stalk girth diminishes with the result that the rind begins to show wrinkling and shrinkage effects (Figure 2). Healthy stalk is shown in Figure 1 for comparison. Chlorosis from leaf sheaths advances to leaf blades. In advanced state of infection, leaves appear blanched; under hot humid conditions (i.e. temperature above 30 °C and relative humidity above 80%), symptoms such as wilting or pre-mature drying of leaves are observed to occur. This is based on observations made on field-inoculated plants. When these conditions are not available, even in artificially inoculated plants rot does not spread extensively.

In nature, chlorosis of leaves may or may not occur. Pronounced ill effects such as wilting may develop in a small proportion of plants under conditions of high humidity and high temperatures (around 30 °C). The basal 2 or 3 internodes show either wet rot with some pith softening or shrinkage with discoloration and wrinkling on the rind. Although a complete collapse of the stalk occurs but rarely, a partial disorganisation of the stalk elements certainly develops[11].

Zusammenfassung. Candida tropicalis, ein bekannter Pilz bei Mensch und Tier, wurde auch bei Mais-Stengelnekrose gefunden. Die Pathogenitätsprüfungen mit Pilz-Reinkultur (Biopathogene) war bei Mais und weissen Mäusen positiv.

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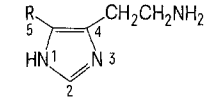
New Delhi 110012 (India), 4 June 1973.

[11] Acknowledgements: We are indebted to Dr. M. J. Thirumalachar, Hindustan Antibiotics Ltd., Pimpri for his advice and for doing preliminary work on toxin production. Gratefulness is also due to Dr. S. P. Raychaudhuri for his interest in the work. We thank Dr. J. P. Verma for translating the summary into German.

TERMINOLOGIA

Naming of Substituted Histamines

Histamine is the trivial name for 4 (or 5)-(2-aminoethyl) imidazole, represented structurally by either formula I or II (R = H). Although derivatives of this compound can be named systematically and unambiguously using the accepted IUPAC nomenclature[1] for substituted imidazoles this gives rise to names which are cumbersome and often uninformative to biologists. Physiologists and pharmacologists prefer that derivatives should be identified by a system of trivial names based on histamine rather than by formal ones based on imidazole. However, we have found no authoritative directive for such a system – only diversity and confusion. Consider, for example, the methyl-substituted compounds represented by structures I–IV.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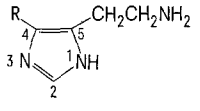
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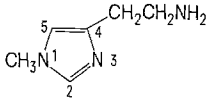
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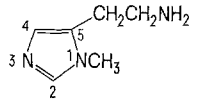
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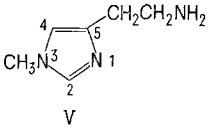
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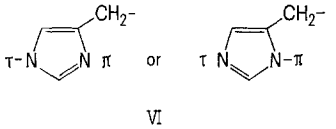
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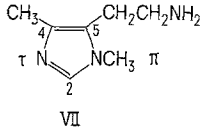
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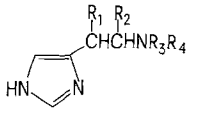
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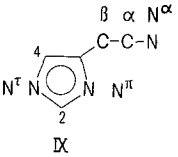
IX

Compound I (R = CH_3) has been variously called: 4(or 5)-methyl-5-(or 4)-β-aminoethylglyoxaline[2], 4(5)-methylhistamine[3,4], 4(5)-methyl-5(4)-aminoethylimidazole[5], 5-methylhistamine[6], 4-methylhistamine[7,8], 2-(5-methyl-4-imidazolyl) ethylamine[9]. Ambiguity arises because the compound is tautomeric and can be represented by an alternative structure II (R = CH_3); using the IUPAC rule that the nitrogen carrying the hydrogen atom is named position 1, this compound can be legitimately numbered in two ways. Compound III was originally named as 1-methyl-4-β-aminoethylglyoxaline[10], and became 1-methyl-4-β-aminoethylimidazole[11]. Subsequently Schayer and Karjala[12] devised a histamine nomenclature which identified it as 1, 4-methylhistamine. However, others have described it simply as methylhistamine, 1-methyl-histamine[13–15], or 3-methylhistamine[16,7,8]. A different kind of ambiguity arises now because compound III may be confused with another ring-N methyl deriva-

