene and quinoline is 1B-1:6,-*heterocyclo*-2-iminedeca-$\Delta^{2:4:7:9}$-tetrene.

The prefix *heterocyclo* is suggested for all compounds containing an element other than carbon in the basal ring. The characteristic name, e.g., hexane, gives the total number of atoms constituting the ring, thus all six membered rings are termed *heterocyclo*-hexanes, whether they contain five carbons and one nitrogen, four carbons and two nitrogens, four carbons, one oxygen and one nitrogen. Immediately after the prefix *heterocyclo* and before the characteristic name the number, character and positions of the non-carbon elements are indicated. The systematic name for Smiles and Hart's[3] thionaphthacoumarin

[1] As described on p. 160. The bivalent group, —NH—, in a bridge as in the basal ring is termed imine, but the tervalent constituent, =N—, in a bridge is termed azine, as suggested by Ingold, although azo would be better if it were not already used in a different connection, e.g., azo compounds.

[2] It should be noted that all atoms forming part of the ring or of a bridge are numbered, whether hydrogen is attached to such atoms or not. In this respect the numbering is different from the common method of numbering used for a substance like naphthalene, where the two carbon atoms common to the two rings are unnumbered.

[3] *J. Chem. Soc.*, 1923, **123**, 2908.



is thus 2B-1:1:9, 2:2:7,-*heterocyclo*-3:8-oxathia-trideca-$\Delta^{5:10:12}$-triene-4-one.

The following examples will serve to illustrate the system :—

Oxygen in ring.

XLIV.	Coumaran	.... 1B-1:5,-*heterocyclo*-2-oxanona-$\Delta^{5:7:9}$-triene.
XLV.	Coumarone	.... 1B-1:5,-*heterocyclo*-2-oxanona-$\Delta^{3:5:7:9}$-tetrene.
XLVI.	Coumarine	.... 1B-1:6,-*heterocyclo*-2-oxadeca-$\Delta^{4:6:8:10}$-tetrene-3-one.
XLVII.	Catechol methylene ether	.... 1B-1:5,-*heterocyclo*-2:4-dioxanona-$\Delta^{5:7:9}$-triene.
XLVIII.	Xanthene	.... 2B-1:10, 3:8,-*heterocyclo*-2-oxatetradeca-$\Delta^{3:5:7:10:12:14}$-hexene.
XLIX.	Pinole	.... 1B-methene-1:8:4,-3:3:7-trimethyl-*heterocyclo*-2-oxahepta-Δ^{6}-ene.
L.	Quercitin	.... 1B-1:6,-13:14-dihydroxy-3-phenyl-*heterocyclo*-2-oxadeca-$\Delta^{3:6:8:10}$-tetrene-4:7:9-triol-5-one.
LI.	No name[1]	.... 1B-1:6,-1:8-dimethyl-3:5-diphenyl-9-phenylhydroxymethyl*heterocyclo*-2:4-dioxadecan-8-ol-7:10-dione.

Sulphur in ring.

LII.	Thianthrene	.... 2B-1:10, 3:8,-*heterocyclo*-2:9-dithiatetradeca-$\Delta^{3:5:7:10:12:14}$-hexene.
LIII.	Dithiobenzoyl	.... 1B-1:5,-*heterocyclo*-2:3-dithianona-$\Delta^{5:7:9}$-triene-4-one.
LIV.	Dimethylthiophthene[2]	.... 1B-1:1:5,-4:6-dimethyl*heterocyclo*-2:8-dithia-octa-$\Delta^{3:6}$-diene.

[1] Diels, *Annalen*, 1923, **434**, 1.
[2] Friedmann, *Ber.*, 1916, **49**, 1346.

LV.	2-Nitropheno-thi-oxin-monoxide[1]	2B-1:10, 3:8,-12-nitro*heterocyclo*-2:9-oxathia-tetradeca-$\Delta^{3:5:7:10:12:14}$-hexene-9-oxide.
LVI.	Unnamed[2]	6B-1:22, 3:20, 6:11, 12:17, methenone-4:27:7, 16:28:19,-*heterocyclo*-5:18-dithiahexacosa-$\Delta^{3:6:8:10:12:14:16:19:22:24:26}$-undecene-2:21-dione.
	Nitrogen in ring.	
LVII.	Indole	1B-1:5, - *heterocyclo* - 2 - iminenona-$\Delta^{3:5:7:9}$-tetrene.
LVIII.	Dihydropentindole[3]	2B-1:1:8, 2:2:6,-*heterocyclo*-7-imine-dodeca-$\Delta^{9:11}$-diene.
LIX.	Isatin	1B-1:5, - *heterocyclo* - 2 - iminenona-$\Delta^{5:7:9}$-triene-3:4-dione.
LX.	1-Phenyl-6:7-benzo-isatin.[4]	2B-1:1:9, 2:2:6, -3-phenyl*heterocyclo*-3-imine-trideca-$\Delta^{7:10:12}$-triene-4:5-dione.
LXI.	Carbazole	2B-1:9, 2:7,-*heterocyclo*-8-iminetri-deca-$\Delta^{2:4:6:9:11:13}$-hexene.
LXII.	Uric acid	1B-1:1:5, - *heterocyclo* - 2:4:6:8 - tetra-imine-nona-3:7:9-trione.
LXIII.	Caffeine	1B-1:1:5,-2:6:8 - trimethyl*heterocyclo*-2:4:6:8 - tetraminenona-Δ^{3}-ene - 7:9-dione.
LXIV.	Dihydroacridine	2B-1:1:10, 3:3:8,-*heterocyclo*-2-imine-tetradeca-$\Delta^{4:6:11:13}$-tetrene.
LXV.	Naphthyridin	1B-1:1:6, - *heterocyclo* - 2:10 - diimine-deca-$\Delta^{2:4:7:9}$-tetrene.
LXVI.	Phenazine	3B-1:10, 2:9, 3:8,- *heterocyclo*-2:9-diimine-tetradeca - $\Delta^{3:5:7:10:12:14}$-hex-ene.
LXVII.	*a*-Naphthacridine	4B-1:1:14, 2:2:11, 3:10, 4:4:9,-*hete-rocyclo*-3-imine-octadeca - $\Delta^{5:7:12:15:17}$ -pentene.[5]
LXVIII.	*sym.* Naphthazine.	5B-1:1:18, 3:16, 4:15, 5:14, 7:7:12,-*heterocyclo* - 4:15-dimine-docosa-$\Delta^{2:5:8:10:13:16:19:21}$-octene.

[1] Krishna, *J. Chem. Soc.*, 1923, **123**, 2783.
[2] Perkin and Plant, *J. Chem. Soc.*, 1923, **123**, 3242.
[3] Fries and Ehlers, *Ber.*, 1923, **56B**, 1308.
[4] Stolle, *J. pr. Chem.*, 1922, [ii], **105**, 137.
[5] An alternative name is 4B-1:1:14, 2:13, 3:3:12, 4:4:9,-*heterocyclo*-2-imine-octadeca-$\Delta^{3:7:10:15:17}$-pentene, but the one given above is selected as, although in both cases the bridges start at carbon atoms numbered 1, 2, 3 and 4, the second and third bridges terminate at 11 and 10 as compared with 13 and 12.

LXIX.	Periquindoline[1]	3B-1:13, 2:11, 4:9,-*heterocyclo*-10:12 diiminehеptadeca - $\Delta^{2:4:6:8:10:13:15:17}$-octene.
LXX.	2:3-Trimethylene-5:6-tetramethylene-pyridine.[2]	2B-1:9, 3:3:7,-*heterocyclo* - 2 - imine-trideca-$\Delta^{1:8}$-diene.
LXXI.	12 - Phenyldibenzcarbazole-5:6:11:13-diquinone.[3]	4B-1:1:17, 3:3:15, 4:4:13, 6:6:11,-14 - phenyl*heterocyclo* - 14 - imine - heneicosa-$\Delta^{7:9:18:20}$ - tetrene- 2:5:12:16-tetrone.
LXXII.	1:2-*o*-phenylene-acetyl - 1:3 - benzdiazole[4]	3B-1:13, 2:10, 4:9,-*heterocyclo*-3:10-diimine-heptadeca-$\Delta^{2:4:6:8:13:15:17}$-heptene-11-one.
LXXIII.	2′:1-*o*-Benzoylene-2-phenyl-1:3-benzdiazole.[4]	4B-1:18, 2:16, 4:9, 10:15,-*heterocyclo*-2:17 - diiminedocosa - $\Delta^{4:6:8:10:12:14:16:18:20:22}$-decene-3-one.
LXXIV.	Anhydro-5 - bromo-indoxyl-*a*-4′-bromo- anthranilide[5]	3B-1:13, 2:11, 4:9,-7:15-dibromo-*heterocyclo* - 2:10 - diiminеheptadeca-$\Delta^{4:6:8:13:15:17}$-hexene-3:12-dione.
LXXV.	Anhydro-8-amino-hexahydrocarbazole-9-acetic acid.[6]	2B-1:11, carbo-2:10:16:6:6,-*heterocyclo*-2:5-diimine-pentadeca - $\Delta^{7:9}$-diene-4-one.
LXXVI.	Unnamed[6]	2B-1:11, 3:8,-*heterocyclo*-2:9:10-triimine-pentadeca-$\Delta^{3:5:7:10}$-tetrene.
LXXVII.	Possible forms of N-methyl-1:2:3-benzotriazole - 1 - oxide.[7]	(*a*) 1 B-1:5,-2-methyl*heterocyclo*-2:3:4-triimine-nona-$\Delta^{3:5:7:9}$-tetrene-2-oxide. (*b*) 1B-1:5,-4-methyl-*heterocyclo*-2:3:4-triiminenona-$\Delta^{2:5:7:9}$-tetrene-2-oxide. (*c*) 2B-1:5,2:4,-3-methyl-*heterocyclo*-2:3:4 - triimine - nona - $\Delta^{5:7:9}$ - triene-2-oxide.
LXXVIII.	N - Phenylnaphtha - triazole.[8]	3B-1:1:10, 2:2:7, 4:6,-5-phenyl*heterocyclo*-4:5:6 - triimine - tetradeca - $\Delta^{8:11:13}$-triene.

[1] Kirchner, *Nachr. K. Ges. Wiss. Goettingen*, 1921, 154.
[2] J. von. Braun, *Ber.*, 1923, **56B**, 1347.
[3] Fries and Ochwat, *ibid.*, 1291.
[4] Bistrzycki and Fassler, *Helv. Chim. Acta*, 1923, **6**, 519.
[5] Heller and Lauth, *Ber.*, 1923, **56B**, 1591.
[6] Perkin and Riley, *J. Chem. Soc.*, 1923, **123**, 2400.
[7] Brady and Day, *ibid.*, 2261.
[8] Charrier and Crippa, *Gazetta*, 1923, **53**, 462.

LXXIX.	Naphthatetrahydro-*iso*quinoline.[1]	2-B-1:1:10, 2:2:7,-*heterocyclo*-4-iminetetradeca-$\Delta^{8:11:13}$-triene.
LXXX.	5-Nitro-2-phenyl-6-methyl-2:1:3-benztriazole.[2]	2B-1:5, 2:4,-3-phenyl-7-methyl-8-nitro-*heterocyclo*-2:3:4-triiminenona-$\Delta^{5:7:9}$-triene.
LXXXI.	Eseroline [3]	.... 2B-1:9, 2:7,-5-methyl-*heterocyclo*-5:8-diimine-trideca-$\Delta^{9:11:13}$-triene.
LXXXII.	Strychnine [4]	.... 3-B-1:17, 6:11, dicarbo-2:15:22:22:23:5:12,-*heterocyclo*-2:5-diimineheneicosa-$\Delta^{13:17:19:21}$-tetrene-3-one-7-ol.[5]
LXXXIII.	Corydaline [6]	.... 3B-1:14, 2:11, 4:9,-3-methyl-7:8:16:17-tetramethoxy-*heterocyclo*-11-imine-octadeca-$\Delta^{4:6:8:14:16:18}$-hexene.
LXXXIV.	Homotetrophan [7]	.... 3B-1:15, 2:11, 4:4:9,-*heterocyclo*-3-imine-nonadeca-$\Delta^{2:5:7:10:15:17:19}$-heptene-10-carboxylic acid.
LXXXV.	Norharman [8]	.... 2B-1:9, 2:7,-*heterocyclo*-5:8-diimine-trideca-$\Delta^{2:4:6:9:11:13}$-hexene.
LXXXVI.	Safranine, T.	.... 2B-1:10,3:8,-5:13-dimethyl-6:12-diamino-9-phenyl*heterocyclo*-2:9-imine-ammonium-tetradeca-$\Delta^{1:3:5:7:9:11:13}$-heptene-9-chloride.
LXXXVII.	Rosinduline (base)	3B-1:1:14, 2:11, 4:9,-13-imino-10-phenyl*heterocyclo*-3:10-diimine-octadeca-$\Delta^{2:4:6:8:11:15:17}$-heptene.
LXXXVIII.	Flavinduline B.	.... 4B-1:1:18, 2:2:7, 8:17, 10:15,-16-phenyl*heterocyclo*-9:16-imine-ammonium-docosa-$\Delta^{3:5:8:10:12:14:16:19:21}$-nonene-16-chloride.
LXXXIX.	Hexamethylene-tetramine.	2B-methene-1:9:5,3:10:7,-*heterocyclo*-1:3:5:7-tetraimine-octane.

[1] Meyer and Schnecko, *Ber.*, 1923, **56B**, 1408.
[2] Angeletti, *Gazetta*, 1923, **53**, 672.
[3] Straus, *Annalen*, 1913, **401**, 358, *cf.* Stedman, *J. Chem. Soc.*, 1921, **119**, 892.
[4] Perkin and Robinson, *J. Chem. Soc.*, 1910, **97**, 305.
[5] An alternative basal ring is one including carbon atoms 22 and 23, as part of the ring, viz., Nos. 3 and 4 and then the -CO·CH_2-becomes a bridge. This system is rejected, however, as it gives a 5B compound as compared with the above 3B formula (cf. footnote 4, p. 155).
[6] Späth and Mosettig, *Annalen*, 1923, **433**, 138; Gadamer and Bruchhausen.
[7] Braun and Stuckenschmidt, *Ber.*, 1923, **56B**, 1724.
[8] Kernack, Perkin and Robinson, *J. Chem. Soc.*, 1922, **121**, 1872.

XC.	No name [1]	.... 1B-1:5,-3-dichlorophenyl-*heterocyclo*-2:3:5:6:7:8-hexaimine-nona-Δ^{1}-ene-9-one-4-thione.

Oxygen and Nitrogen in ring.

XCI.	Isatogenic acid.	2B-1:6, 2:4,-*heterocyclo*-3:2-oxaimine-deca-$\Delta^{6:8:10}$-triene-5-one-4-carboxylic acid.
XCII.	Coumaroquinoline.[2]	2B-1:1:10, 2:2:7,-*heterocyclo*-6:11-oxaimine-tetradeca-$\Delta^{3:8:11:13}$-tetrene-5-one.
XCIII.	Bis-N:N'-diethylglyoxalondioxin.[3]	2B-1:1:9, 3:3:7,-4:6:10:12-tetraethyl-*heterocyclo*-2:8-dioxa-4:6:10:12-tetraimine-dodeca-5:11-dione.
XCIV.	Indazolylbenzoic acid lactone.[4]	4B-1:13, 2:10, 3:10, 4:9,-*heterocyclo*-11:2:3-oxadiimine-heptadeca-$\Delta^{4:6:8:13:15:17}$-hexene-12-one.
XCV.	Phenoxazine	.... 2B-1:10, 3:8,-*heterocyclo*-2:9-oxaimine-tetradeca-$\Delta^{3:5:7:10:12:14}$-hexene.
XCVI.	Triphendioxazine.[5]	4B-1:18, 3:16, 5:14, 7:12-*heterocyclo*-2:13:6:17-dioxadiimine-docosa-$\Delta^{3:5:7:9:11:14:16:18:20:22}$-decene.
XCVII.	Lactone of 3-bromo-5-hydroxypiperidone-3-carboxylic acid.[6]	1B-methene-1:8:4,-4-bromo-*heterocyclo*-2:6-oxaiminehepta-3:5-dione.
XCVIII.	Carbonylsalicylamide.[7]	1B-1:6,-*heterocyclo*-2:4-oxaimine-deca-$\Delta^{6:8:10}$-triene-3:5-dione.
XCIX.	Hydrocotarnine	.... 2B-1:1:9, 3:7,-11-methyl-8-methoxy-*heterocyclo*-4:6:11-dioxaimine-trideca-$\Delta^{2:7}$diene.
C.	Cryptopine [8]	.... 3B-1:18, 2:15, 7:12,-4-methyl-9:10-dimethoxy-*heterocyclo*-19:21:4-dioxaimine-heneicosa-$\Delta^{1:7:9:11:15:17}$-hexene-13-one.

[1] Bülow and Seidel, *Ber.*, 1924, **57B**, 357.
[2] Kondo and Tetsukichi, *J. Pharm. Soc., Japan*, 1923, 615.
[3] Biltz and Lemberg, *Annalen*, 1923, **432**, 177.
[4] Heller, *Ber.*, 1916, **49**, 525.
[5] *Ber.*, 1890, **23**, 182; 1894, **27**, 2784; 1899, **32**, 126.
[6] Tranbe, Johow and Tepohl, *Ber.*, 1923, **56B**, 1861.
[7] Comanducci, *Rend. Accad. Sci. Fis. Math. Napoli*, 1921, [iii], **27**, 48.
[8] *J. Chem. Soc.*, 1916, **109**, 815; 1919, **115**, 713.

CI.	Protopine [1]	.... 4B-1:21, 2:18, 7:15, 9:9:13,-4-methyl-*heterocyclo*-10:12:22:24:4-tetroxa-imine-tetracosa-$\Delta^{1:7:14:18:20}$-pentene-16-one.
CII.	Tetrahydroberberine.	4B-1:17, 3:15, 4:12, 6:6:10,-18:19-dimethoxy-*heterocyclo*-7:9:15-dioxaimine-heneicosa-$\Delta^{4:11:17:19:21}$-pentene.
CIII.	Meldola's blue	.... 3B-1:1:14, 2:2:11, 4:9,-7-dimethylamino-*heterocyclo*-10:3-oxonium-imine-octadeca-$\Delta^{3:5:7:9:12:15:17}$-heptene-10-chloride.
CIV.	Gallocyanine	.... 3B-1:10, 2:13, 4:9,-7-dimethylamino-*heterocyclo*-11:10:3-oxaoxoniumimine-hexadeca-$\Delta^{3:5:7:9:14:16}$-hexene-15:16-diol-12-one.

Sulphur and Nitrogen in ring.

CV.	Saccharin	.... 1B-1:5-*heterocyclo*-2:3-sulphone-imine-nona-$\Delta^{5:7:9}$-triene-4-one.
CVI.	6-Phenyldinaphthiazine-5:7:12:14-diquinone. [2]	4B-1:1:18, 3:3:16, 5:5:14, 7:7:12,-15-phenyl*heterocyclo*-4:15-thiaimine-docosa-$\Delta^{8:10:19:21}$-tetrene-2:6:13:17-tetrone.
CVII.	No name [3]	.... 4B-1:1:18, 2:15, 4:4:13, 6:6:11,-16-amino*heterocyclo*-14:3-thiaimine-docosa-$\Delta^{2:7:9:15:19:21}$-hexene-5:12:17-trione.
CVIII.	No name [3]	.... 5B-1:22, 3:20, 4:4:9, 10:19, 12:17,-*heterocyclo*-18:21:2:11-dithiadiimine-hexacosa-$\Delta^{2:5:7:10:12:14:16:19::22:24:26}$-undecene.
CIX.	4-Ketotetrahydro-1:5-heptabenzthiazine. [4]	1B-1:6,-*heterocyclo*-7:11-thiaimine-undeca-$\Delta^{1:3:5}$-triene-10-one.
CX.	2-Methyl-*a*-naptha-thiazole methiodide. [5]	2B-1:1:9, 2:2:6, -3:4-dimethyl-*heterocyclo*-5:3-thiaammonium-trideca-$\Delta^{3:7:10:12}$-tetrene-3-iodide.

[1] Perkin, *J. Chem. Soc.*, 1916, **109**, 815 ; 1919, **115**, 713.
[2] Fries and Ochwat, *Ber.*, 1923, **56B**, 1291.
[3] *Ibid.*, 1923, **56B**, 1291.
[4] Mayer and Horst, *ibid.*, 1415.
[5] Smith, *J. Chem. Soc.*, 1923, **123**, 2289.

CXI.	2:6-Dimethylbenz-bis-thiazole.[1]	2B-1:9, 3:3:7,-5:11-dimethyl*heterocyclo*-4:12:6:10-dithiadiimine-dodeca-$\Delta^{1:5:8:10}$-tetrene.
CXII.	2:6-Dimethyl-β-benz-bisthiazole.[1]	2B-1:9, 3:3:7,-5:11-dimethyl*heterocyclo*-4:10:6:12-dithiadiimine-dodeca-$\Delta^{1:5:8:11}$-tetrene.
CXIII.	Thio-2-methyl-benzothiazole.[2]	1B-1:5,-4-methyl*heterocyclo*-2:4-thiaimine-nona-$\Delta^{5:7:9}$-triene-3-thione.
CXIV.	No name [3]	1B-1:5,-*heterocyclo*-2:3:4-dithiaimine-nona-$\Delta^{5:7:9}$-triene-3-oxide.
CXV.	Methylene blue	2B-1:10, 3:8,-5:13-tetramethyldiamino*heterocyclo*-2:9-sulphoniumimine-tetradeca-$\Delta^{2:4:6:8:10:12:14}$-heptene-2-chloride.

Non-carbon Elements in both bridge and ring.

CXVI.	2:5-Oxido-4-hydroxy-6:8-diketo-7:9-diethyl-3:4:5:6:8:9-tetrahydropurine.[4]	2B-1:6, oxa-1:10:4,-7:9-diethyl-*heterocyclo*-3:5:7:9-tetraimine-nona-Δ^{3}-ene-6-ol-2:8-dione.
CXVII.	1-Benzyl-morpho-pyrrolidine.[5]	1B-benzylimine-1:8:4,-*heterocyclo*-6-oxaheptane.
CXVIII.	Betain form of 7-hydroxy-2-phenyl-benzopyrilium.[6]	2B-2:7, oxa-1:11:4,-10-phenyl-*heterocyclo*-1-oxoniumdeca-$\Delta^{2:4:6:8:10}$-penten-9-ol.
CXIX.	Flavanthrene	6B-1:1:24, 3:3:22, 4:19, 11:11:16, azine-2:2:29:6, carbo-5:17:30:9:9, -*heterocyclo*-18-imine-octacosa-$\Delta^{5:7:12:14:17:20:25:27}$-octene-10:23-dione.
CXX.	Morphine.[7]	4B-2:11, 3:3:15, 4:9, oxa-1:18:5, -12-methyl*heterocyclo*-12-imine-heptadeca-$\Delta^{4:6:8}$-triene-6:16-diol.
CXXI.	Morphine (Pschorr).	3B-1:1:12, oxa-3:18:16, carbo-2:2:17:6:10, -9-methyl-*heterocyclo*-9-iminehexadeca-$\Delta^{13:15}$-diene-4:15-diol.

[1] Edge, *J. Chem. Soc.*, 1923, **123**, 2331.
[2] Mills, Clark and Aeschlemann, *ibid.*, 2362.
[3] D.R.P. 370854.
[4] Biltz and Lemberg, *Annalen*, 1923, **432**, 177.
[5] Von Braun and Seeman, *Ber.*, 1923, **56B**, 1840.
[6] Buck and Heilbron, *J. Chem. Soc.*, 1923, **123**, 2525.
[7] Faltis, *Arch. Pharm.*, 1917, **255**, 85.

Spiro compounds.

CXXII.	No name.[1]	.... 1B-oxadimethylmethene, 1:4:5:1-*cyclo*propane.
CXXIII.	Acetyl-pseudoindoxyl*spirocyclo*-pentane.[2]	2B-3:8,-tetramethene-1:10:11:12:13 1,-2-acetyl-*heterocyclo*-2-iminenona-$\Delta^{3:5:7}$-triene-9-one.
CXXIV.	Copellidyl pyrrolidinum bromide.[3]	1B-tetramethene-1:7:8:9:10:1,-2-methyl-5-ethyl-*heterocyclo*-1-ammoniumhexane-1-bromide.
CXXV.	Succinylo-fluorescein-diethyl ether (lactone form).[4]	3B-1:10, 3:8, oxatrimethene-16-one-2:15:16:17:18:2,-6:12-diethoxy*heterocyclo*-9-oxatetradeca-$\Delta^{3:5:7:10:12:14}$-hexene.
CXXVI.	Rhodamine B, base	3B-1:10, 3:8, (1 B-17:22) oxamethenone-hexamethine-2:15....22:2, -6:12-tetraethyldiamino-*heterocyclo*-9-oxatetradeca-$\Delta^{3:5:7:10:12:14}$-hexene.
CXXVII.	5-Bromosalicylic acid-phthalylidene-ether-ester.[5]	2B-2:7, (1 B-12:17) 14-bromo-10:18-dioxa-11-methenone-hexamethine-2:10....18:2,-*heterocyclo*-9-oxanona-$\Delta^{2:4:6}$-triene-8-one.

My thanks are due to Dr. H. E. Watson for numerous valuable suggestions and to Mr. P. Ramaswami Ayyar for unstinted help in manuscript and proof reading.

Department of General and Organic Chemistry,
Indian Institute of Science,
Bangalore.

[1] Bruylants, *Bull. Soc. Chim. Belg.*, 1923, **32**, 358.
[2] Perkin and Plant, *J. Chem. Soc.*, 1923, **123**, 3243.
[3] Von Braun, Lemke and Nelken, *Ber.*, 923, **56B**, 1564; for similar compounds compare *ibid.*, 1924, **57B**, 480.
[4] Biggs and Pope, *J. Chem. Soc.*, 1923, **123**, 2937.
[5] Kaufmann, *Ber. Deutsch. Pharm. Ges.*, 1923, **33**, 120.

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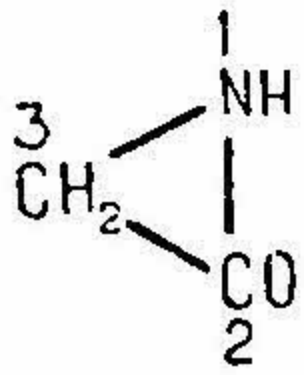
PLATE XII.



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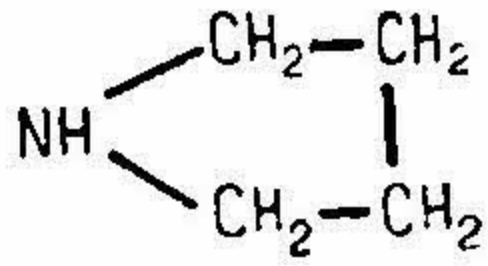

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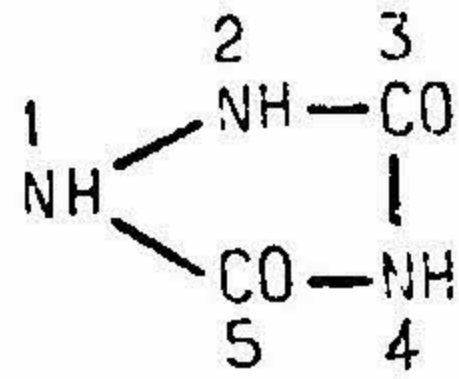

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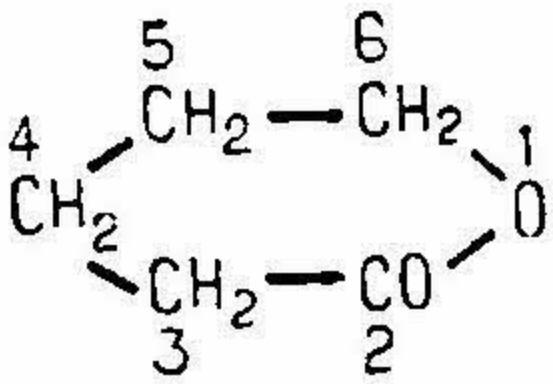

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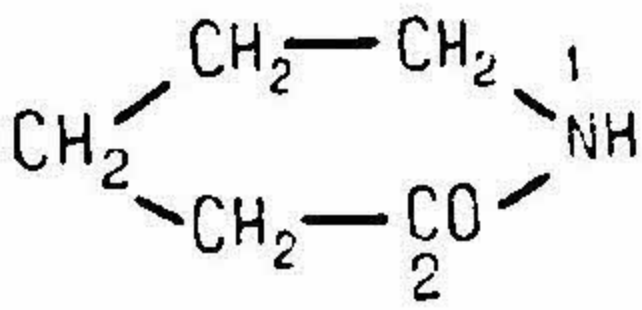

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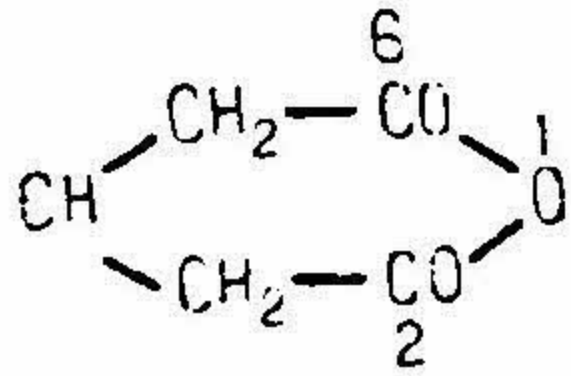

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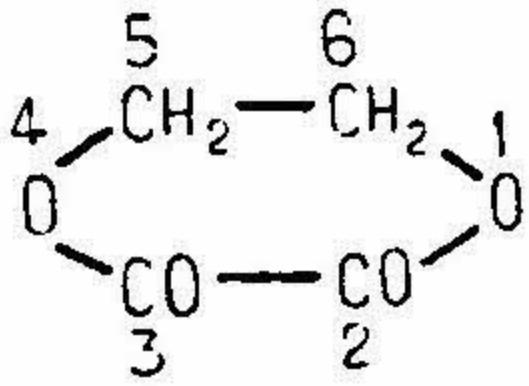

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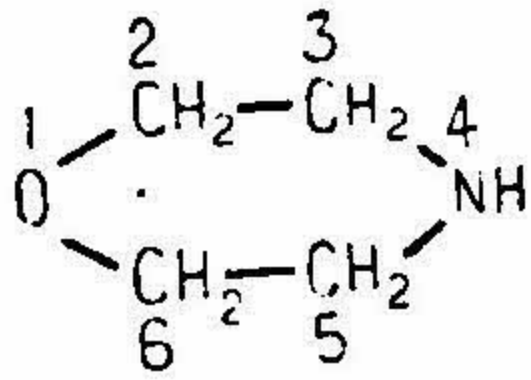

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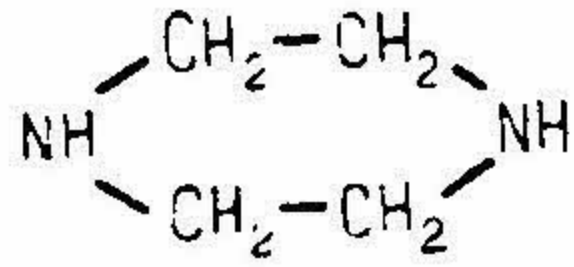

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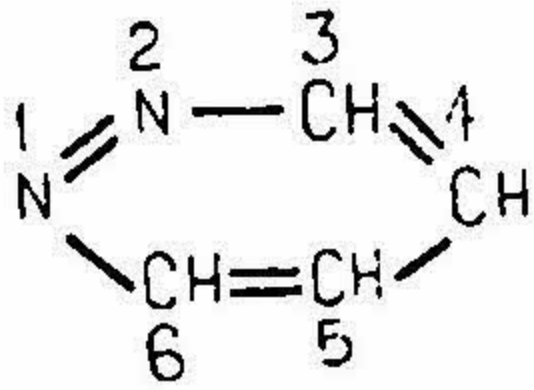

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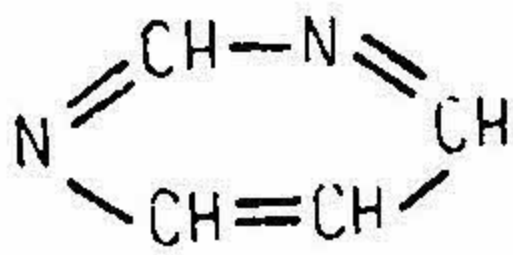

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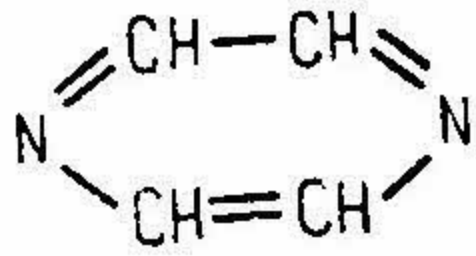
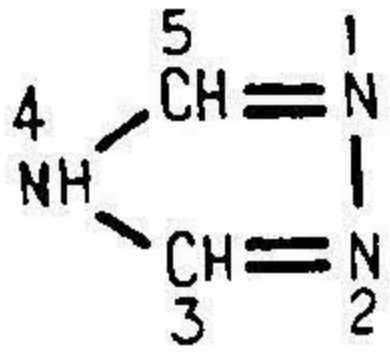


XXIII.

PLATE XIII.