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tive (IV) which has also been called 1-methylhistamine[7,8] or 3-methylhistamine[17,18]; indeed, VAN DER MERWE[3] referred to 'both isomers of 1-methylhistamine'. As shown by these above examples, several methods of nomenclature have been used and there is no one generally accepted practice. In no case have we found an explanation advanced in favour of a particular nomenclature that would serve for guidance. A nomenclature is required that is logical, simple and unambiguous. Each possible substitution site needs to be uniquely identified. There are two special problems to overcome, these are: 1. the equivalence of the two tautomeric forms resulting in two structures and potentially two names for the same compound, and 2. the non-equivalence of three nitrogen atoms whereby any system must distinguish the three different compounds that can be derived from nitrogen substitution.

It is usual to differentiate between the substitution site in aromatic rings and those in aliphatic carbon chains. For histamine, the position of a substituent can be identified using the nomenclature of the imidazole ring or the ethane chain. In the systematic imidazole nomenclature[19], the imino nitrogen atom (the one carrying a substituent group – which may be hydrogen is assigned position 1 and the other ring atoms are numbered serially in a way that assigns the smallest possible number, 3, to the other nitrogen atom; the position of the aminoethyl side-chain is explicitly stated along with any other substituents. Thus structure III is 1-methyl-4-(aminoethyl)imidazole; this name is unambiguous. However, when we use the name 'histamine' the position of the aminoethyl side-chain is no longer specified although we can still locate other substituents using the imidazole numbering. This is the root cause of the difficulty. Structure III is a 1-methylimidazole, so is structure IV, but they represent different compounds and so cannot both be called 1-methylhistamine. We need some means of identifying the positional relationship between the aminoethyl side-chain and the ring nitrogen atoms when histamine nomenclature is used. SCHAYER's system[12] does this by naming compounds III and IV as 1,4- and 1,5-methyl- histamines respectively; this has much to commend it. It is unambiguous and easy to use but it has three shortcomings, viz: 1. both compounds are sometimes referred to as 1-methylhistamines, which is confusing; 2. the nomenclature could be extended to accommodate a second methyl substituent but it loses clarity; 3. the nitrogen atoms are not identified per se so that in general one has to refer to 'the nitrogen atom adjacent to, or remote from, the side-chain'.

To avoid these difficulties the side-chain can be located numerically, either 4 or 5, by convention, irrespective of nitrogen substitution. If it is located at position 4, then compound III only is named 1-methylhistamine. This leads to a contradiction with the biochemist's nomenclature[20] widely used for histidine since, by this naming, 1-methylhistamine would arise by decarboxylation of the compound referred to by biochemists as 3-methylhistidine. In order also to correlate histamine and histidine nomenclature we proposed[8] to introduce the system, already in use for histidine, that located the side-chain at position 5; this assigned position 1 to the adjacent ring nitrogen atom and led us to name compound III as 3-methylhistamine with the numbering shown in formula V. Events have since overtaken us. The numbering of histidine derivatives has itself been the subject of controversy. As reported by the IUPAC-IUB Commission on Biochemical Nomenclature[21] 'the prolonged and well-entrenched ambiguity in the nomenclature of the ring N-methylhistidines (the chemists' N-1 being the biochemists' N-3 and vice versa) leads to the proposal that a new trivial system for designating these substances is necessary'. The Commission recommended a novel locants system for histidine such that the imidazole N nearer the side-chain residue is designated *pros* (symbol π) and the one farther, *tele* (symbol τ) as in VI. This recommendation is now in practice (e.g.[22]); it would seem to provide a compelling basis and be a most logical way of solving the histamine problem. By direct analogy, compound III would be *tele*-methylhistamine or N^{τ}-methylhistamine, its isomer (IV) would be *pros*methylhistamine or N^{π}-methylhistamine. This system would have the added advantage of correlating the nomenclature between histidines and their decarboxylation products, thus *tele*methylhistidine on decarboxylation would furnish *tele*methylhistamine. Additional substituents in the ring can be accommodated by combining this recommendation with our previous proposal[8]. It follows that the ring-carbon atom between the two nitrogen atoms is position 2 (this has not been a subject of controversy) and the remaining free position is 4. By this system, structures I and II ($R = CH_3$) represent the two tautomeric forms of 4-methylhistamine. Compound VII, with two ring substituents, is called N^{π}, 4-dimethylhistamine.