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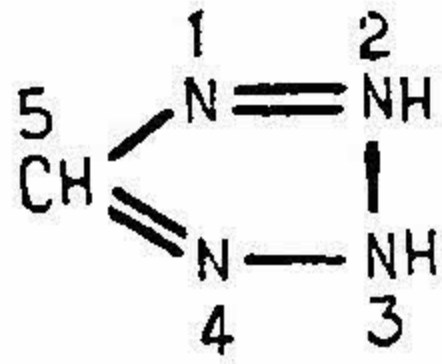

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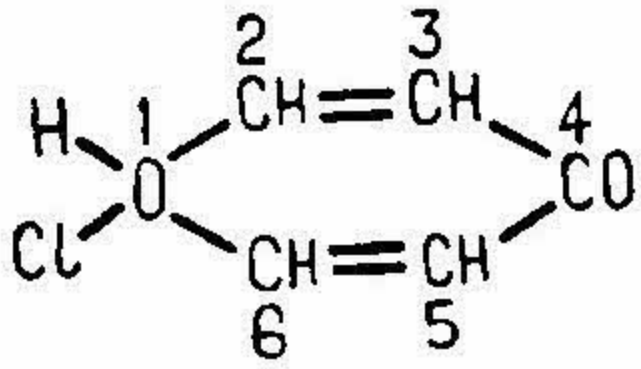

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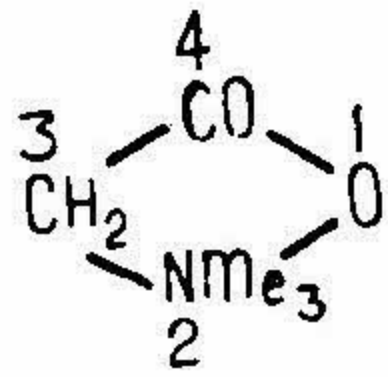

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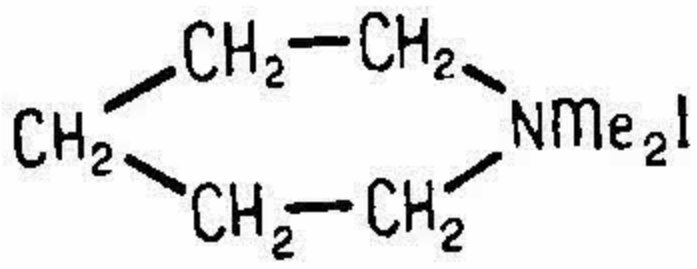

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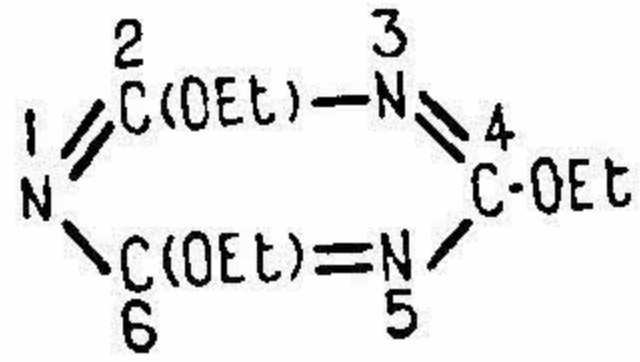

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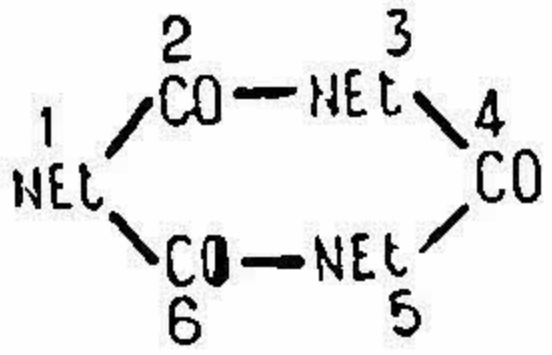

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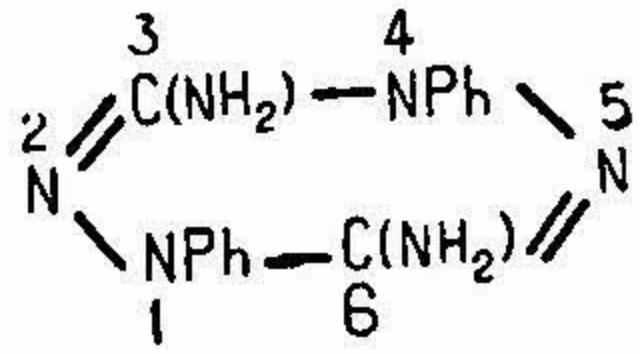

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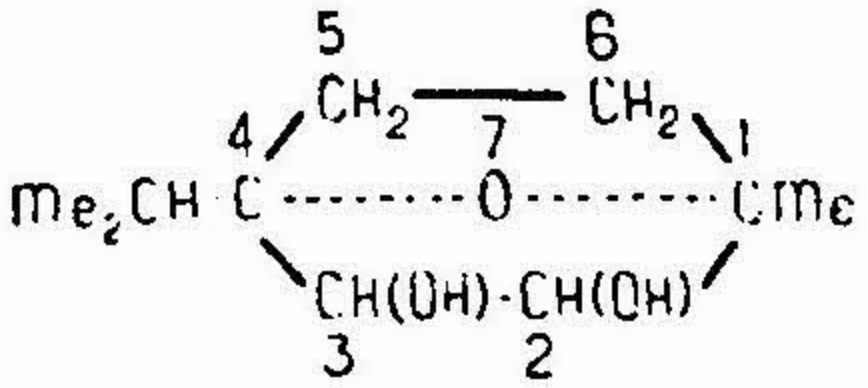

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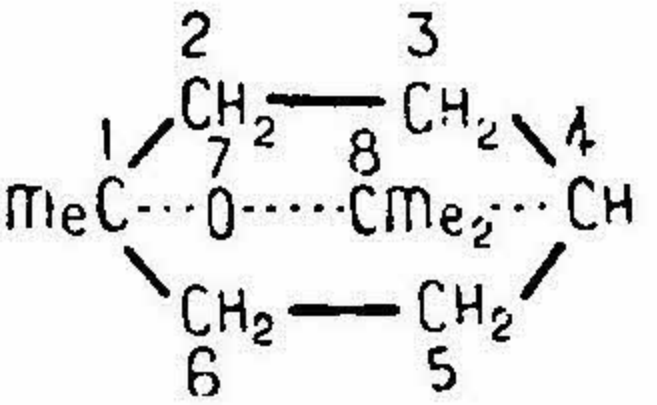

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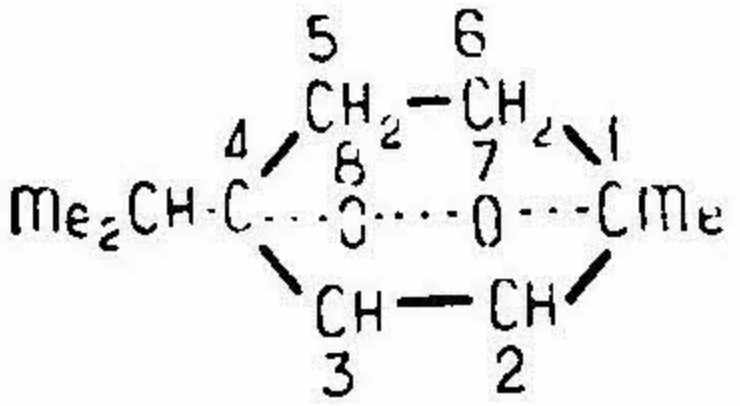

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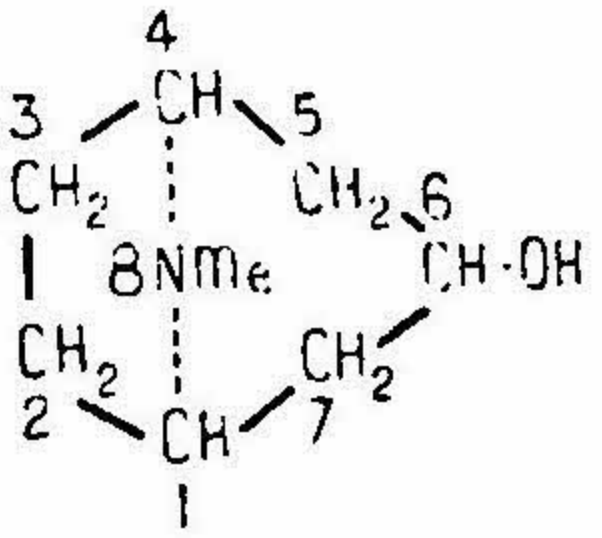

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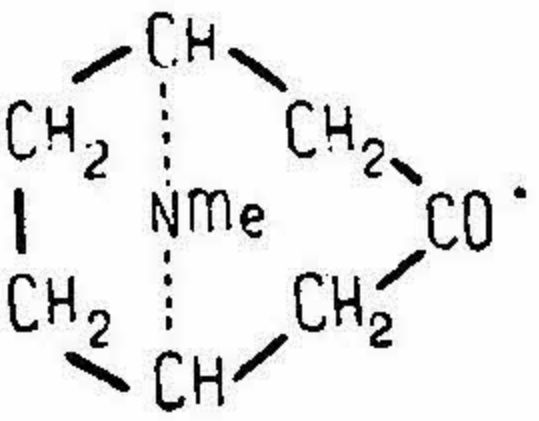

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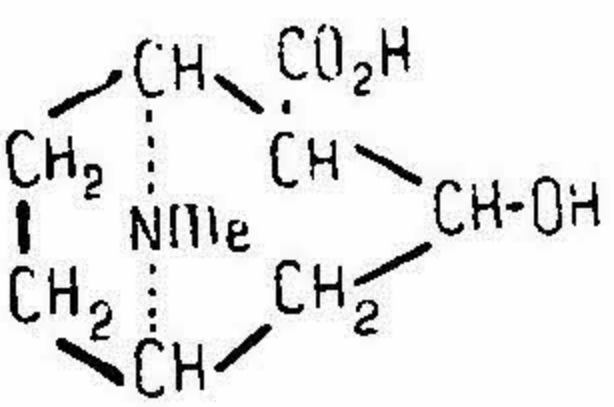

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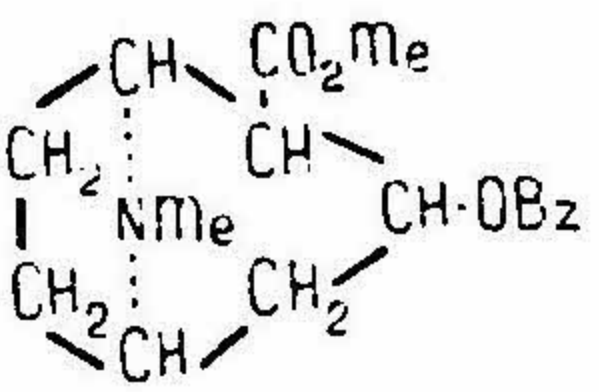

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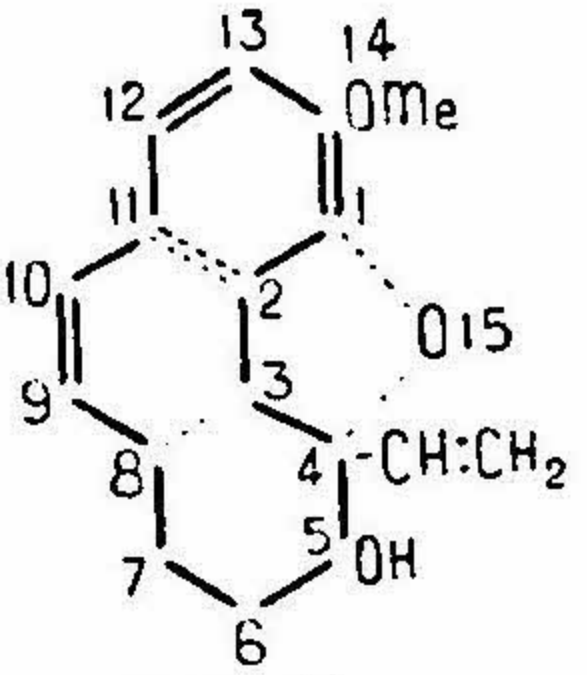

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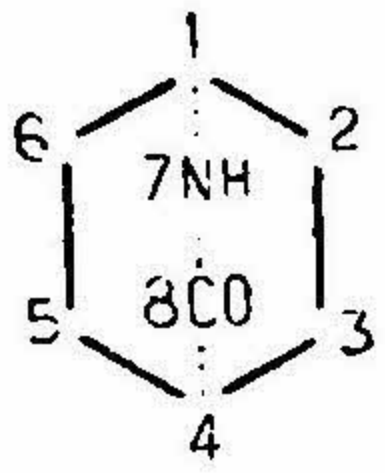

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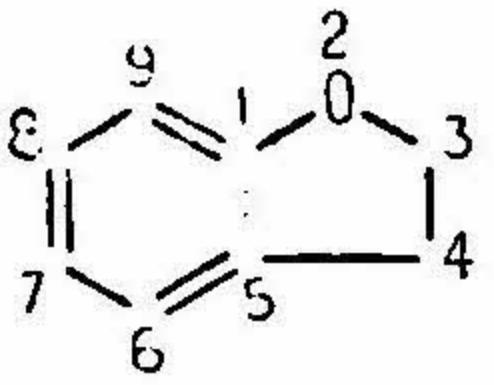

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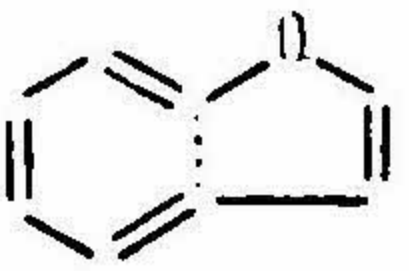

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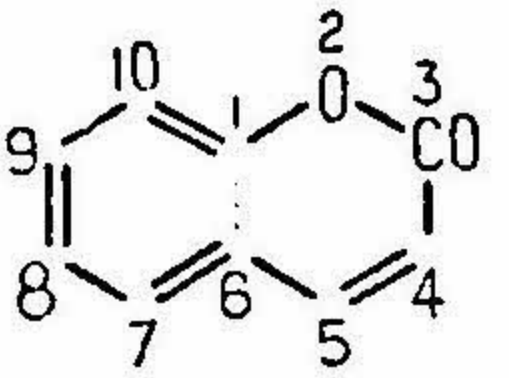

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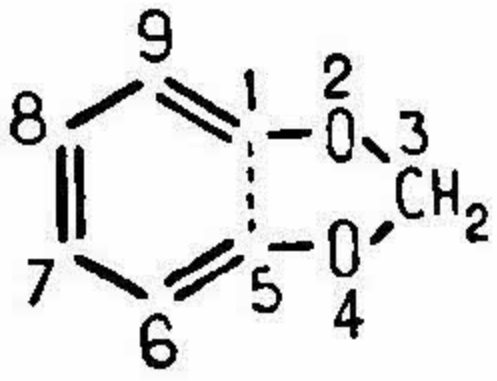

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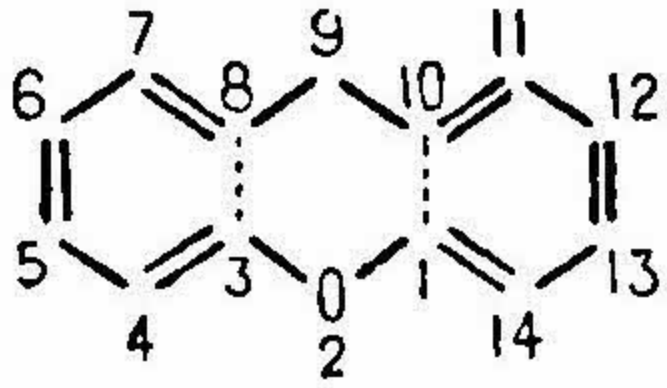

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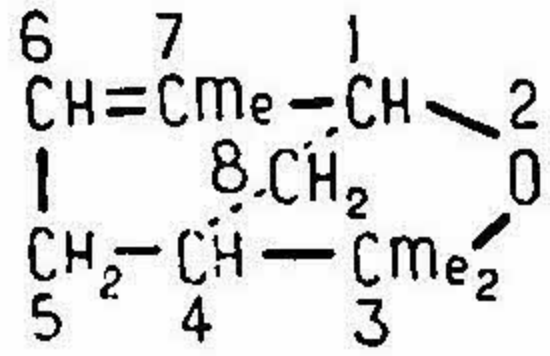

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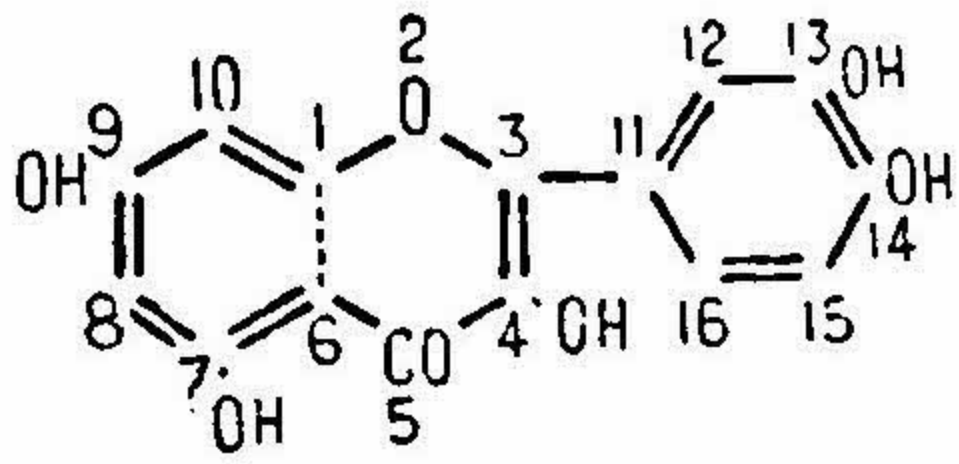

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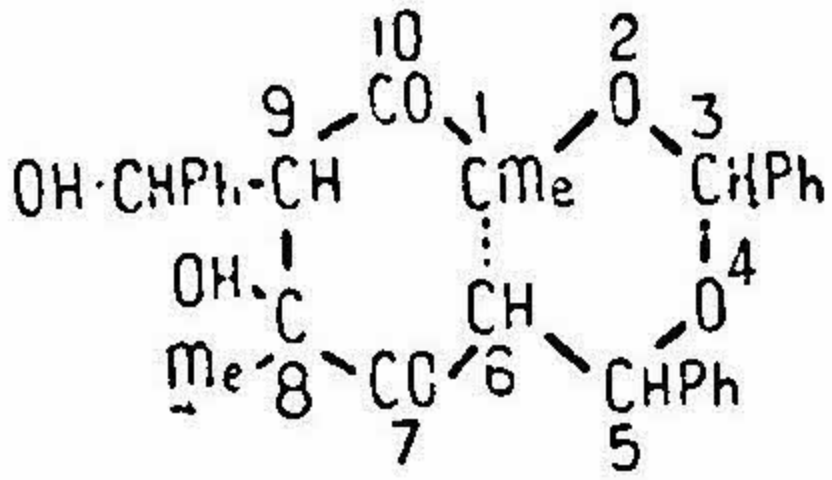

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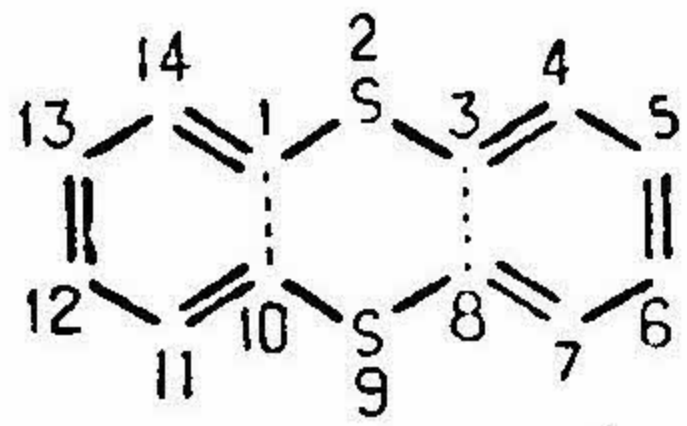

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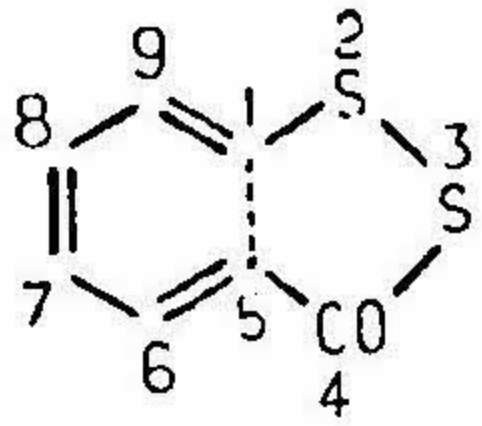

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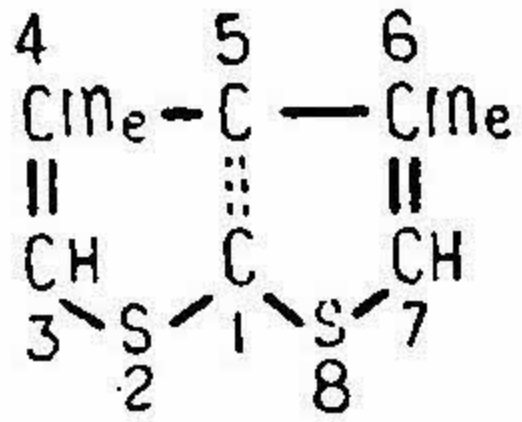

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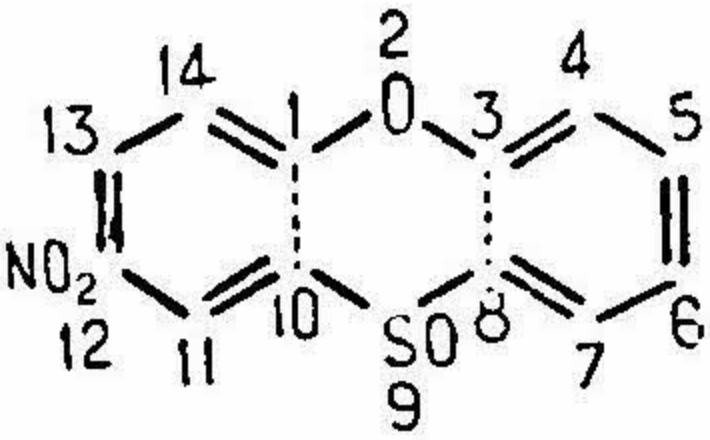

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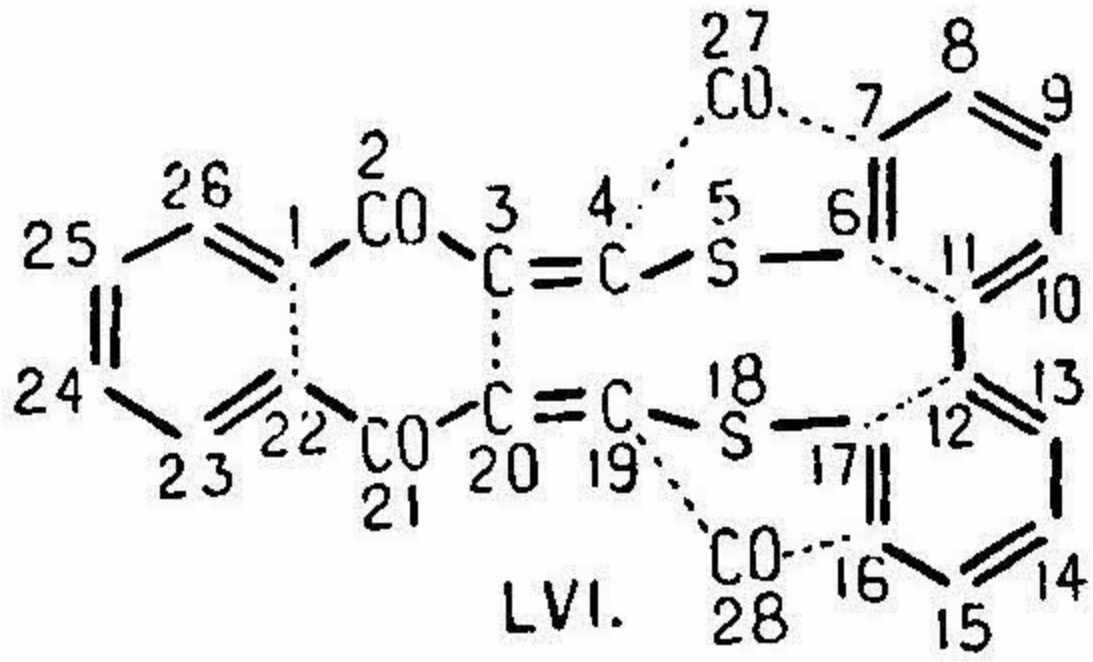

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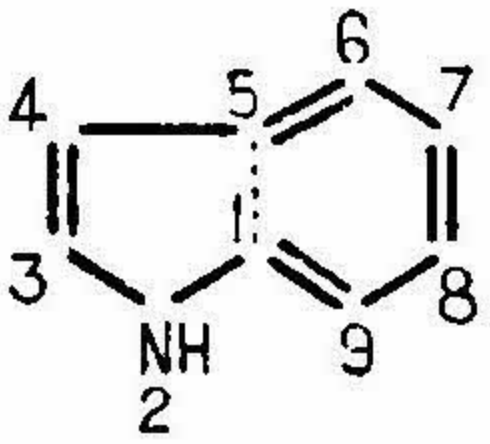
PLATE XVI.



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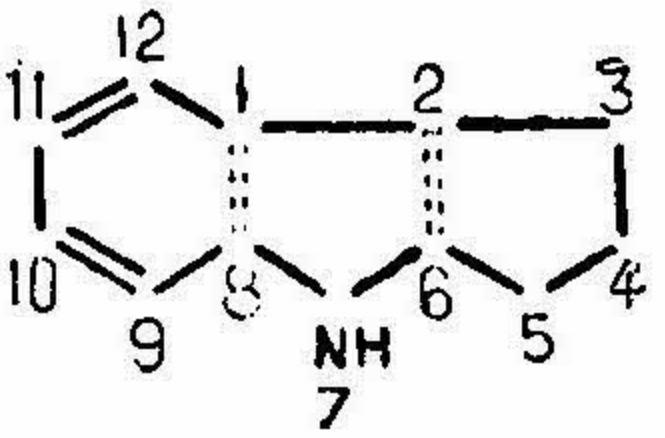

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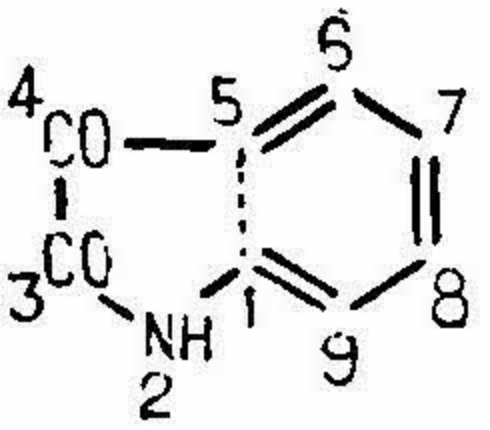

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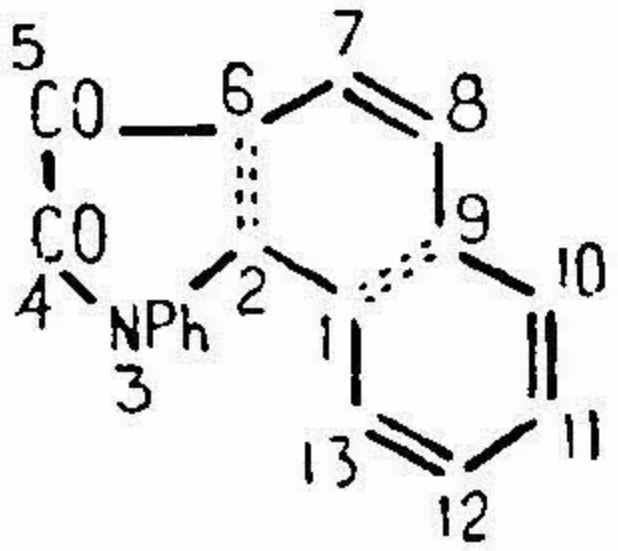

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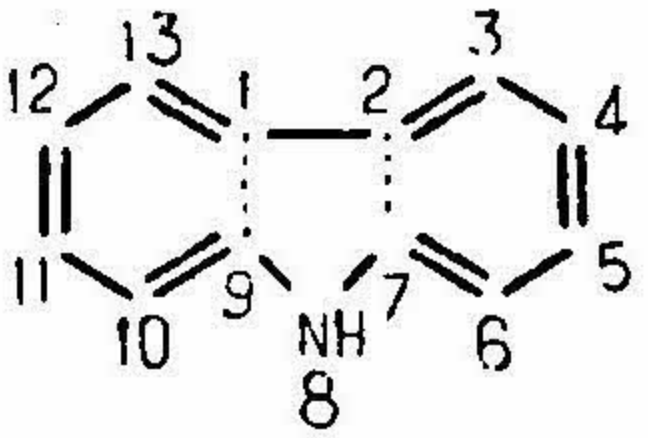

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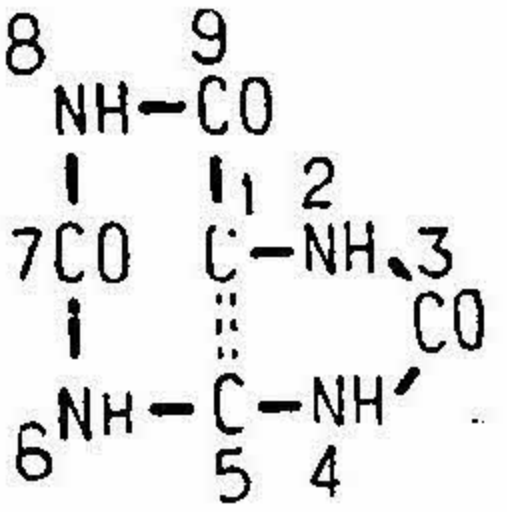

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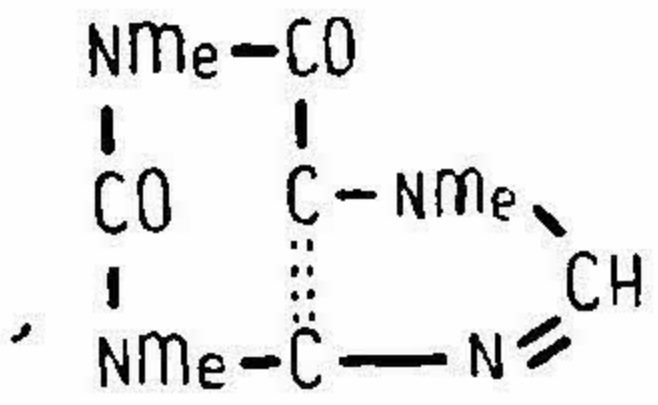

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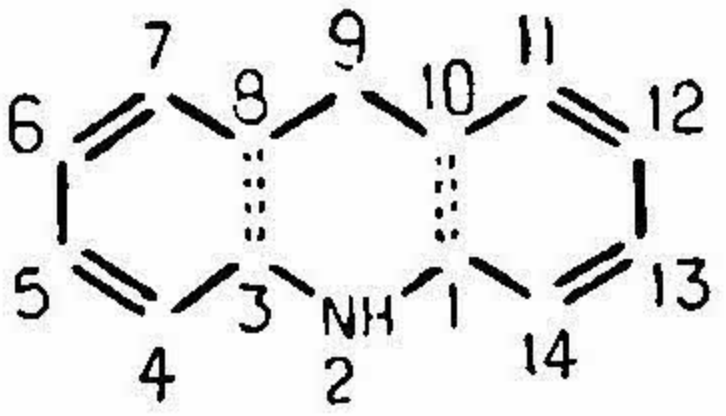

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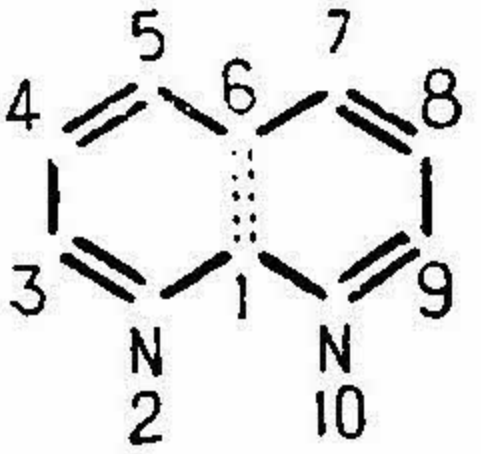

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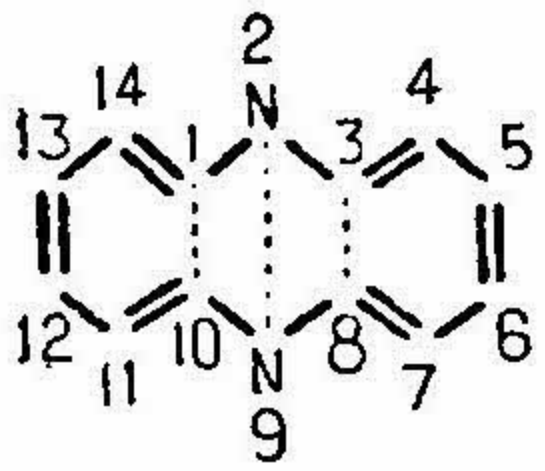

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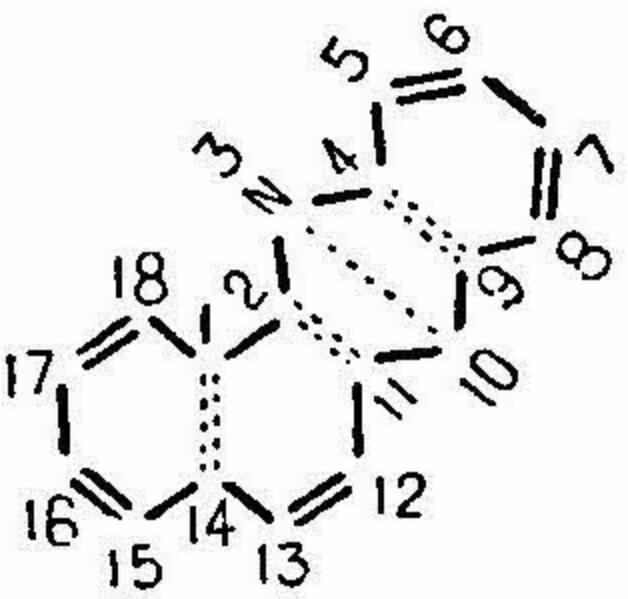

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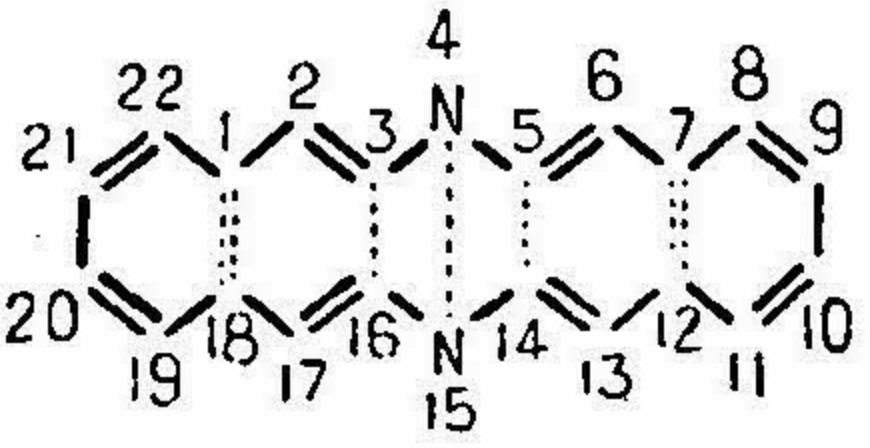