For the naming of side-chain substituted histamine derivatives we have to identify the carbon skeleton, which in this case is ethane, and number serially the carbon atoms. We can choose numerical (1 and 2) or alphabetical (α and β) conventions. The use of numbers 1 and 2 in the side-chain would introduce an ambiguity since the ring also has a 2 position therefore we suggest using the Greek letters, α and β. This conforms with established practice, both for histamine and histidine. The carbon atom adjacent to the amino group is called the α-position, the other carbon atom is β. For example, VIII ($R_2 = CH_3$) is α-methylhistamine[6,23] and VIII ($R_1 = OH$) is β-hydroxyhistamine[24]. Substituents on the side-chain amino group have in the past been assigned the prefix N- or N^{α}-. The latter designation should now be preferred since it distinguishes positively this nitrogen atom from the ring nitrogen atoms; it imparts a unity to the nomenclature since each nitrogen atom is now uniquely identified by a Greek letter as superscript. Structure VIII ($R_3 = R_4 = CH_3$), for example is N^{α}, N^{α}-dimethylhistamine[25,26]. These pro-

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[16] R. LEBERMAN and B. R. RABIN, Nature, Lond. *185*, 768 (1960).
[17] R. B. BARLOW, *Introduction to Chemical Pharmacology*, 2nd Edn. (Methuen, London 1964), p. 350.
[18] F. E. ROTH and I. I. A. TABACHNICK, in *Drill's Pharmacology in Medicine*, 3rd Edn. (Ed. J. R. DIPALMA; McGraw-Hill 1965), p. 765.
[19] Handbook for Chemical Society Authors, The Chemical Society, London, page 196, (1960).
[20] K. HOFMANN, *Imidazole and its Derivatives* (Interscience, New York 1953), p. 188.
[21] IUPAC-IUB, Commission on Biochemical Nomenclature, Recommendations (1971); Biochem. J. *126*, 773 (1972).
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posals are summarized in formula IX; clearly they are applicable to any substituents[27].

Résumé. Un système de nomenclature triviale des histamines substituées est proposé. Les positions des substituants sont identifiées sans aucune ambiguité dans la formule IX. Le noyau peut être substitué en position N^{π}, 2, N^{τ}, et 4, et la chaîne latérale en position N^{α}, α, et β.

[27] Acknowledgements. We are greatly indebted to Professor G. Bertaccini (Parma), Dr. W. E. Cohn (Oak Ridge, Tenn.), Dr. M. I. Grossman (Los Angeles), Professor W. Klyne (London), Professor M. J. Rand (Melbourne), and Dr. R. W. Schayer (Orangeburg N.Y.) for reading drafts of this article and giving us their opinions and comments.