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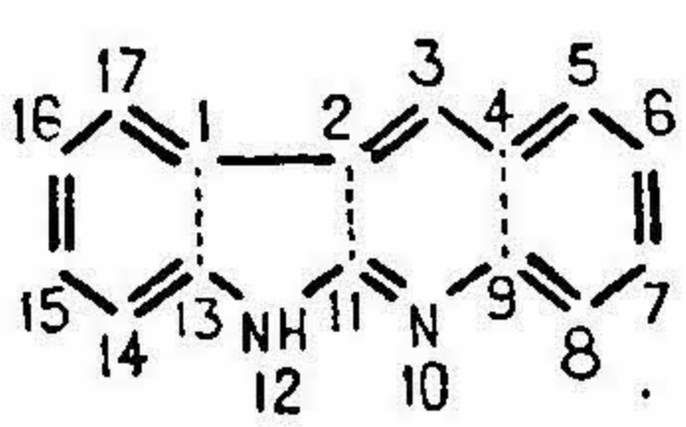

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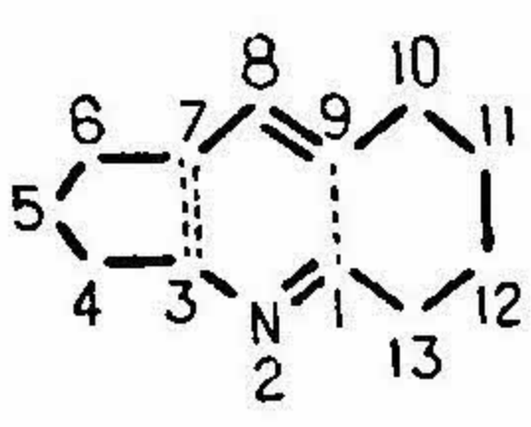

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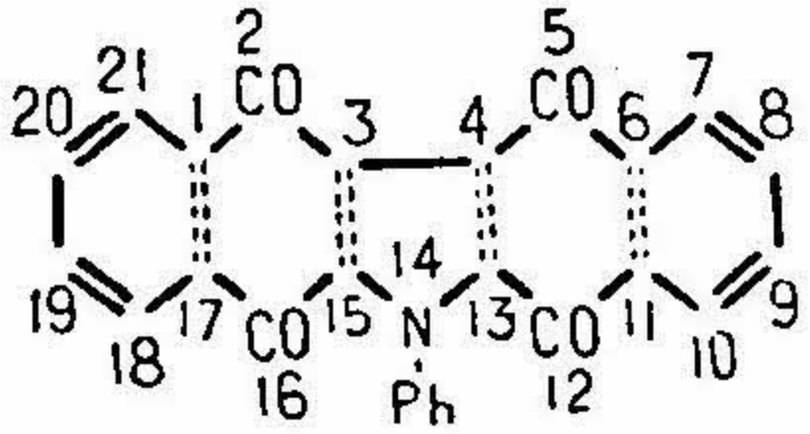

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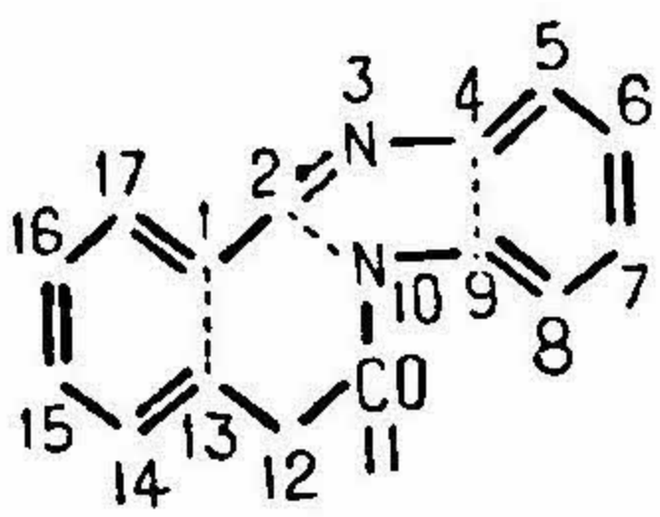

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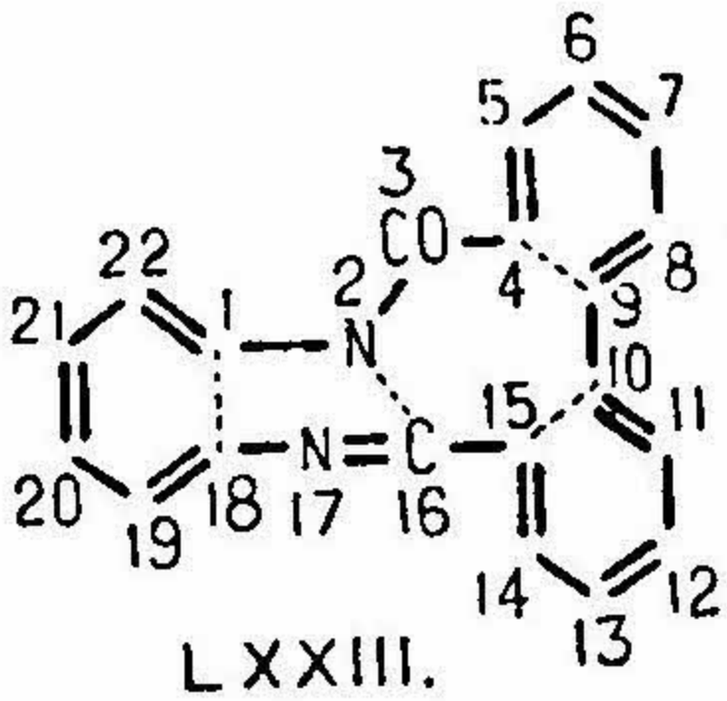

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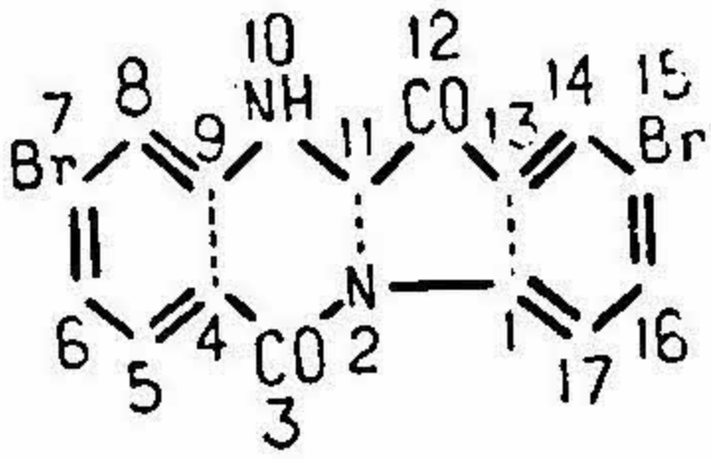

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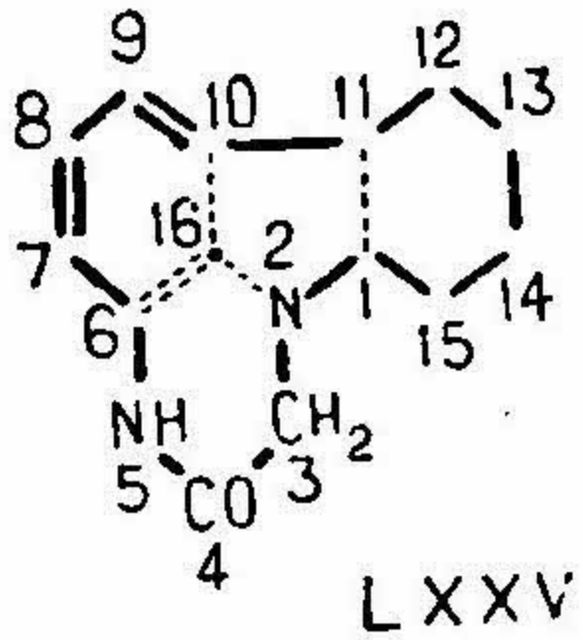

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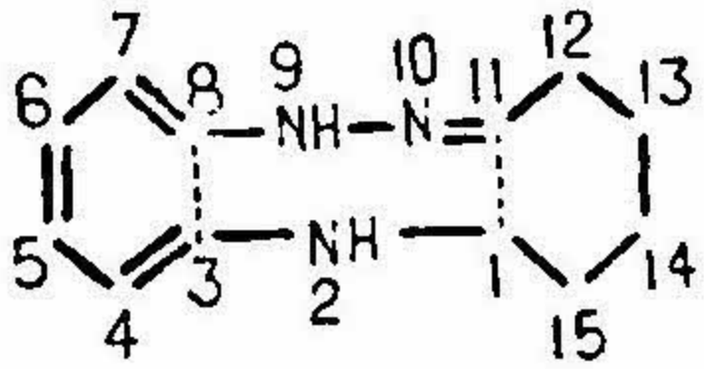

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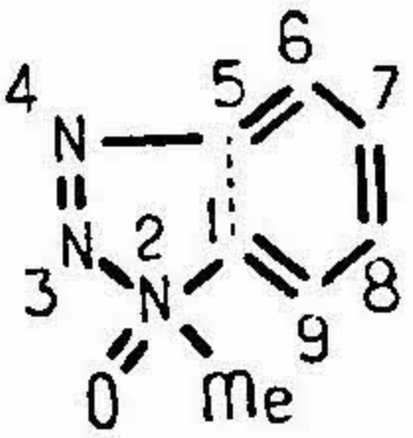

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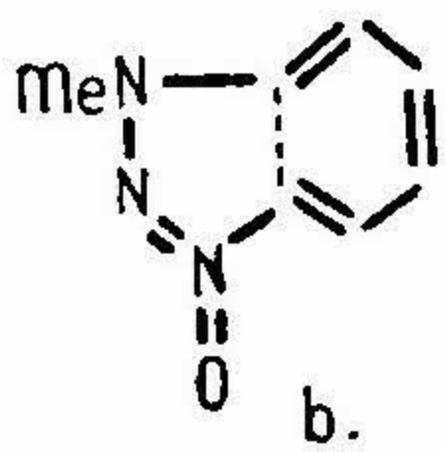

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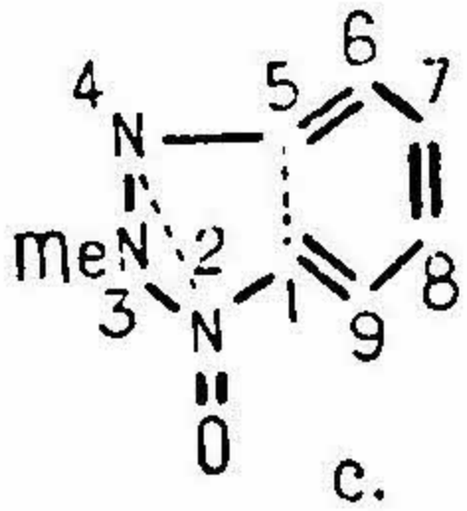

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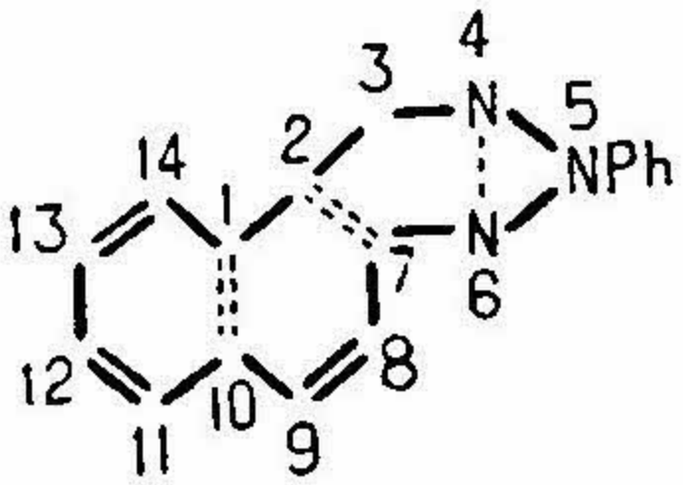

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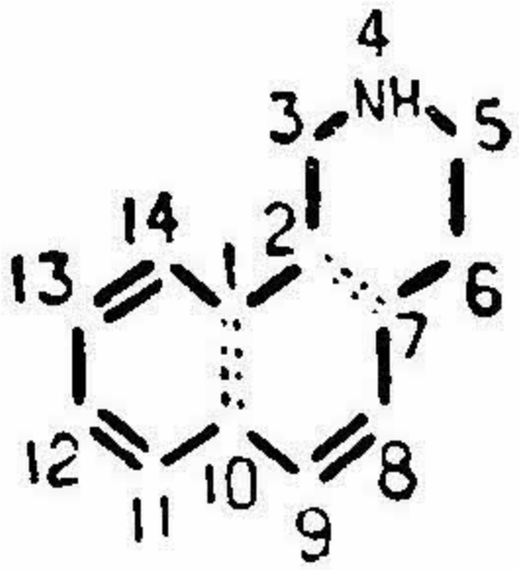

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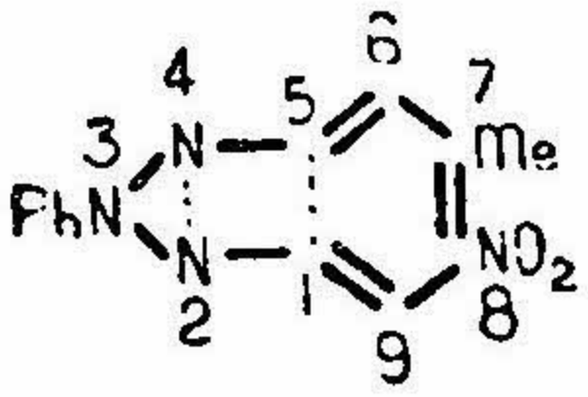

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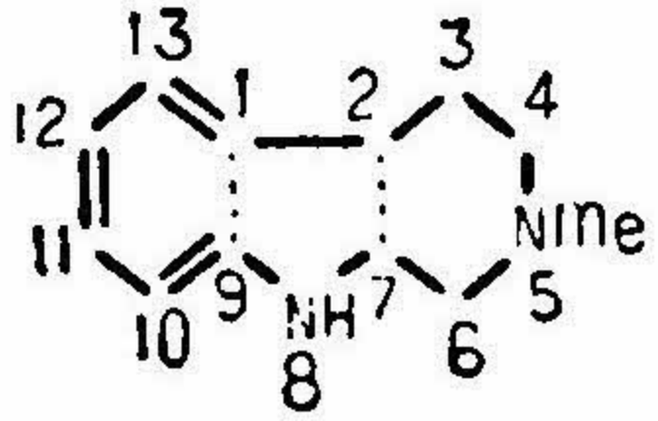

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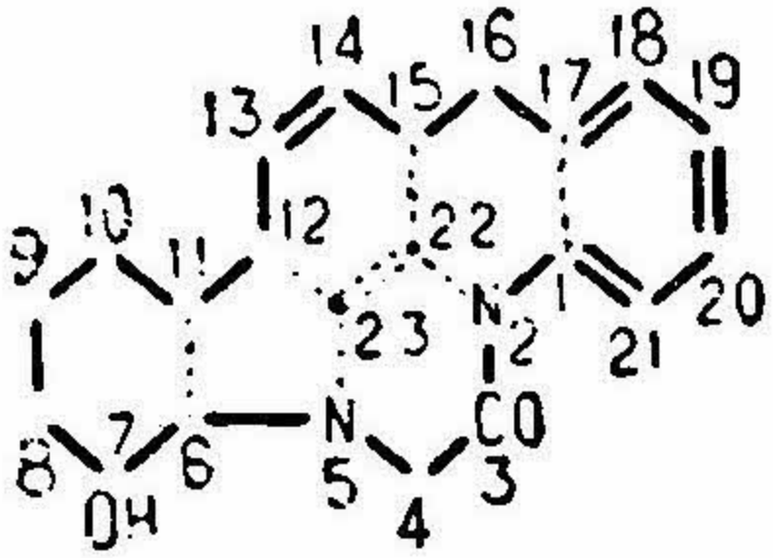

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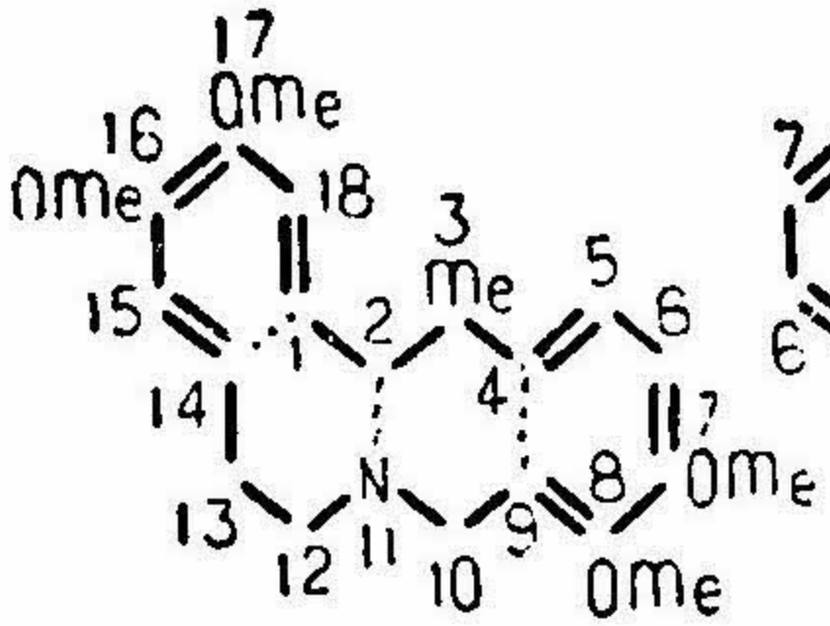

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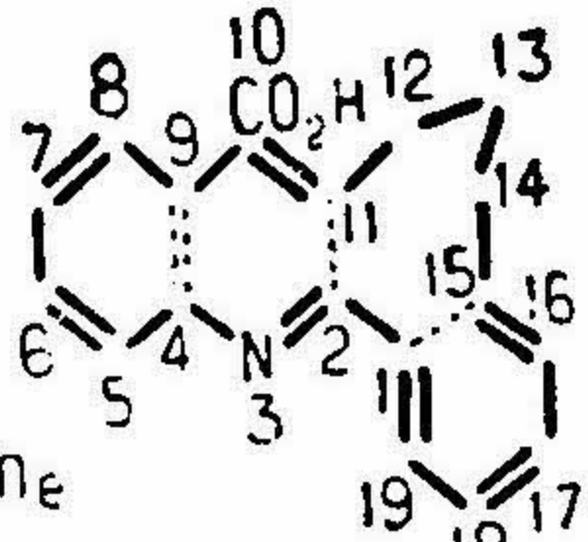

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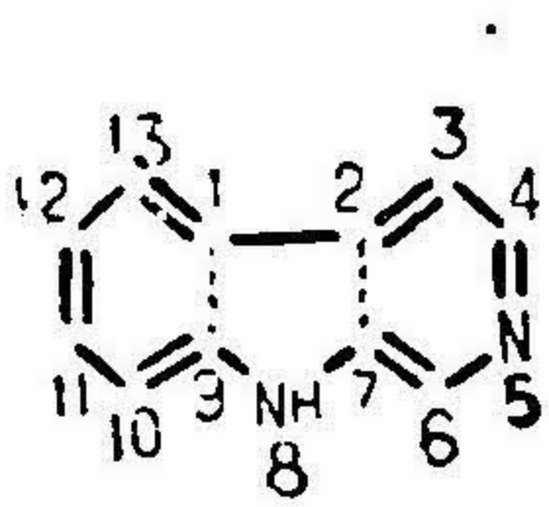

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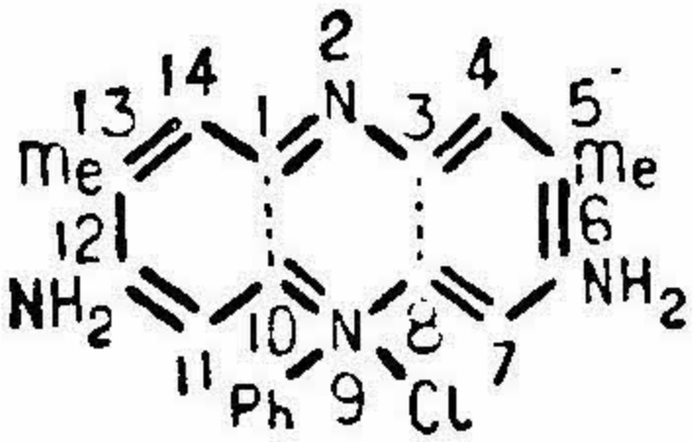

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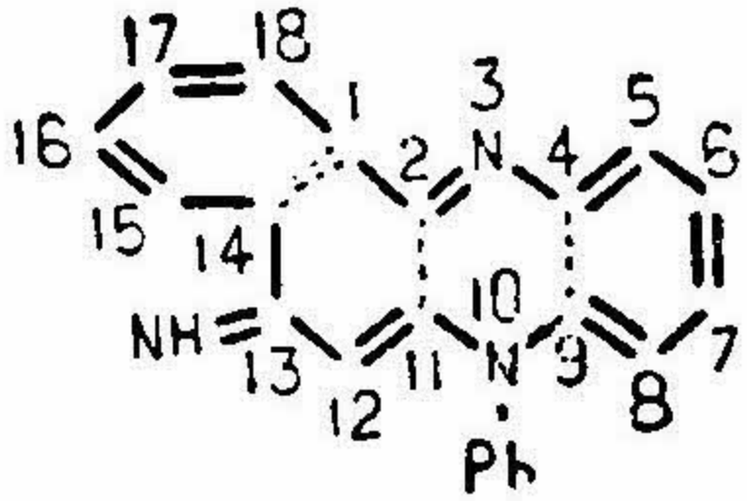

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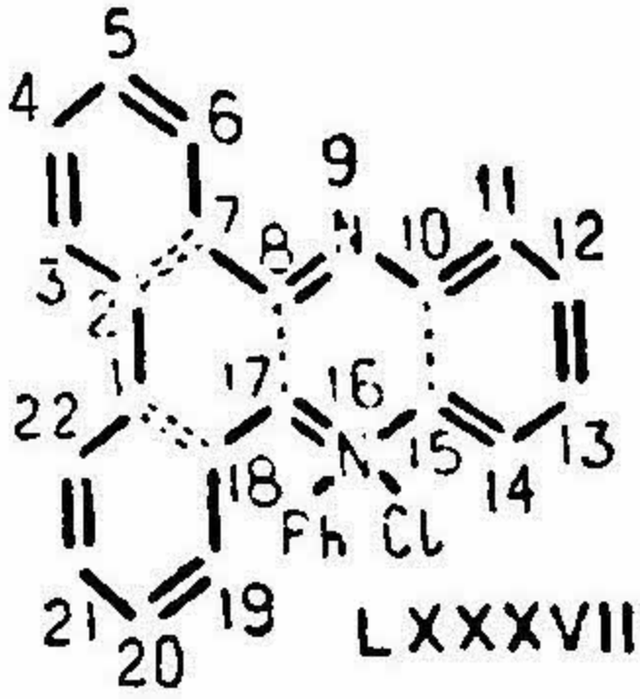

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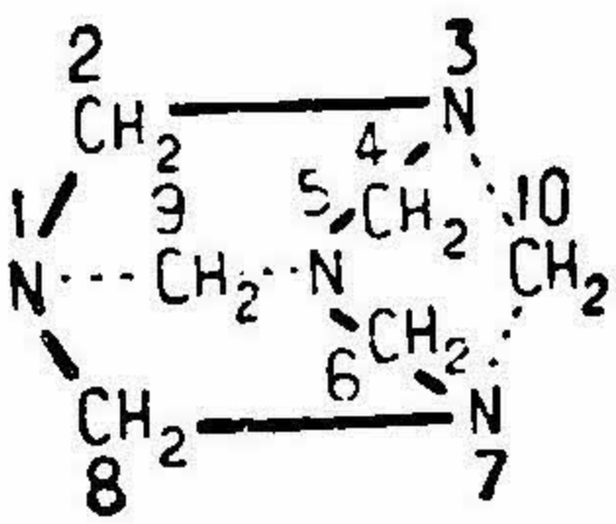

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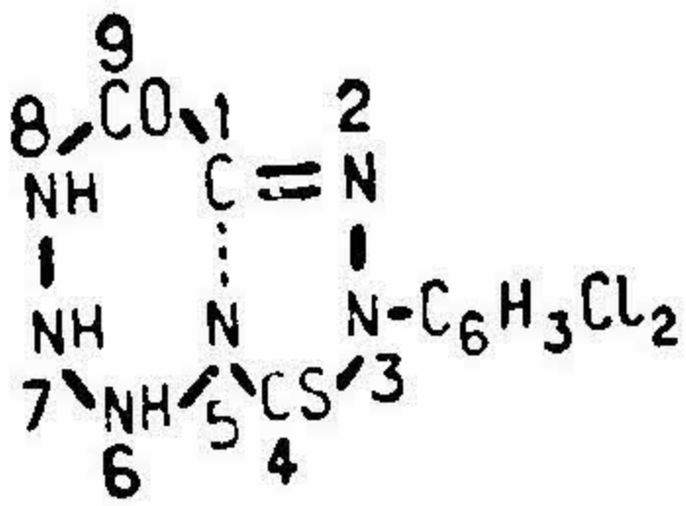

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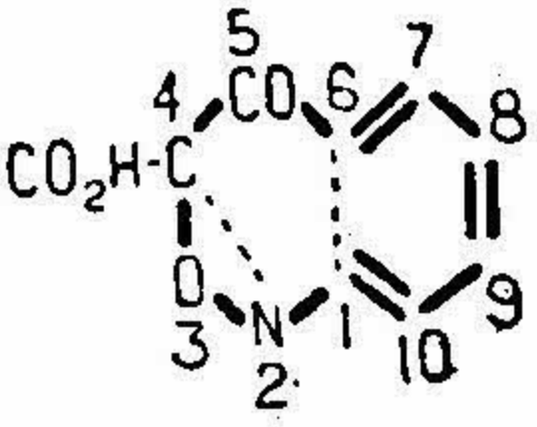

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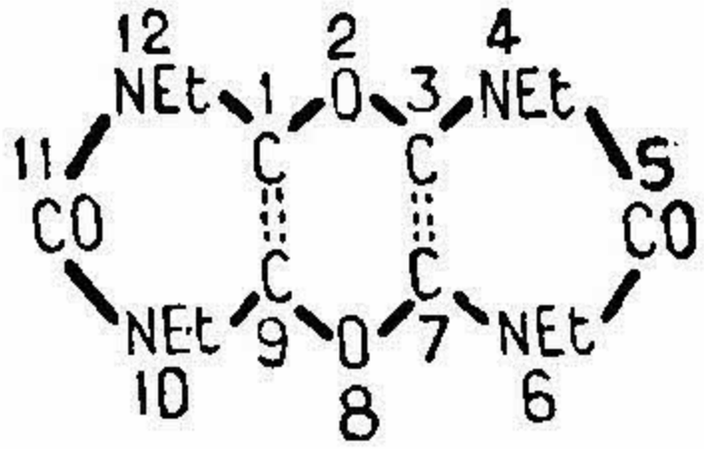

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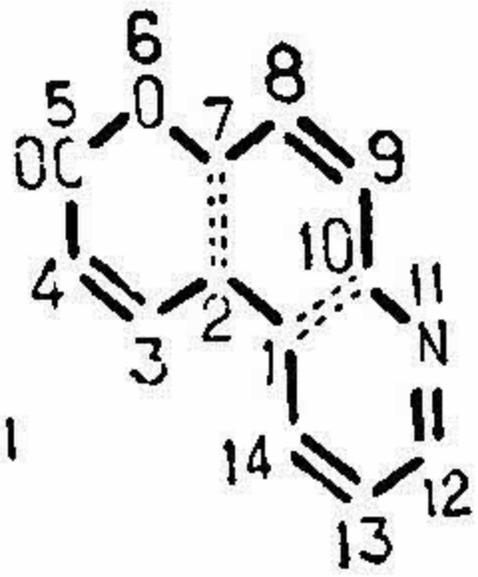

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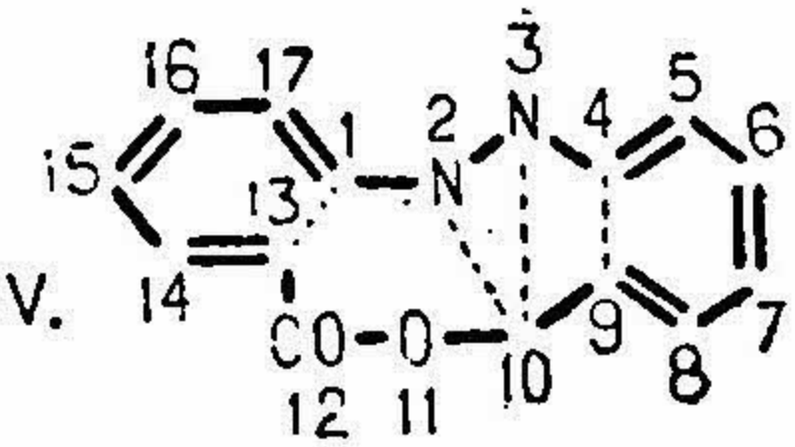

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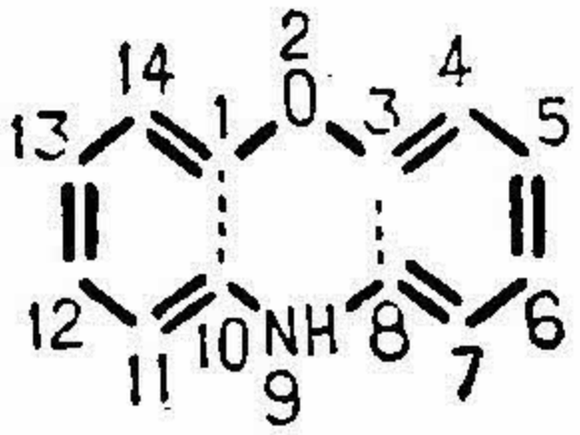

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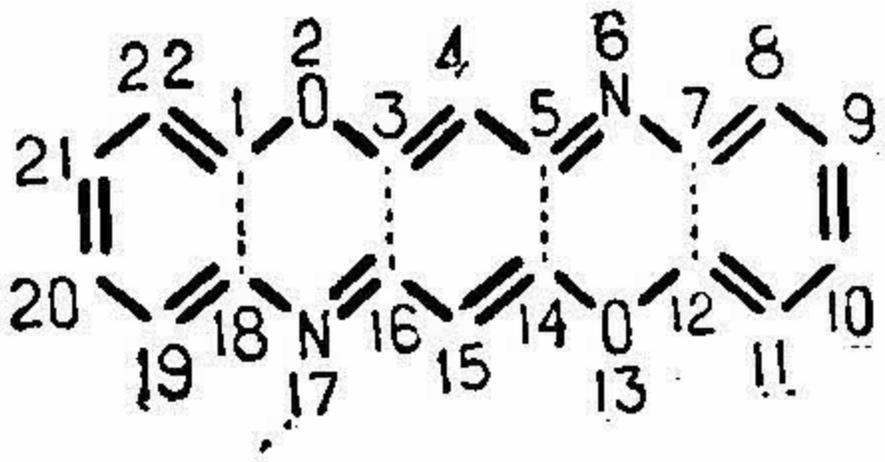

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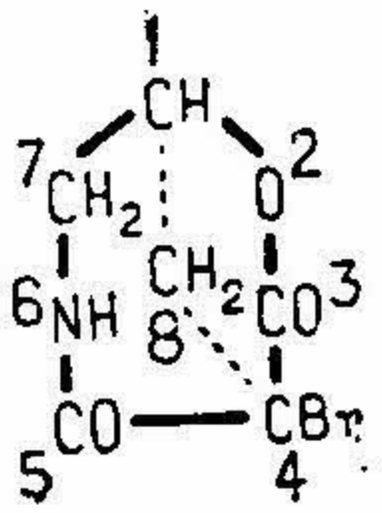
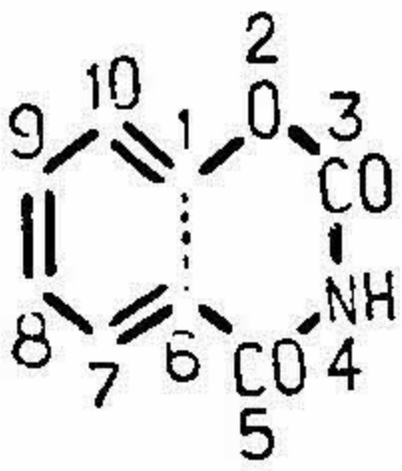


XCVII



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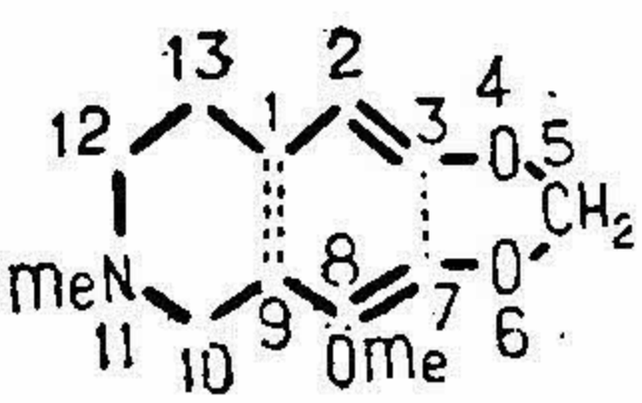

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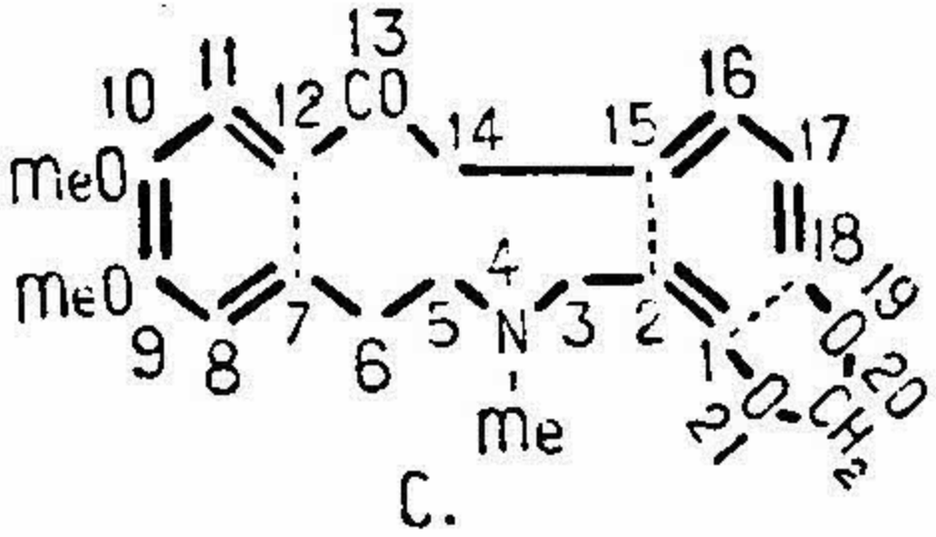