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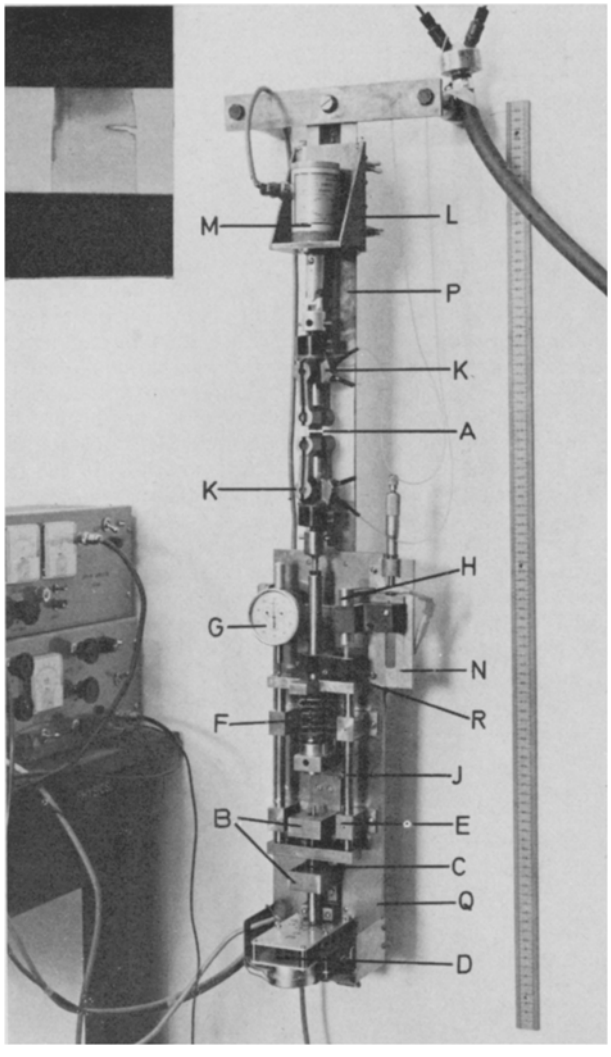
25 July 1973.

PRO EXPERIMENTIS

A Simple Low-Cost Tensometer for Bio-Materials Testing

It has become apparent over recent years that a need exists to augment biochemical and structural studies of biological materials with accurate measurements of their mechanical properties. The requirements of systems for mechanical testing of polymeric fibrous materials have been reviewed by Butterworth and Abbott[1]. Commercial devices exist for these measurements but they are expensive and suffer from the deficiency of having been designed for use with samples which are often large and strong compared with available biological specimens. The instrument described below overcomes these difficulties, and its construction is well within the ability of any competent machine shop.



Tensometer showing various features mentioned in text. A, specimen; K, pneumatic grips. Insert: specimen of regenerated chitin in process of fracture.

Basically, the tensometer (Figure) consists of a straight optical-bench (P) having an accurately ground triangular cross-section. A 6 mm thick steel plate (Q) carrying an electrically driven micrometer screw system is firmly pinned and screwed to one end of the flat upper face of the optical-bench and a saddle (L) carrying a force transducer (M) is free to move over the remaining length. The saddle fits the profile of the optical-bench accurately and can be locked firmly into position by means of two large screws which press into a groove on one of the faces of the optical-bench. All load-bearing components are constructed of mild steel and are designed for maximum rigidity. The whole device can be mounted either vertically on a wall or horizontally, as required.

A small integrated gearbox and reversible synchronous motor (D) (type Multur, E. Halstrup and Co., Kirchzarten, W. Germany) having 10 pre-set adjustable speeds between 0.01 and 10 rev/min, drives a 12 mm diameter screw (C) having 16 turns per cm which is supported firmly between two 20 mm O.D. thrust bearings (F.A.G., Schweinfurt, W. Germany). These allow the screw to turn relatively freely while permitting negligible lateral displacement. The extension of the specimen is produced by the action of this screw on one of the cross-members of a frame (J) which slides freely in 4 brass bearings (E) accurately machined to support its longitudinal members. The motor, the supports for the thrust-bearings (B) and the 4 brass bearings are mounted rigidly onto the steel plate which is in turn attached to the optical-bench. Measurement of displacement is effected by a linear variable differential transformer having a 5 mm linear response region (type 175 XSA, Shaevitz, Pennsauken, N.J., USA), whose plunger is attached to an adjustable arm (R) clamped onto the sliding frame. The body of the variable transformer (H) is mounted on a carriage (N) attached to a micrometer screw gauge. This latter device enables the zero of the system to be set at any point.

The motor-gearbox operates at adjustable pre-set speeds and remote control is used to minimize mechanical

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