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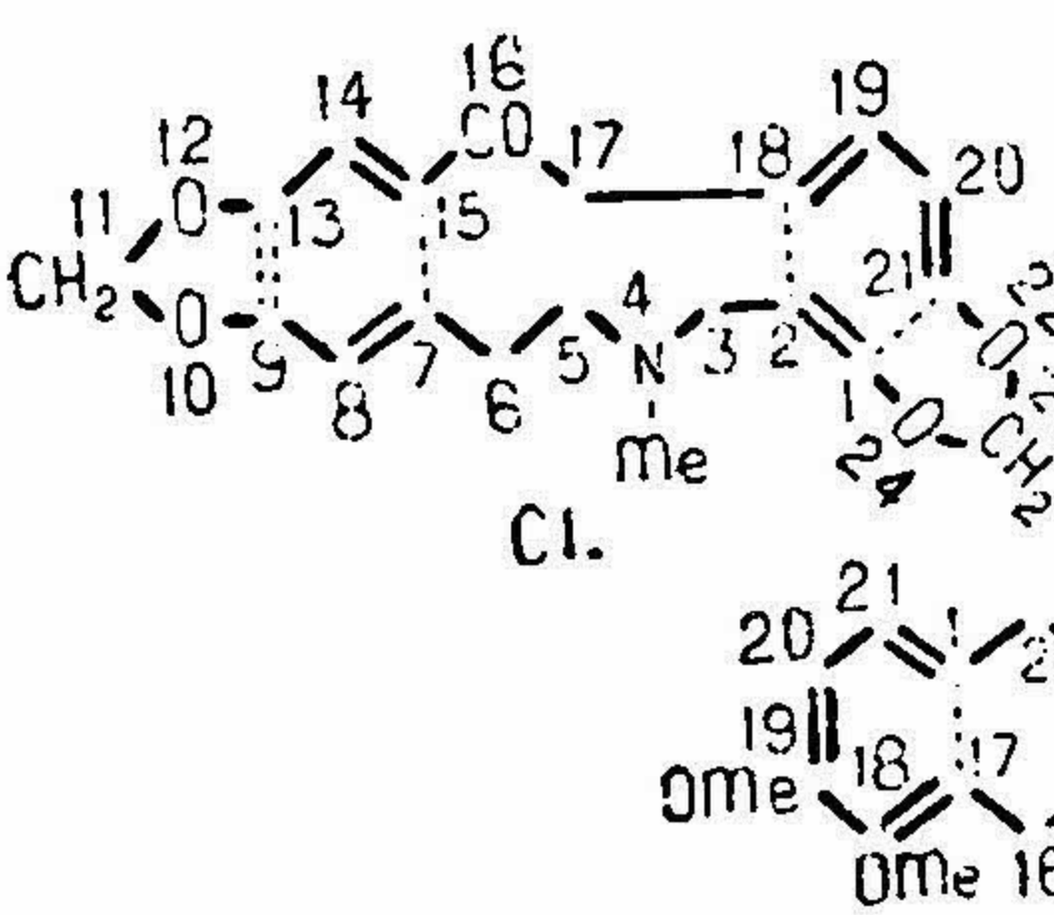

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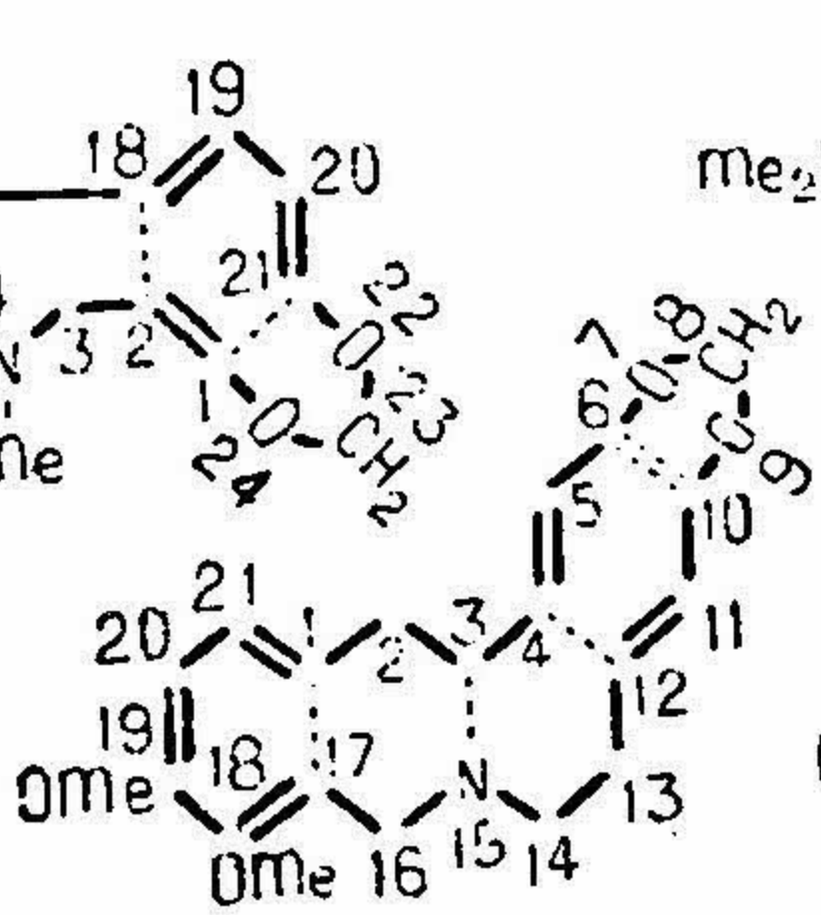

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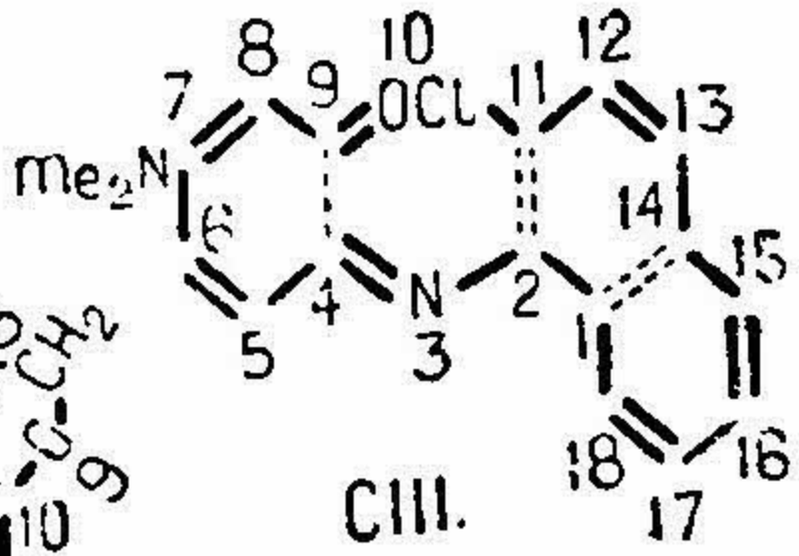
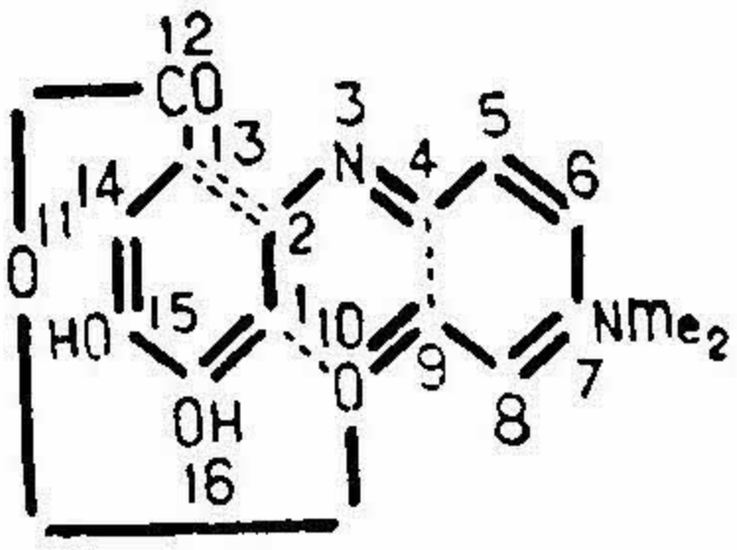


CIII.

PLATE XX.



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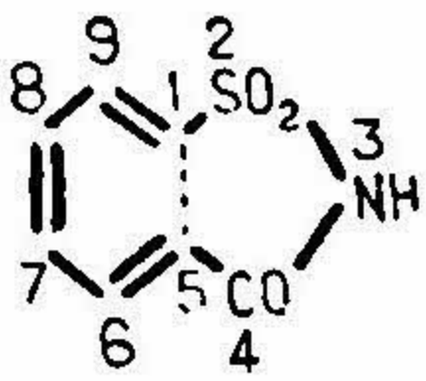

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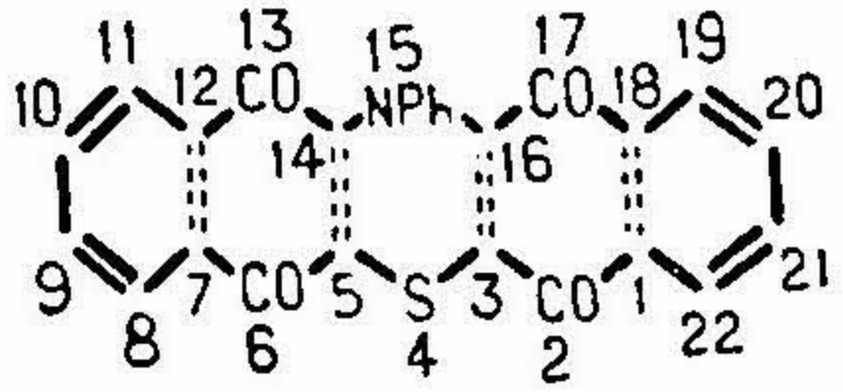

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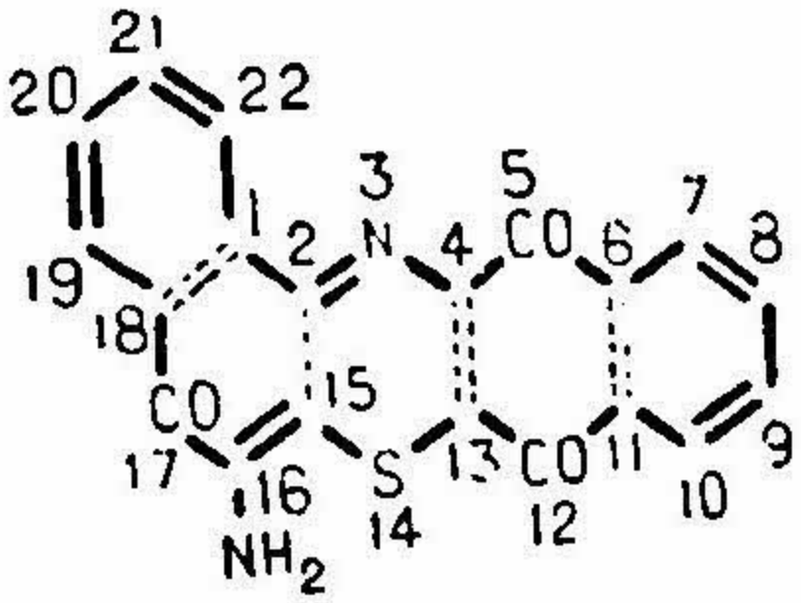

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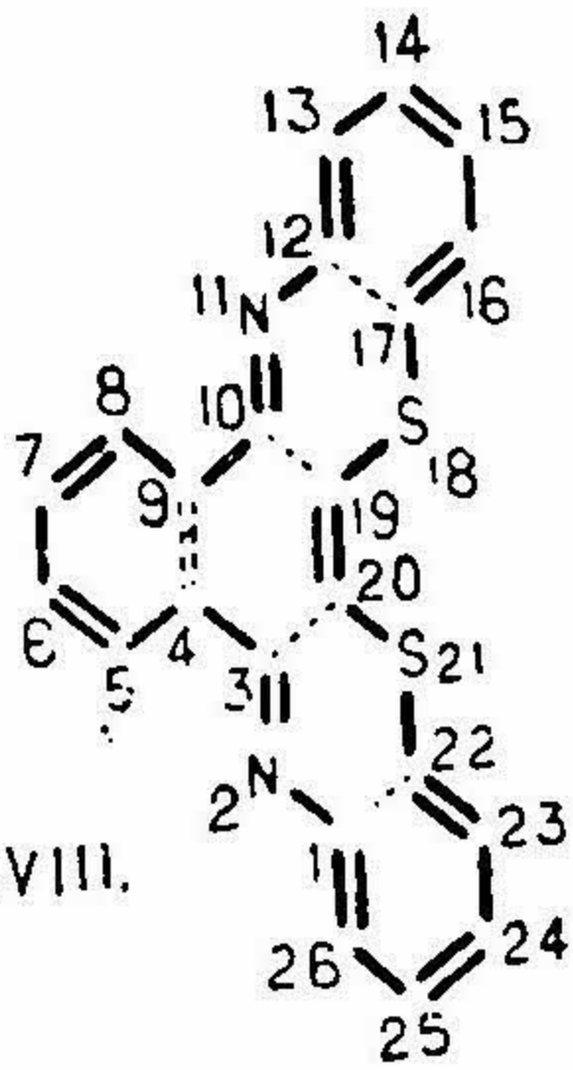

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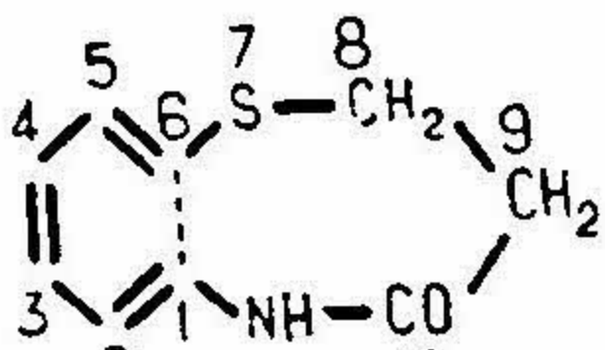

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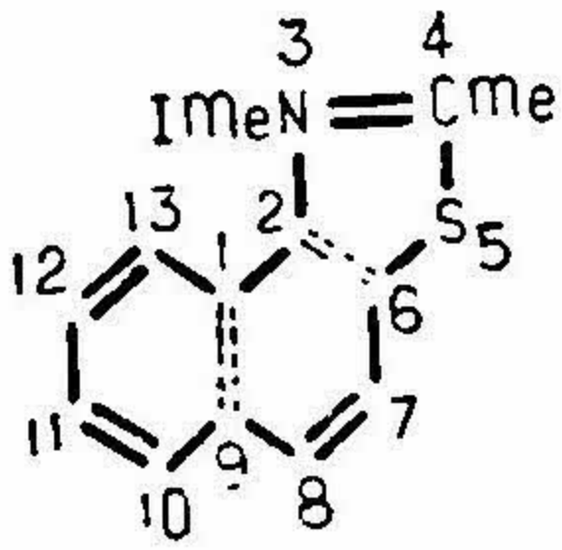

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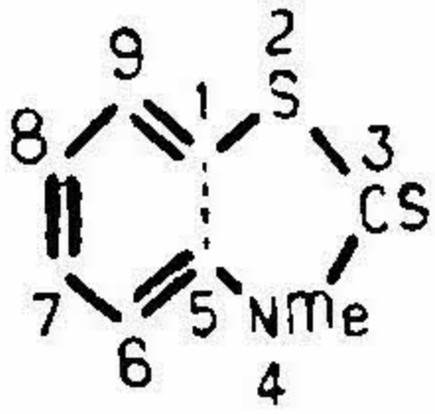

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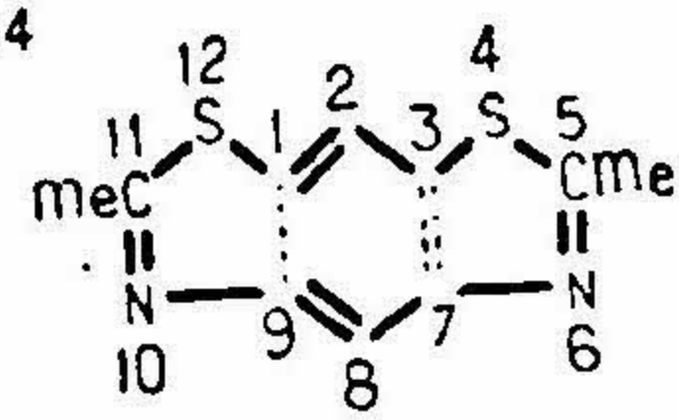

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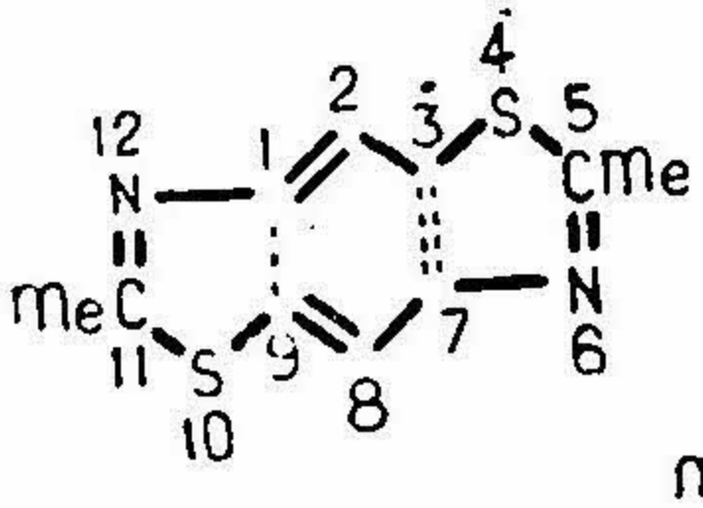

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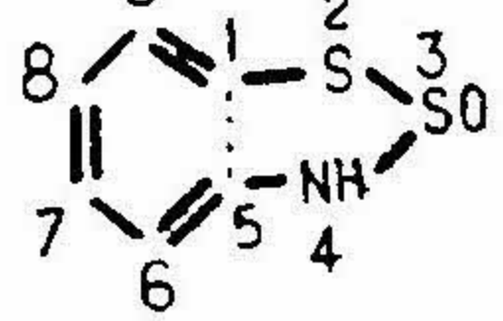

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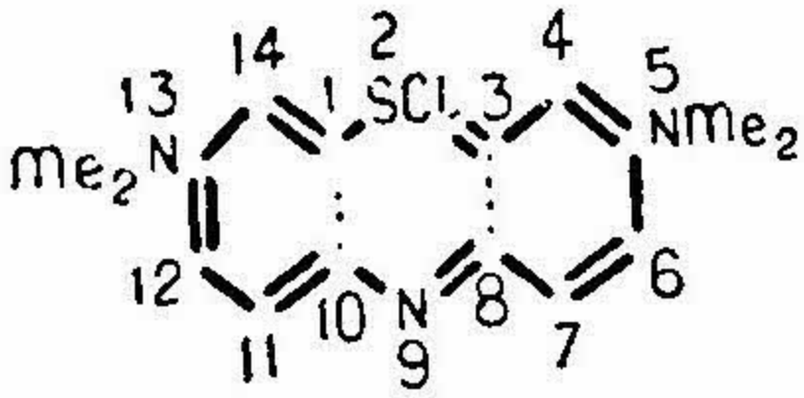
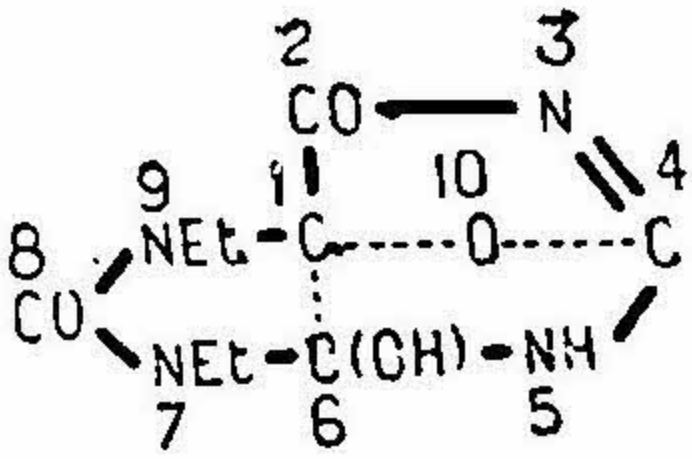


CXV.

PLATE XXI.



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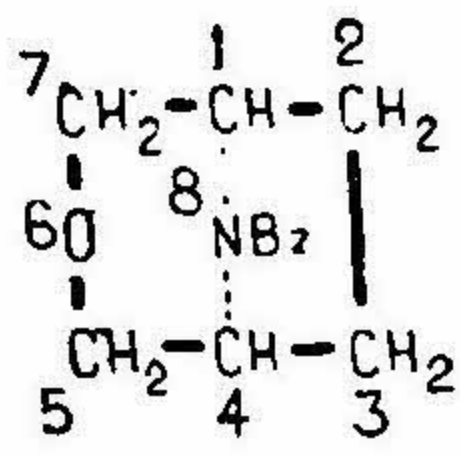

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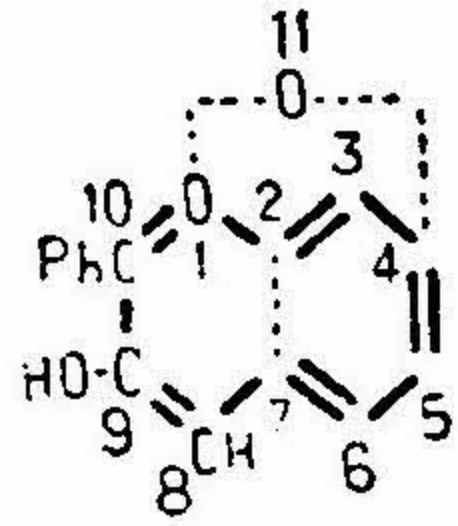

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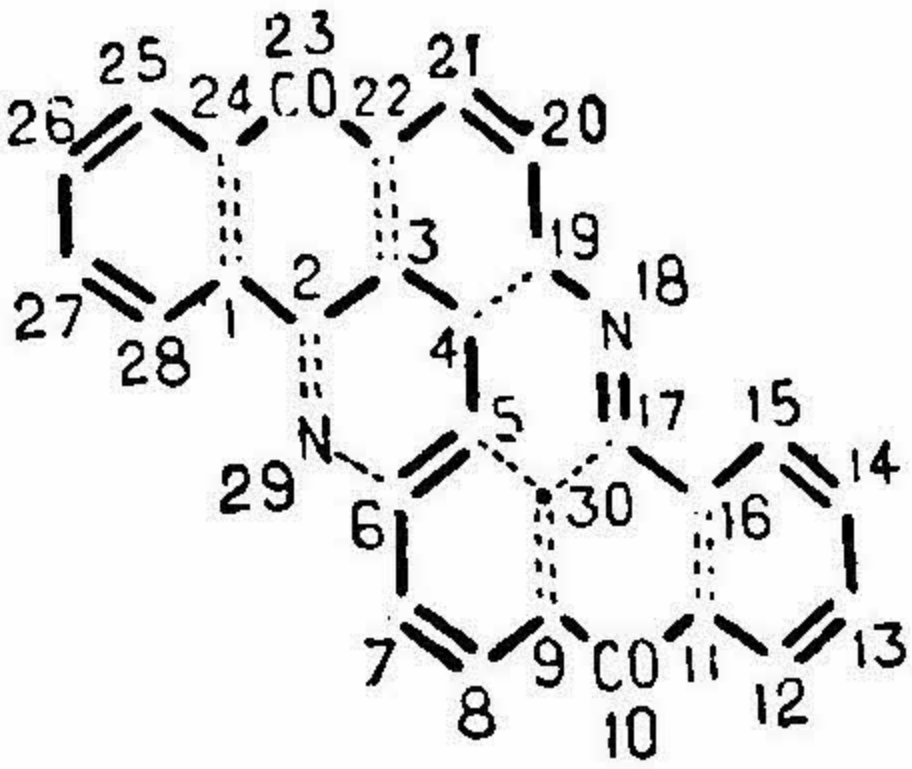

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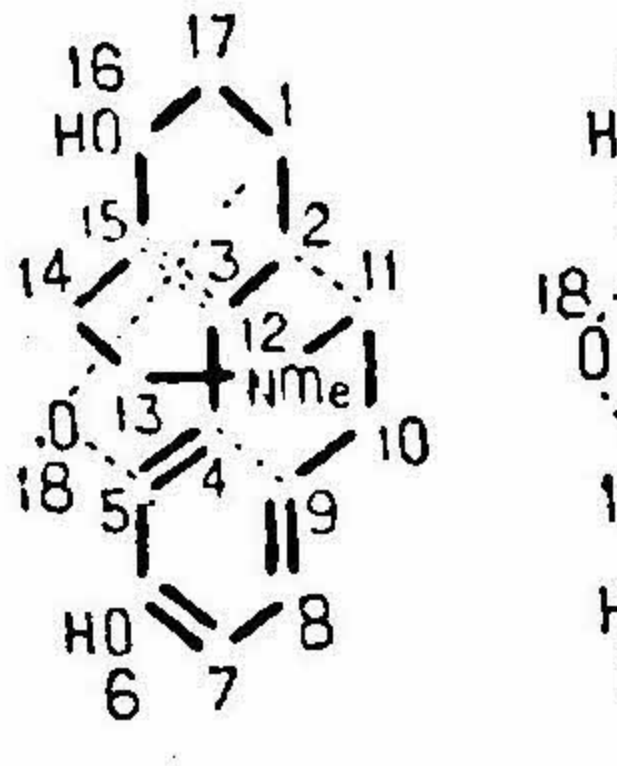

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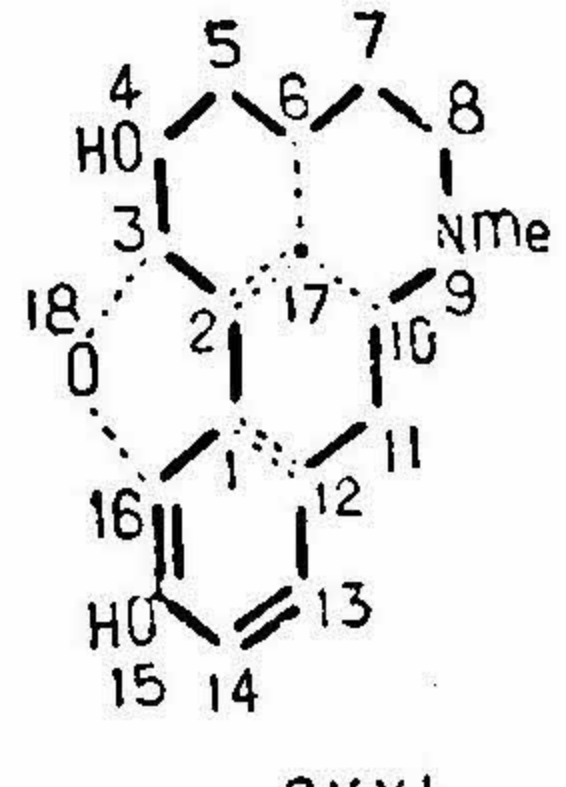
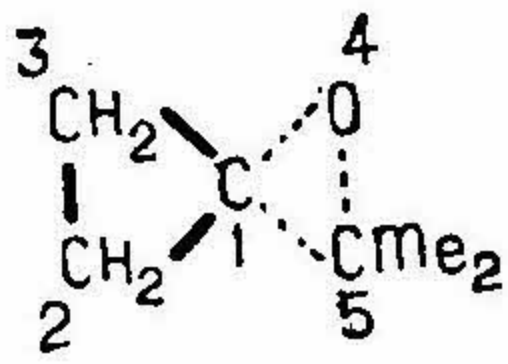


CXXI.



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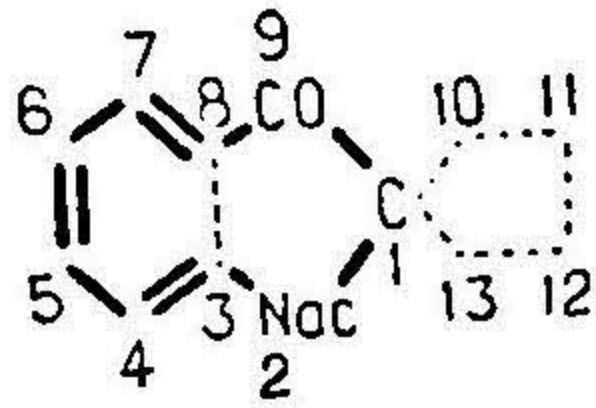

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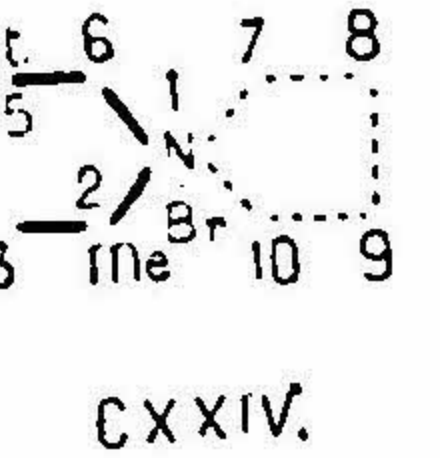

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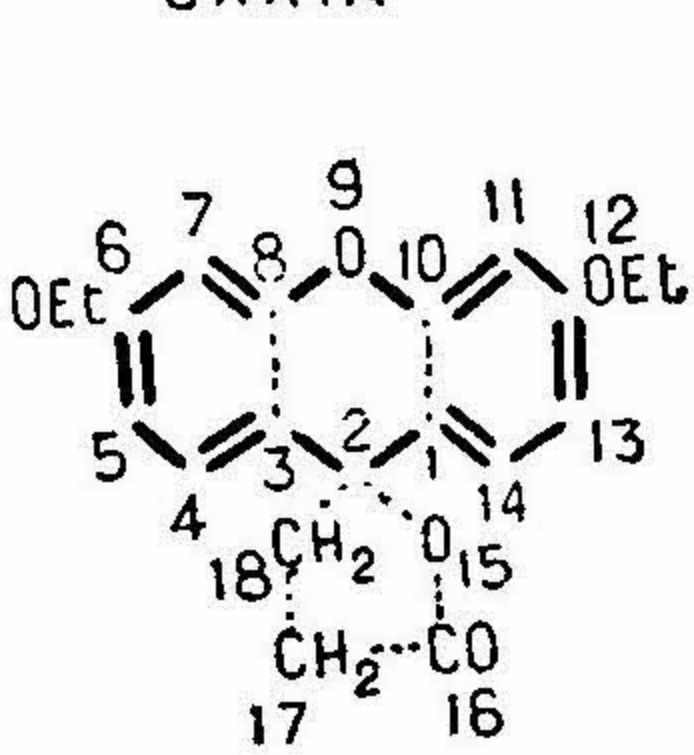

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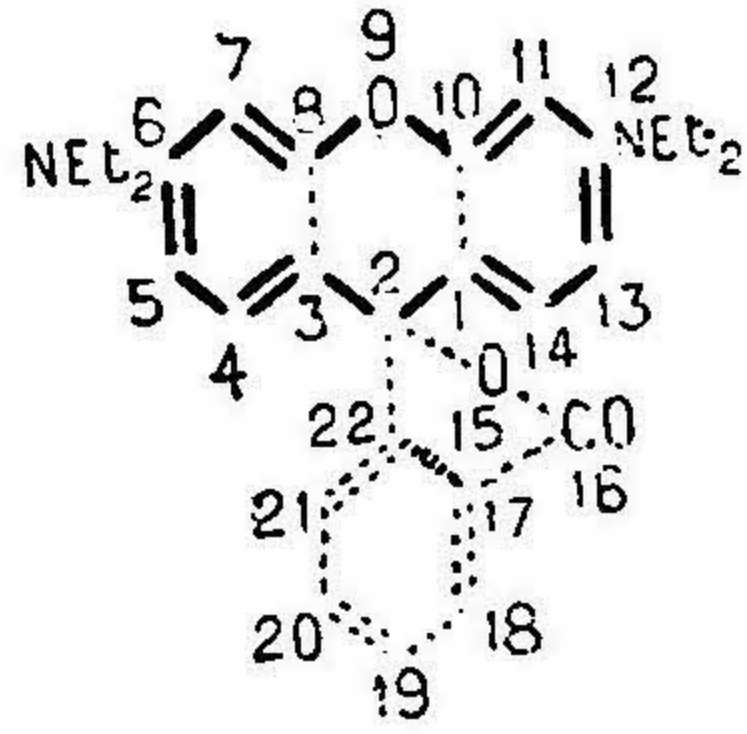

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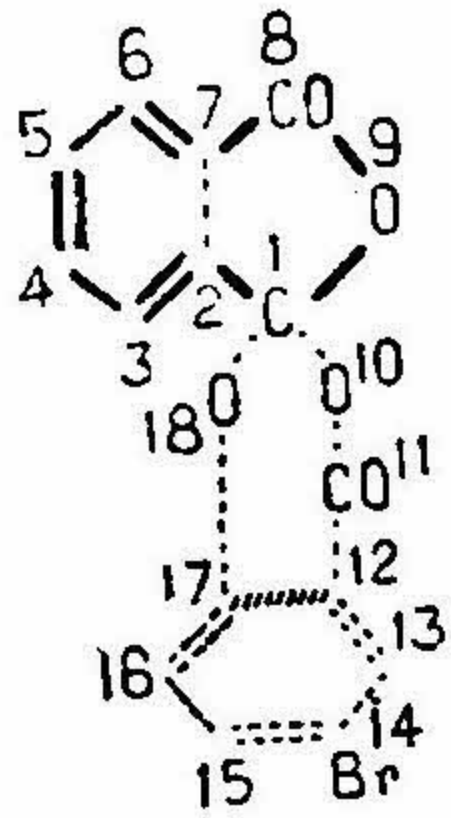

CXXVII.